Cisco 1100 Terminal Gateway Software Configuration Guide, Cisco IOS XE 17

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Preface

This section briefly describes the objectives of this document and provides links to additional information on related products and services:

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- Important Information on Features and Commands, on page xi
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Objectives

This guide provides an overview of the Cisco 1100 Terminal Gateway and explains how to configure the various features on these routers.

The structure of this document is explained in the Overview section.

Important Information on Features and Commands

For more information about Cisco IOS XE software, including features available on the router (described in configuration guides), see the Cisco IOS XE 17 Software Documentation set.

To verify support for specific features, use Cisco Feature Navigator. For more information about this, see the Using Cisco Feature Navigator section.

To find reference information for a specific Cisco IOS XE command, see the Cisco IOS Master Command List, All Releases.

Related Documentation

- Hardware Installation Guide for the Cisco Terminal Gateway
- Release Notes for the Cisco Terminal Gateway

Commands

Cisco IOS XE commands are identical in look, feel, and usage to Cisco IOS commands on most platforms. To find reference information for a specific Cisco IOS XE command, see the Cisco IOS Master Command List, All Releases document.

Features

The router runs Cisco IOS XE software which is used on multiple platforms. For more information on the available software features, see the configuration guides on the Cisco IOS XE 17 page.

To verify support for specific features, use the Cisco Feature Navigator tool. For more information, see Using Cisco Feature Navigator, on page 56.

Document Conventions

This documentation uses the following conventions:

Convention	Description
^ or **Ctrl**	The ^ and **Ctrl** symbols represent the Control key. For example, the key combination **^D** or **Ctrl-D** means hold down the **Control** key while you press the **D** key. Keys are indicated in capital letters but are not case sensitive.
string	A string is a nonquoted set of characters shown in italics. For example, when setting an SNMP community string to public, do not use quotation marks around the string or the string will include the quotation marks.

Command syntax descriptions use the following conventions:

Convention	Description
bold	Bold text indicates commands and keywords that you enter exactly as shown.
italics	Italic text indicates arguments for which you supply values.
[x]	Square brackets enclose an optional element (keyword or argument).
|	A vertical line indicates a choice within an optional or required set of keywords or arguments.
[x | y]	Square brackets enclosing keywords or arguments separated by a vertical line indicate an optional choice.
{x | y}	Braces enclosing keywords or arguments separated by a vertical line indicate a required choice.

Nested sets of square brackets or braces indicate optional or required choices within optional or required elements. For example:

Convention	Description
[x {y | z}]	Braces and a vertical line within square brackets indicate a required choice within an optional element.

Examples use the following conventions:

Convention	Description
`screen`	Examples of information displayed on the screen are set in Courier font.
`bold screen`	Examples of text that you must enter are set in Courier bold font.
< >	Angle brackets enclose text that is not printed to the screen, such as passwords.
!	An exclamation point at the beginning of a line indicates a comment line. (Exclamation points are also displayed by the Cisco IOS XE software for certain processes.)
[ ]	Square brackets enclose default responses to system prompts.

⚠ **Caution** Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Note Means *reader take note*. Notes contain helpful suggestions or references to materials that may not be contained in this manual.

Obtaining Documentation and Submitting a Service Request

- To receive timely, relevant information from Cisco, sign up at Cisco Profile Manager.
- To get the business impact you're looking for with the technologies that matter, visit Cisco Services.
- To submit a service request, visit Cisco Support.
- To discover and browse secure, validated enterprise-class apps, products, solutions and services, visit Cisco Marketplace.
- To obtain general networking, training, and certification titles, visit Cisco Press.

- To find warranty information for a specific product or product family, access Cisco Warranty Finder.

CHAPTER 1

Introduction

The Cisco 1100 Terminal Services Gateway is a modular terminal gateway that provides asynchronous connections to the console ports for different kinds of network devices such as Cisco third-party network devices, and servers. The Cisco 1100 Terminal Services Gateway offers integrated asynchronous ports, optional switching, and simplified Ethernet. It also supports secure tunnels, such as IPSec, generic routing encapsulation (GRE), and Cisco Dynamic Multipoint VPN, all at scale.

The Cisco 1100 Services Terminal Gateway with the LAN and WAN connections can be configured by means of interface modules and Network Interface Modules (NIMs).

The following features are provided for enterprise and service provider applications:

- Enterprise Applications
  - High-end branch gateway
  - Centralized Management
  - Zero Touch Provisioning
  - Mulit Tenant
  - Role based access to server and session
  - Regional site aggregation
  - Key server or PfR master controller
  - Device consolidation or "Rack in a Box"
- Service Provider Applications
  - High-end managed services in Customer-Premises Equipment (CPE)
  - Services consolidation platform
  - Flexible customer edge terminal gateway

The Cisco 1100 Terminal Services Gateway runs Cisco IOS XE software, and uses software components in many separate processes. This modular architecture increases network resiliency, compared to standard Cisco IOS software.

Sections in this Document

Table 1: Sections in this Document

Section	Description
Overview	Provides a high-level description of the router and describes the main internal processes of the router.
Using Cisco IOS XE Software	Describes the basics of using Cisco IOS XE software with the router.
Managing the Device Using Web User Interface, on page 69	Describes the uses of a Gigabit Ethernet management interface and a web user interface.
Console Port, Telnet, and SSH Handling, on page 75	Describes software features that are common across Cisco IOS XE platforms.
Installing the Software, on page 91	Contains important information about filesystems, packages, licensing, and installing software.
Basic Router Configuration, on page 29	Describes the basic tasks required to configure a router.
Slot and Subslot Configuration, on page 117	Provides information about the chassis slot numbers and subslots where the service modules are installed.
System Messages, on page 127	Provides information about syslog messages.
Trace Management, on page 133	Describes the tracing function where logs of internal events on a router are recorded.
Environmental Monitoring and PoE Management, on page 139	Describes the environmental monitoring features on a router.
Information About Factory Reset	Describes how it can be used to protect or restore a router to an earlier, fully functional state.

Processes

The list of background processes in the following table may be useful for checking router state and troubleshooting. However, you do not need to understand these processes to understand most router operations.

Table 2: Individual Processes

Process	Purpose	Affected FRUs	Sub Package Mapping
Chassis Manager	Controls chassis management functions, including management of the High Availability (HA) state, environmental monitoring, and FRU state control.	RP SIP ESP	RPControl SIPBase ESPBase
Host Manager	Provides an interface between the IOS process and many of the information gathering functions of the underlying platform kernel and operating system.	RP SIP ESP	RPControl SIPBase ESPBase
Logger	Provides IOS logging services to processes running on each FRU.	RP SIP ESP	RPControl SIPBase ESPBase
IOS	Implements all forwarding and routing features for the router.	RP	RPIOS
Forwarding Manager	Manages downloading of configuration details to the ESP and the communication of forwarding plane information, such as statistics, to the IOS process.	RP ESP	RPControl ESPBase
Pluggable Services	Provide integration between platform policy applications, such as authentication and the IOS process.	RP	RPControl
Shell Manager	Provides user interface (UI) features relating to non-IOS components of the consolidated package. These features are also available for use in diagnostic mode when the IOS process fails.	RP	RPControl

Process	Purpose	Affected FRUs	Sub Package Mapping
IO Module process	Exchanges configuration and other control messages with a NIM.	IO Module	SIPSPA
CPP driver process	Manages CPP hardware forwarding engine on the ESP.	ESP	ESPBase
CPP HA process	Manages HA state for the CPP hardware forwarding engine.	ESP	ESPBase
CPP SP process	Performs high-latency tasks for the CPP-facing functionality in the ESP instance of the Forwarding Manager process.	ESP	ESPBase

For further details of router capabilities and models, see the Hardware Installation Guide for Cisco 1100 Terminal Gateway.

CHAPTER 2

Configure Initial Router Settings on Cisco 1100 Terminal Gateway

This chapter describes how to perform the initial configuration on Cisco 1100 Terminal Gateway. It contains the following sections:

Perform Initial Configuration on Cisco 1100 Terminal Gateway

You can perform initial configuration on Cisco 1100 Terminal Gateway by using either the setup command facility or the Cisco IOS command-line interface (CLI):

Use Cisco Setup Command Facility

The setup command facility prompts you to enter the information about your router and network. The facility steps guides you through the initial configuration, which includes LAN and WAN interfaces. For more general information about the setup command facility, see the following document:

Cisco IOS Configuration Fundamentals Configuration Guide , Release 12.4, Part 2: Cisco IOS User Interfaces: Using AutoInstall and Setup: http://www.cisco.com/c/en/us/support/ios-nx-os-software/ios-xe-3s/products-installation-and-configuration-guides-list.html.

This section explains how to configure a hostname for the router, set passwords, and configure an interface to communicate with the management network.

Note The messages that are displayed will vary based on your router model, the installed interface modules, and the software image. The following example and the user entries (in **bold**) are shown only as examples.

Note If you make a mistake while using the setup command facility, you can exit and run the setup command facility again. Press **Ctrl-C**, and enter the **setup** command in privileged EXEC mode (Router#)

To configure the initial router settings by using the setup command facility, follow these steps:

SUMMARY STEPS

1. From the Cisco IOS-XE CLI, enter the **setup** command in privileged EXEC mode:
2. To proceed using the setup command facility, enter **yes**.
3. To enter the basic management setup, enter **yes**.
4. Enter a hostname for the router (this example uses ‘myrouter’):
5. Enter an enable secret password. This password is encrypted (for more security) and cannot be seen when viewing the configuration.
6. Enter an enable password that is different from the enable secret password. This password is *not* encrypted (and is less secure) and can be seen when viewing the configuration.
7. Enter the virtual terminal password, which prevents unauthenticated access to the router through ports other than the console port:
8. Respond to the following prompts as appropriate for your network:
9. Respond to the following prompts as appropriate for your network:
10. Respond to the following prompts. Select [2] to save the initial configuration:

DETAILED STEPS

Step 1 From the Cisco IOS-XE CLI, enter the **setup** command in privileged EXEC mode:

Example:

```
Router> enable

Password: <password>

Router# setup

         --- System Configuration Dialog ---
Continue with configuration dialog? [yes/no]:
```

You are now in the Setup Configuration Utility.

Depending on your router model, the installed interface modules, and the software image, the prompts in the setup command facility vary. The following steps and the user entries (in bold) are shown only as examples.

Note This setup command facility is also entered automatically if there is no configuration on the router when it is booted into Cisco IOS-XE.

Note If you make a mistake while using the setup command facility, you can exit and run the setup command facility again. Press Ctrl-C, and enter the setup command at the privileged EXEC mode prompt (Router#). For more information on using the setup command facility, see *The Setup Command* chapter in *Cisco IOS Configuration Fundamentals Command Reference* , Release 12.2T, at the following URL: http://www.cisco.com/en/US/docs/ios/12_2t/fun/command/reference/122tfr.html

Step 2 To proceed using the setup command facility, enter **yes**.

Example:

```
Continue with configuration dialog? [yes/no]:
At any point you may enter a question mark '?' for help.
```

```
Use ctrl-c to abort configuration dialog at any prompt.
Default settings are in square brackets '[]'.
```

Step 3 To enter the basic management setup, enter **yes**.

Example:

```
Would you like to enter basic management setup? [yes/no]: yes
```

Step 4 Enter a hostname for the router (this example uses ‘myrouter’):

Example:

```
Configuring global parameters:
Enter host name [Router]: myrouter
```

Step 5 Enter an enable secret password. This password is encrypted (for more security) and cannot be seen when viewing the configuration.

Example:

```
The enable secret is a password used to protect access to
privileged EXEC and configuration modes. This password, after
entered, becomes encrypted in the configuration.
Enter enable secret: cisco
```

Step 6 Enter an enable password that is different from the enable secret password. This password is *not* encrypted (and is less secure) and can be seen when viewing the configuration.

Example:

```
The enable password is used when you do not specify an
enable secret password, with some older software versions, and
some boot images.
Enter enable password: cisco123
```

Step 7 Enter the virtual terminal password, which prevents unauthenticated access to the router through ports other than the console port:

Example:

```
The virtual terminal password is used to protect
access to the router over a network interface.
Enter virtual terminal password: cisco
```

Step 8 Respond to the following prompts as appropriate for your network:

Example:

```
Configure SNMP Network Management? [no]: yes
    Community string [public]:
```

A summary of the available interfaces is displayed.

Note The interface summary includes interface numbering, which is dependent on the router model and the installed modules and interface cards.

Example:

```
Current interface summary
```

```
Interface      IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0     unassigned      YES NVRAM  administratively down down
GigabitEthernet0/1/0  10.10.10.12     YES DHCP   up                    up
GigabitEthernet0/2/0    unassigned      YES NVRAM  administratively down down
SSLVPN-VIF0                unassigned      NO  unset  up
Any interface listed with OK? value "NO" does not have a valid configuration
```

Step 9 Respond to the following prompts as appropriate for your network:

Example:

```
Configuring interface GigabitEthernet0/1/0
:
  Configure IP on this interface? [yes]: yes
    IP address for this interface [10.10.10.12
]:
    Subnet mask for this interface [255.0.0.0] : 255.255.255.0
    Class A network is 10.0.0.0, 24 subnet bits; mask is /24
```

The following configuration command script was created:

Example:

```
hostname myrouter
enable secret 5 $1$t/Dj$yAeGKviLLZNOBX0b9eifO0 enable password cisco123 line vty 0 4 password cisco
 snmp-server community public !
no ip routing
!
interface GigabitEthernet0/0/0
shutdown
no ip address
!
interface GigabitEthernet0/1/0
no shutdown
ip address 10.10.10.12 255.255.255.0
!
interface GigabitEthernet0/2/0
shutdown
no ip address
!
end
```

Step 10 Respond to the following prompts. Select [2] to save the initial configuration:

Example:

```
[0] Go to the IOS command prompt without saving this config.
[1] Return back to the setup without saving this config.
[2] Save this configuration to nvram and exit.
Enter your selection [2]: 2
Building configuration...
Use the enabled mode 'configure' command to modify this configuration.
Press RETURN to get started! RETURN
```

The user prompt is displayed:

Example:

```
myrouter>
```

Complete the Configuration

When using the Cisco Setup, and after you have provided all the information requested by the facility, the final configuration appears. To complete your router configuration, follow these steps:

SUMMARY STEPS

1. Choose to save the configuration when the facility prompts you to save the configuration.
2. When the messages stop appearing on your screen, press **Return** to get the Router> prompt.
3. Choose to modify the existing configuration or create another configuration. The Router> prompt indicates that you are now at the command-line interface (CLI) and you have just completed a initial router configuration. Nevertheless, this is *not* a complete configuration. At this point, you have two choices:

DETAILED STEPS

Step 1 Choose to save the configuration when the facility prompts you to save the configuration.

- If you answer 'no', the configuration information you entered is *not* saved, and you return to the router enable prompt (Router#). Enter setup to return to the System Configuration Dialog.
- If you answer 'yes', the configuration is saved, and you are returned to the user EXEC prompt (Router>).

Example:

```
Use this configuration? {yes/no} : yes
Building configuration...
Use the enabled mode 'configure' command to modify this configuration.
Press RETURN to get started!
%LINK-3-UPDOWN: Interface Ethernet0/0, changed state to up
%LINK-3-UPDOWN: Interface Ethernet0/1, changed state to up
%LINK-3-UPDOWN: Interface Serial0/0/0, changed state to up
%LINK-3-UPDOWN: Interface Serial0/0/1, changed state to down
%LINK-3-UPDOWN: Interface Serial0/2, changed state to down
%LINK-3-UPDOWN: Interface Serial1/0, changed state to up
%LINK-3-UPDOWN: Interface Serial1/1, changed state to down
%LINK-3-UPDOWN: Interface Serial1/2, changed state to down
<Additional messages omitted.>
```

Step 2 When the messages stop appearing on your screen, press **Return** to get the Router> prompt.

Step 3 Choose to modify the existing configuration or create another configuration. The Router> prompt indicates that you are now at the command-line interface (CLI) and you have just completed a initial router configuration. Nevertheless, this is *not* a complete configuration. At this point, you have two choices:

- Run the setup command facility again, and create another configuration.

Example:

```
Router> enable
Password: password
Router# setup
```

- Modify the existing configuration or configure additional features by using the CLI:

Example:

```
Router> enable
Password: password
```

```
Router# configure terminal
Router(config)#
```

Use Cisco IOS XE CLI—Manual Configuration

This section describes you how to access the command-line interface (CLI) to perform the initial configuration on the router.

Note To configure the initial router settings by using the Cisco IOS CLI, you must set up a console connection.

If the default configuration file is installed on the router prior to shipping, the system configuration dialog message does not appear, To configure the device, follow these steps:

SUMMARY STEPS

1. Enter the appropriate answer when the following system message appears on the router.
2. Press Return to terminate autoinstall and continue with manual configuration:
3. Press Return to bring up the Router> prompt.
4. Type enable to enter privileged EXEC mode:

DETAILED STEPS

Step 1 Enter the appropriate answer when the following system message appears on the router.

Example:

```
--- System Configuration Dialog ---
At any point you may enter a question mark '?' for help.
Use ctrl-c to abort configuration dialog at any prompt.
Default settings are in square brackets '[]'.
Would you like to enter the initial configuration dialog? [yes/no]: no
```

Step 2 Press Return to terminate autoinstall and continue with manual configuration:

Example:

```
Would you like to terminate autoinstall? [yes]
 Return
```

Several messages are displayed, ending with a line similar to the following:

Example:

```
...
Copyright (c) 1986-2012 by cisco Systems, Inc.
Compiled <date
> <time
> by <person
>
```

Step 3 Press Return to bring up the Router> prompt.

Example:

```
...
flashfs[4]: Initialization complete.
Router>
```

Step 4 Type enable to enter privileged EXEC mode:

Example:

```
Router> enable

Router#
```

Configure Cisco 1100 Terminal Gateway Hostname

The hostname is used in CLI prompts and default configuration filenames. If you do not configure the router hostname, the router uses the factory-assigned default hostname "Router."

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **hostname** *name*
4. Verify that the router prompt displays your new hostname.
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	**hostname** *name* **Example:** `Router(config)# hostname myrouter`	Specifies or modifies the hostname for the network server.
Step 4	Verify that the router prompt displays your new hostname. **Example:**	—

	Command or Action	Purpose
	`myrouter(config)#`	

Step 5	**end**
	Example:
	`myrouter# end`
		(Optional) Returns to privileged EXEC mode.

Configure the Enable and Enable Secret Passwords

To provide an additional layer of security, particularly for passwords that cross the network or are stored on a TFTP server, you can use either the **enable password** command or **enable secret** command. Both commands accomplish the same thing—they allow you to establish an encrypted password that users must enter to access privileged EXEC (enable) mode.

We recommend that you use the **enable secret** command because it uses an improved encryption algorithm. Use the **enable password** command only if you boot an older image of the Cisco IOS XE software.

For more information, see the “Configuring Passwords and Privileges” chapter in the Cisco IOS Security Configuration Guide . Also see the Cisco IOS Password Encryption Facts tech note and the Improving Security on Cisco Routers tech note.

Note If you configure the **enable secret** command, it takes precedence over the **enable password** command; the two commands cannot be in effect simultaneously.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **enable password** *password*
4. **enable secret** *password*
5. **end**
6. **enable**
7. **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:**	Enters global configuration mode.

	Command or Action	Purpose
	`Router# configure terminal`	
Step 3	**enable password** *password* **Example:** `Router(config)# enable password pswd2`	(Optional) Sets a local password to control access to various privilege levels. • We recommend that you perform this step only if you boot an older image of the Cisco IOS-XE software or if you boot older boot ROMs that do not recognize the **enable secret** command.
Step 4	**enable secret** *password* **Example:** `Router(config)# enable secret greentree`	Specifies an additional layer of security over the **enable password** command. • Do not use the same password that you entered in Step 3 .

Step 5	**end**
	Example:
	`Router(config)# end`
		Returns to privileged EXEC mode.

Step 6	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Verify that your new enable or enable secret password works.

Step 7	**end**
	Example:
	`Router(config)# end`
		(Optional) Returns to privileged EXEC mode.

Configure the Console Idle Privileged EXEC Timeout

This section describes how to configure the console line’s idle privileged EXEC timeout. By default, the privileged EXEC command interpreter waits 10 minutes to detect user input before timing out.

When you configure the console line, you can also set communication parameters, specify autobaud connections, and configure terminal operating parameters for the terminal that you are using. For more information on configuring the console line, see the *Cisco IOS Configuration Fundamentals and Network Management Configuration Guide* . In particular, see the “Configuring Operating Characteristics for Terminals” and “Troubleshooting and Fault Management” chapters.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **line console 0**
4. **exec-timeout** *minutes* [*seconds*]
5. **end**

6. **show running-config**

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 0** **Example:** `Router(config)# line console 0`	Configures the console line and starts the line configuration command collection mode.
Step 4	**exec-timeout** *minutes* [*seconds*] **Example:** `Router(config-line)# exec-timeout 0 0`	Sets the idle privileged EXEC timeout, which is the interval that the privileged EXEC command interpreter waits until user input is detected. • The example shows how to specify no timeout. Setting the exec-timeout value to 0 will cause the router to never log out after it is logged in. This could have security implications if you leave the console without manually logging out using the disable command.

Step 5	**end**
	Example:
	`Router(config)# end`
		Returns to privileged EXEC mode.

Step 6	**show running-config** **Example:** `Router(config)# show running-config`	Displays the running configuration file. • Verify that you properly configured the idle privileged EXEC timeout.

Examples

The following example shows how to set the console idle privileged EXEC timeout to 2 minutes 30 seconds:

```
line console
 exec-timeout 2 30
```

The following example shows how to set the console idle privileged EXEC timeout to 30 seconds:

```
line console
 exec-timeout 0 30
```

Gigabit Ethernet Management Interface Overview

The router uses gi0/0/0 or gi0/0/1 as management port.

The purpose of this interface is to allow users to perform management tasks on the router. It is an interface that should not and often cannot forward network traffic. It ca, however, be used to access the router through Telnet and SSH to perform management tasks on the router. The interface is most useful before a router begins routing, or in troubleshooting scenarios when other forwarding interfaces are inactive.

Note he following aspects of the management ethernet interface:

- The router has one management ethernet interface named GigabitEthernet0.
- IPv4, IPv6, and ARP are the only routed protocols supported for the interface.
- The interface provides a way to access to the router even if forwarding interfaces are not functional, or the IOS process is down.

Default Gigabit Ethernet Configuration

By default, a forwarding VRF is configured for the interface with a special group named “Mgmt-intf.” This cannot be changed. This isolates the traffic on the management interface away from the forwarding plane. The basic configuration is like other interfaces; however, there are many forwarding features that are not supported on these interfaces. No forwarding features can be configured on the GigabitEthernet0 interface as it is only used for management.

```
For example, the default configuration is as follows:
interface GigabitEthernet0
vrf forwarding Mgmt-intf
ip address 172.18.77.212 255.255.255.240
negotiation auto
```

Gigabit Ethernet Port Numbering

The Gigabit Ethernet Management port is always GigabitEthernet0.

The port can be accessed in configuration mode.

```
Router# config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface gigabitethernet0
Router(config-if)#
```

Configure Gigabit Ethernet Interfaces

This sections shows how to assign an IP address and interface description to an Ethernet interface on your router.

For comprehensive configuration information on Gigabit Ethernet interfaces, see the “Configuring LAN Interfaces” chapter of *Cisco IOS Interface and Hardware Component Configuration Guide* , http://www.cisco.com/en/US/docs/ios/12_2/interface/configuration/guide/icflanin.html

For information on interface numbering, see the software configuration guide for your router.

SUMMARY STEPS

1. **enable**
2. **show ip interface brief**

3. **configure terminal**
4. **interface** {**fastethernet** | **gigabitethernet**} **0**/*port*
5. **description** *string*
6. **ip address** *ip-address mask*
7. **no shutdown**
8. **end**
9. **show ip interface brief**

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 interface brief** **Example:** `Router# show ip interface brief`	Displays a brief status of the interfaces that are configured for IP. • Learn which type of Ethernet interface is on your router.
Step 3	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 4	**interface** {**fastethernet** | **gigabitethernet**} **0**/*port* **Example:** `Router(config)# interface gigabitethernet 0/0/0`	Specifies the Ethernet interface and enters interface configuration mode. **Note** For information on interface numbering, see Slots, Subslots (Bay), Ports, and Interfaces in section page 1-38 .
Step 5	**description** *string* **Example:** `Router(config-if)# description GE int to 2nd floor south wing`	(Optional) Adds a description to an interface configuration. The description helps you remember what is attached to this interface. The description can be useful for troubleshooting.
Step 6	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 172.16.74.3 255.255.255.0`	Sets a primary IP address for an interface.
Step 7	**no shutdown** **Example:** `Router(config-if)# no shutdown`	Enables an interface.

	Command or Action	Purpose

Step 8	**end**
	Example:
	`Router(config)# end`
		Returns to privileged EXEC mode.

Step 9	**show ip interface brief** **Example:** `Router# show ip interface brief`	Displays a brief status of the interfaces that are configured for IP. Verify that the Ethernet interfaces are up and configured correctly.

Configuration Examples

Configuring the GigabitEthernet Interface: Example

```
!
interface GigabitEthernet0/0/0
 description GE int to HR group
 ip address 172.16.3.3 255.255.255.0
 duplex negotiation auto
 speed negotiation auto
 no shutdown
!
```

Sample Output for the show ip interface brief Command

```
Router#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   unassigned      YES NVRAM  administratively down down
GigabitEthernet0/0/1   unassigned      YES NVRAM  administratively down down
GigabitEthernet0/0/2   unassigned      YES NVRAM  administratively down down
GigabitEthernet0/0/3   unassigned      YES NVRAM  administratively down down
GigabitEthernet0       10.0.0.1        YES manual up                    up
```

Specify a Default Route or Gateway of Last Resort

This section describes how to specify a default route with IP routing enabled. For alternative methods of specifying a default route, see the Configuring a Gateway of Last Resort Using IP Commands Technical Specifications Note.

The Cisco IOS-XE software uses the gateway (router) as a last resort if it does not have a better route for a packet and if the destination is not a connected network. This section describes how to select a network as a default route (a candidate route for computing the gateway of last resort). The way in which routing protocols propagate the default route information varies for each protocol.

Configure IP Routing and IP Protocols

For comprehensive configuration information about IP routing and IP routing protocols, see the Configuring IP Routing Protocol-Independent Feature at cisco.com.

IP Routing

IP routing is automatically enabled in the Cisco ISO- XE software. When IP routing is configured, the system will use a configured or learned route to forward packets, including a configured default route.

Note This task section does not apply when IP routing is disabled. To specify a default route when IP routing is disabled, refer to the Configuring a Gateway of Last Resort Using IP Commands Technical Specifications Note at cisco.com.

Default Routes

A router might not be able to determine the routes to all other networks. To provide complete routing capability, the common practice is to use some routers as smart routers and give the remaining routers default routes to the smart router. (Smart routers have routing table information for the entire internetwork.) These default routes can be passed along dynamically, or can be configured into the individual routers.

Most dynamic interior routing protocols include a mechanism for causing a smart router to generate dynamic default information that is then passed along to other routers.

Default Network

If a router has an interface that is directly connected to the specified default network, the dynamic routing protocols running on the router generates or sources a default route. In the case of RIP, the router will advertise the pseudonetwork 0.0.0.0. In the case of IGRP, the network itself is advertised and flagged as an exterior route.

A router that is generating the default for a network may also need a default of its own. One way a router can generate its own default is to specify a static route to the network 0.0.0.0 through the appropriate device.

Gateway of Last Resort

When default information is being passed along through a dynamic routing protocol, no further configuration is required. The system periodically scans its routing table to choose the optimal default network as its default route. In the case of RIP, there is only one choice, network 0.0.0.0. In the case of IGRP, there might be several networks that can be candidates for the system default. The Cisco IOS-XE software uses both administrative distance and metric information to determine the default route (gateway of last resort). The selected default route appears in the gateway of last resort display of the **show ip route** EXEC command.

If dynamic default information is not being passed to the software, candidates for the default route are specified with the **ip default-network** global configuration command. In this usage, the **ip default-network** command takes an unconnected network as an argument. If this network appears in the routing table from any source (dynamic or static), it is flagged as a candidate default route and is a possible choice for the default route.

If the router has no interface on the default network, but does have a route to it, it considers this network as a candidate default path. The route candidates are examined and based on administrative distance and metric, the best one is chosen. The gateway to the best default path becomes the gateway of last resort.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip routing**

4. **ip route** *dest-prefix mask next-hop-ip-address* [*admin-distance*] [**permanent**]
5. Do one of the following:
   - **ip default-network** *network-number*
   -
   - **ip route** *dest-prefix mask next-hop-ip-address*
6. **end**
7. **show ip route**

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 routing** **Example:** `Router(config)# ip routing`	Enables IP routing.
Step 4	**ip route** *dest-prefix mask next-hop-ip-address* [*admin-distance*] [**permanent**] **Example:** `Router(config)# ip route 192.168.24.0 255.255.255.0 172.28.99.2`	Establishes a static route.

Step 5	Do one of the following:
	• **ip default-network** *network-number*
	•
	• **ip route** *dest-prefix mask next-hop-ip-address*
	Example:
	`Router(config)# ip default-network 192.168.24.0`
	Example:
	`Router(config)# ip route 0.0.0.0 0.0.0.0 172.28.99.1`
		Selects a network as a candidate route for computing the gateway of last resort.
		Creates a static route to network 0.0.0.0 0.0.0.0 for computing the gateway of last resort.

Step 6	**end** **Example:**	Returns to privileged EXEC mode.

	Command or Action	Purpose
	`Router(config)# end`	
Step 7	**show ip route** **Example:** `Router# show ip route`	Displays the current routing table information. Verify that the gateway of last resort is set.

Configuration Examples

Specifying a Default Route: Example

```
!
ip route 192.168.24.0 255.255.255.0 172.28.99.2
!
ip default-network 192.168.24.0
!
```

Sample Output for the show ip route Command

```
Router# show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX -  EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2 i - IS-IS, su - IS-IS summary, L1 -
IS-IS level-1, L2 - IS-IS level-2 ia - IS-IS inter area, * - candidate default,
U - per-user static route o - ODR, P - periodic downloaded static route, H - NHRP,
l - LISP a - application route + - replicated route, % - next hop override
Gateway of last resort is not set 40.0.0.0/8 is variably subnetted, 2 subnets, 2 masks C
40.0.0.0/24 is directly connected, Loopback1 L 40.0.0.1/32 is directly connected, Loopback1
 Router#
```

Configure Virtual Terminal Lines for Remote Console Access

Virtual terminal (vty) lines are used to allow remote access to the router. This section shows you how to configure the virtual terminal lines with a password, so that only authorized users can remotely access the router.

By default, the router has five virtual terminal lines. However, you can create additional virtual terminal lines. See the Cisco IOS XE Dial Technologies Configuration Guide at http://www.cisco.com/en/US/docs/ios/dial/configuration/guide/2_xe/dia_2_xe_book.html .

Line passwords and password encryption is described in the C isco IOS XE Security Configuration Guide: Secure Connectivity document available at the following URL: http://www.cisco.com/en/US/docs/ios/ios_xe/sec_secure_connectivity/configuration/guide/2_xe/sec_secure_connectivity_xe_book.html . See the Security with Passwords, Privilege Levels, and Login Usernames for CLI Sessions on Networking Devices section. If you want to secure the virtual terminal lines (vty) with an access list, see the Access Control Lists: Overview and Guidelines.

SUMMARY STEPS

1. **enable**

2. **configure terminal**
3. **line vty** *line-number* [*ending-line-number*]
4. **password** *password*
5. **login**
6. **end**
7. **show running-config**
8. From another network device, attempt to open a Telnet session to the router.

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`	Starts the line configuration command collection mode for the virtual terminal lines (vty) for remote console access. • Make sure that you configure all vty lines on your router. **Note** To verify the number of vty lines on your router, use the **line vty ?** command.
Step 4	**password** *password* **Example:** `Router(config-line)# password guessagain`	Specifies a password on a line.
Step 5	**login** **Example:** `Router(config-line)# login`	Enables password checking at login.

Step 6	**end**
	Example:
	`Router(config-line)# end`
		Returns to privileged EXEC mode.

Step 7	**show running-config** **Example:** `Router# show running-config`	Displays the running configuration file. Verify that you bave properly configured the virtual terminal lines for remote access.

	Command or Action	Purpose

Step 8	From another network device, attempt to open a Telnet session to the router.
	Example:
	`Router# 172.16.74.3`
	Example:
	`Password:`
		Verifies that you can remotely access the router and that the virtual terminal line password is correctly configured.

Configuration Examples

The following example shows how to configure virtual terminal lines with a password:

```
!
line vty 0 4
 password guessagain
 login
!
```

What to Do Next

After you configure the vty lines, follow these steps:

- (Optional) To encrypt the virtual terminal line password, see the “Configuring Passwords and Privileges” chapter in the Cisco IOS Security Configuration Guide . Also see the Cisco IOS Password Encryption Facts tech note.
- (Optional) To secure the VTY lines with an access list, see the “Part 3: Traffic Filtering and Firewalls” in the Cisco IOS Security Configuration Guide .

Configure the Auxiliary Line

This section describes how to enter line configuration mode for the auxiliary line. How you configure the auxiliary line depends on your particular implementation of the auxiliary (AUX) port. See the following documents for information on configuring the auxiliary line:

- *Configuring a Modem on the AUX Port for EXEC Dialin Connectivity* , Technical Specifications Note http://www.cisco.com/en/US/tech/tk801/tk36/technologies_tech_note09186a0080094bbc.shtml
- *Configuring Dialout Using a Modem on the AUX Port* , sample configuration http://www.cisco.com/en/US/tech/tk801/tk36/technologies_configuration_example09186a0080094579.shtml
- *Configuring AUX-to-AUX Port Async Backup with Dialer Watch* , sample configuration http://www.cisco.com/en/US/tech/tk801/tk36/technologies_configuration_example09186a0080093d2b.shtml
- *Modem-Router Connection Guide* , Technical Specifications Note http://www.cisco.com/en/US/tech/tk801/tk36/technologies_tech_note09186a008009428b.shtml

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **line aux 0**

4. See the Technical Specifications Note and sample configurations to configure the line for your particular implementation of the AUX port.

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 aux 0** **Example:** `Router(config)# line aux 0`	Starts the line configuration command collection mode for the auxiliary line.
Step 4	See the Technical Specifications Note and sample configurations to configure the line for your particular implementation of the AUX port.	—

Verify Network Connectivity

This section describes how to verify network connectivity for your router.

Before you begin

- All configuration tasks describe in this chapter must be completed.
- The router must be connected to a properly configured network host.

SUMMARY STEPS

1. **enable**
2. **ping** [*ip-address* | *hostname*]
3. **telnet** {*ip-address* | *hostname*}

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	**ping** [*ip-address* | *hostname*] **Example:** `Router# ping 172.16.74.5`	Diagnoses initial network connectivity. To verify connectivity, ping the next hop router or connected host for each configured interface to.

Step 3	**telnet** {*ip-address* | *hostname*}
	Example:
	`Router# telnet 10.20.30.40`
		Logs in to a host that supports Telnet. If you want to test the vty line password, perform this step from a different network device, and use your router's IP address.

Examples

The following display shows sample output for the ping command when you ping the IP address 192.168.7.27:

```
Router# ping

Protocol [ip]:
Target IP address: 192.168.7.27

Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.7.27, timeout is 2 seconds:
!!!!!
Success rate is 100 percent, round-trip min/avg/max = 1/2/4 ms
```

The following display shows sample output for the ping command when you ping the IP hostname donald:

```
Router# ping donald

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.7.27, timeout is 2 seconds:
!!!!!
Success rate is 100 percent, round-trip min/avg/max = 1/3/4 ms
```

Save Your Device Configuration

This section describes how to avoid losing your configuration at the next system reload or power cycle by saving the running configuration to the startup configuration in NVRAM. The NVRAM provides 256KB of storage on the router.

SUMMARY STEPS

1. **enable**
2. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**copy running-config startup-config** **Example:** `Router# copy running-config startup-config`	Saves the running configuration to the startup configuration.

Save Backup Copies of Configuration and System Image

To aid file recovery and minimize downtime in case of file corruption, we recommend that you save backup copies of the startup configuration file and the Cisco IOS-XE software system image file on a server.

SUMMARY STEPS

1. **enable**
2. **copy nvram:startup-config** {**ftp:** | **rcp:** | **tftp:**}
3. **show {bootflash0|bootflash1}:**
4. **copy {bootflash0|bootflash1}:** {**ftp:** | **rcp:** | **tftp:**}

DETAILED STEPS

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

Step 2	**copy nvram:startup-config** {**ftp:** | **rcp:** | **tftp:**}
	Example:
	`Router# copy nvram:startup-config ftp:`
		Copies the startup configuration file to a server. The configuration file copy can serve as a backup copy.Enter the destination URL when prompted.

Step 3	**show {bootflash0|bootflash1}:** **Example:** `Router# show {bootflash0|bootflash1}:`	Displays the layout and contents of a flash memory file system. Learn the name of the system image file.

Step 4	**copy {bootflash0|bootflash1}:** {**ftp:** | **rcp:** | **tftp:**}
	Example:
	`Router# copy {bootflash0|bootflash1}: ftp:`
		Copies a file from flash memory to a server.
		• Copy the system image file to a server to serve as a backup copy.

	Command or Action	Purpose
		• Enter the filename and destination URL when prompted.

Configuration Examples

Copying the Startup Configuration to a TFTP Server: Example

The following example shows the startup configuration being copied to a TFTP server:

```
Router# copy nvram:startup-config tftp:

Remote host[]? 172.16.101.101

Name of configuration file to write [rtr2-confg]? <cr>

Write file rtr2-confg on host 172.16.101.101?[confirm] <cr>

![OK]
```

Copying from Flash Memory to a TFTP Server: Example

The following example shows the use of the **show {flash0|flash1}:** command in privileged EXEC to learn the name of the system image file and the use of the **copy {flash0|flash1}: tftp:** privileged EXEC command to copy the system image to a TFTP server. The router uses the default username and password.

```
Router#Directory of bootflash:
11 drwx 16384 Jun 12 2012 17:31:45 +00:00 lost+found 64897 drwx 634880 Sep 6 2012 14:33:26
 +00:00 core 340705 drwx 4096 Oct 11 2012 19:28:27 +00:00 .prst_sync 81121 drwx 4096 Jun
12 2012 17:32:39 +00:00 .rollback_timer 12 -rw- 0 Jun 12 2012 17:32:50 +00:00 tracelogs.336
 713857 drwx 1347584 Oct 11 2012 20:24:26 +00:00 tracelogs 162241 drwx 4096 Jun 12 2012
17:32:51 +00:00 .installer 48673 drwx 4096 Jul 2 2012 17:14:51 +00:00 vman_fdb 13 -rw-
420654048 Aug 28 2012 15:01:31 +00:00
crankshaft-universalk9.BLD_MCP_DEV_LATEST_20120826_083012.SSA.bin 14 -rw- 727035 Aug 29
2012 21:03:25 +00:00 uut2_2000_ikev1.cfg 15 -rw- 420944032 Aug 29 2012 19:40:28 +00:00
crankshaft-universalk9.BLD_MCP_DEV_LATEST_20120829_033026.SSA.bin 16 -rw- 1528 Aug 30 2012
 14:24:38 +00:00 base.cfg 17 -rw- 360900 Aug 31 2012 19:10:02 +00:00 uut2_1000_ikev1.cfg
18 -rw- 421304160 Aug 31 2012 16:34:19 +00:00
crankshaft-universalk9.BLD_MCP_DEV_LATEST_20120821_193221.SSA.bin 19 -rw- 421072064 Aug 31
 2012 18:31:57 +00:00 crankshaft-universalk9.BLD_MCP_DEV_LATEST_20120830_110615.SSA.bin 20
 -rw- 453652 Sep 1 2012 01:48:15 +00:00 uut2_1000_ikev1_v2.cfg 21 -rw- 16452768 Sep 11 2012
 20:36:20 +00:00 upgrade_stage_1_of_1.bin.2012-09-05-Delta 22 -rw- 417375456 Sep 12 2012
20:28:23 +00:00 crankshaft-universalk9.2012-09-12_00.45_cveerapa.SSA.bin 23 -rw- 360879 Oct
 8 2012 19:43:36 +00:00 old-config.conf 24 -rw- 390804800 Oct 11 2012 15:34:08 +00:00
_1010t.bin 7451738112 bytes total (4525948928 bytes free)
Router#show bootflash: -#- --length-- ---------date/time--------- path 1 4096 Oct 11 2012
20:22:19 +00:00 /bootflash/ 2 16384 Jun 12 2012 17:31:45 +00:00 /bootflash/lost+found 3
634880 Sep 06 2012 14:33:26 +00:00 /bootflash/core 4 1028176 Sep 06 2012 14:31:17 +00:00
/bootflash/core/UUT2_RP_0_iomd_17360.core.gz 5 1023738 Sep 06 2012 14:31:24 +00:00
/bootflash/core/UUT2_RP_0_iomd_23385.core.gz 6 1023942 Sep 06 2012 14:31:30 +00:00
/bootflash/core/UUT2_RP_0_iomd_24973.core.gz 7 1023757 Sep 06 2012 14:31:37 +00:00
/bootflash/core/UUT2_RP_0_iomd_26241.core.gz 8 1023726 Sep 06 2012 14:31:43 +00:00
/bootflash/core/UUT2_RP_0_iomd_27507.core.gz 9 1023979 Sep 06 2012 14:31:50 +00:00
/bootflash/core/UUT2_RP_0_iomd_28774.core.gz 10 1023680 Sep 06 2012 14:31:56 +00:00
/bootflash/core/UUT2_RP_0_iomd_30045.core.gz 11 1023950 Sep 06 2012 14:32:02 +00:00
/bootflash/core/UUT2_RP_0_iomd_31332.core.gz 12 1023722 Sep 06 2012 14:32:09 +00:00
/bootflash/core/UUT2_RP_0_iomd_5528.core.gz 13 1023852 Sep 06 2012 14:32:15 +00:00
/bootflash/core/UUT2_RP_0_iomd_7950.core.gz 14 1023916 Sep 06 2012 14:32:22 +00:00
```

```
/bootflash/core/UUT2_RP_0_iomd_9217.core.gz 15 1023875 Sep 06 2012 14:32:28 +00:00
/bootflash/core/UUT2_RP_0_iomd_10484.core.gz 16 1023907 Sep 06 2012 14:32:35 +00:00
/bootflash/core/UUT2_RP_0_iomd_11766.core.gz 17 1023707 Sep 06 2012 14:32:41 +00:00
/bootflash/core/UUT2_RP_0_iomd_13052.core.gz 18 1023963 Sep 06 2012 14:32:48 +00:00
/bootflash/core/UUT2_RP_0_iomd_14351.core.gz 19 1023915 Sep 06 2012 14:32:54 +00:00
/bootflash/core/UUT2_RP_0_iomd_15644.core.gz 20 1023866 Sep 06 2012 14:33:00 +00:00
/bootflash/core/UUT2_RP_0_iomd_17171.core.gz 21 1023518 Sep 06 2012 14:33:07 +00:00
/bootflash/core/UUT2_RP_0_iomd_18454.core.gz 22 1023938 Sep 06 2012 14:33:13 +00:00
/bootflash/core/UUT2_RP_0_iomd_19741.core.gz 23 1024017 Sep 06 2012 14:33:20 +00:00
/bootflash/core/UUT2_RP_0_iomd_21039.core.gz 24 1023701 Sep 06 2012 14:33:26 +00:00
/bootflash/core/UUT2_RP_0_iomd_22323.core.gz 25 4096 Oct 11 2012 19:28:27 +00:00
/bootflash/.prst_sync 26 4096 Jun 12 2012 17:32:39 +00:00 /bootflash/.rollback_timer 27 0
Jun 12 2012 17:32:50 +00:00 /bootflash/tracelogs.336 28 1347584 Oct 11 2012 20:24:26 +00:00
 /bootflash/tracelogs 29 392 Oct 11 2012 20:22:19 +00:00
/bootflash/tracelogs/inst_cleanup_R0-0.log.gz 30 308 Oct 11 2012 18:39:43 +00:00
/bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011183943.gz 31 308 Oct 11 2012 18:49:44
 +00:00 /bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011184944.gz 32 42853 Oct 04
2012 07:35:39 +00:00 /bootflash/tracelogs/hman_R0-0.log.0498.20121004073539.gz 33 307 Oct
11 2012 18:59:45 +00:00 /bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011185945.gz
34 308 Oct 11 2012 19:19:47 +00:00
/bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011191947.gz 35 307 Oct 11 2012 19:37:14
 +00:00 /bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011193714.gz 36 308 Oct 11
2012 19:47:15 +00:00 /bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011194715.gz 37
308 Oct 11 2012 19:57:16 +00:00
/bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011195716.gz 38 308 Oct 11 2012 20:07:17
 +00:00 /bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011200717.gz 39 307 Oct 11
2012 20:12:18 +00:00 /bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011201218.gz 40
306 Oct 11 2012 20:17:18 +00:00
/bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011201718.gz 41 44220 Oct 10 2012
11:47:42 +00:00 /bootflash/tracelogs/hman_R0-0.log.32016.20121010114742.gz 42 64241 Oct 09
 2012 20:47:59 +00:00 /bootflash/tracelogs/fman-fp_F0-0.log.12268.20121009204757.gz 43 177
 Oct 11 2012 19:27:03 +00:00 /bootflash/tracelogs/inst_compmatrix_R0-0.log.gz 44 307 Oct
11 2012 18:24:41 +00:00 /bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011182441.gz
45 309 Oct 11 2012 18:29:42 +00:00
/bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011182942.gz 46 43748 Oct 06 2012
13:49:19 +00:00 /bootflash/tracelogs/hman_R0-0.log.0498.20121006134919.gz 47 309 Oct 11
2012 18:44:43 +00:00 /bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011184443.gz 48
309 Oct 11 2012 19:04:46 +00:00
/bootflash/tracelogs/inst_cleanup_R0-0.log.0000.20121011190446.gz 49 2729 Oct 09 2012
21:21:49 +00:00 /bootflash/tracelogs/IOSRP_R0-0.log.20011.20121009212149 50 116 Oct 08 2012
 21:06:44 +00:00 /bootflash/tracelogs/binos_log_R0-0.log.20013.20121008210644
```

Note To avoid losing work you have completed, be sure to save your configuration occasionally as you proceed. Use the **copy running-config startup-config** command to save the configuration to NVRAM.

Verify Initial Configuration on Cisco 1100 Terminal Server Gateway

Enter the following commands at Cisco IOS-XE to verify the initial configuration on the router:

- **show version**—Displays the system hardware version; the installed software version; the names and sources of configuration files; the boot images; and the amount of installed DRAM, NVRAM, and flash memory.
- **show diag**—Lists and displays diagnostic information about the installed controllers, interface processors, and port adapters.

- **show interfaces**— Shows interfaces are operating correctly and that the interfaces and line protocol are in the correct state; either up or down.
- **show ip interface brief—** Displays a summary status of the interfaces configured for IP protocol.
- **show configuration—** Verifies that you have configured the correct hostname and password.
- **show platform—** Displays the software/rommon version, and so on.

When you have completed and verified the initial configuration, specific features and functions are ready to be configured.

CHAPTER 3

Basic Router Configuration

This section includes information about some basic terminal server gateway configuration, and contains the following sections:

Default Configuration

When you boot up the router, the router looks for a default file name-the PID of the router. For example, the Cisco 1100 Terminal Server Gateway look for a file named c1100.cfg. The device looks for this file before finding the standard files-router-confg or the ciscortr.cfg.

The device looks for the c1100.cfg file in the bootflash. If the file is not found in the bootflash, the router then looks for the standard files-router-confg and ciscortr.cfg. If none of the files are found, the router then checks for any inserted USB that may have stored these files in the same particular order.

Note If there is a configuration file with the PID as its name in an inserted USB, but one of the standard files are in bootflash, the system finds the standard file for use.

Use the **show running-config** command to view the initial configuration, as shown in the following example:

```
Router# show running-config
Building configuration... Current configuration : 977 bytes !
                   version 15.3
                   service timestamps debug datetime msec
                   service timestamps log datetime msec
                   no platform punt-keepalive disable-kernel-core
                   !
page21image1612800
hostname Router
```

```
!
boot-start-marker
boot-end-marker
!
!
vrf definition Mgmt-intf
!
address-family ipv4
exit-address-family
!
address-family ipv6
exit-address-family
!
!
no aaa new-model
!
ipv6 multicast rpf use-bgp
!
!
multilink bundle-name authenticated
!
!
redundancy
mode none
!
interface GigabitEthernet0/0/0
no ip address
negotiation auto
!
interface GigabitEthernet0/0/1
no ip address
negotiation auto
!
interface GigabitEthernet0/0/2
no ip address
negotiation auto
!
interface GigabitEthernet0/0/3
no ip address
negotiation auto
!
interface GigabitEthernet0/0/4
no ip address
negotiation auto
interface GigabitEthernet0/0/5
no ip address
negotiation auto

!

ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
control-plane
!
!
line con 0
stopbits 1
line vty 0 4
login
```

```
end
```

Configuring Global Parameters

To configure the global parameters for your router, follow these steps.

SUMMARY STEPS

1. **configure terminal**
2. **hostname** *name*
3. **enable secret** *password*
4. **no ip domain-lookup**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`Router> enable`
	`Router# configure terminal`
	`Router(config)#`
		Enters global configuration mode when using the console port.
		Use the following to connect to the router with a remote terminal:
		`telnet router-name or address`
		`Login: login-id`
		`Password: *********`
		`Router> enable`

Step 2	**hostname** *name* **Example:** `Router(config)# hostname Router`	Specifies the name for the router.
Step 3	**enable secret** *password* **Example:** `Router(config)# enable secret cr1ny5ho`	Specifies an encrypted password to prevent unauthorized access to the router.
Step 4	**no ip domain-lookup** **Example:** `Router(config)# no ip domain-lookup`	Disables the router from translating unfamiliar words (typos) into IP addresses. For complete information on global parameter commands, see the Cisco IOS Release Configuration Guide documentation set.

Configuring Gigabit Ethernet Interfaces

To manually define onboard Gigabit Ethernet interfaces, follow these steps, beginning from global configuration mode.

SUMMARY STEPS

1. **interface gigabitethernet** *slot/bay/port*
2. **ip address** *ip-address mask*
3. **ipv6 address** *ipv6-address/prefix*
4. **no shutdown**
5. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface gigabitethernet** *slot/bay/port* **Example:** `Router(config)# interface gigabitethernet 0/0/1`	Enters the configuration mode for a Gigabit Ethernet interface on the router.
Step 2	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 192.168.12.2 255.255.255.0`	Sets the IP address and subnet mask for the specified Gigabit Ethernet interface. Use this Step if you are configuring an IPv4 address.
Step 3	**ipv6 address** *ipv6-address/prefix* **Example:** `Router(config-if)# ipv6 address 2001.db8::ffff:1/128`	Sets the IPv6 address and prefix for the specified Gigabit Ethernet interface. Use this step instead of Step 2, if you are configuring an IPv6 address.
Step 4	**no shutdown** **Example:** `Router(config-if)# no shutdown`	Enables the Gigabit Ethernet interface and changes its state from administratively down to administratively up.
Step 5	**exit** **Example:** `Router(config-if)# exit`	Exits configuration mode for the Gigabit Ethernet interface and returns to privileged EXEC mode.

Configuring a Loopback Interface

Before you begin

The loopback interface acts as a placeholder for the static IP address and provides default routing information.

To configure a loopback interface, follow these steps.

SUMMARY STEPS

1. **interface** *type number*
2. (Option 1) **ip address** *ip-address mask*
3. (Option 2) **ipv6 address** *ipv6-address/prefix*
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface** *type number* **Example:** `Router(config)# interface Loopback 0`	Enters configuration mode on the loopback interface.
Step 2	(Option 1) **ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.108.1.1 255.255.255.0`	Sets the IP address and subnet mask on the loopback interface. (If you are configuring an IPv6 address, use the **ipv6 address** *ipv6-address/prefix* command described below.
Step 3	(Option 2) **ipv6 address** *ipv6-address/prefix* **Example:** `Router(config-if)# 2001:db8::ffff:1/128`	Sets the IPv6 address and prefix on the loopback interface.
Step 4	**exit** **Example:** `Router(config-if)# exit`	Exits configuration mode for the loopback interface and returns to global configuration mode.

Example

Verifying Loopback Interface Configuration

The loopback interface in this sample configuration is used to support Network Address Translation (NAT) on the virtual-template interface. This configuration example shows the loopback interface configured on the Gigabit Ethernet interface with an IP address of 192.0.2.0/24, which acts as a static IP address. The loopback interface points back to virtual-template1, which has a negotiated IP address.

```
!
interface loopback 0
ip address 192.0.2.0 255.255.255.0 (static IP address)
ip nat outside
!
interface Virtual-Template1
ip unnumbered loopback0
no ip directed-broadcast
ip nat outside
```

Enter the **show interface loopback** command. You should see an output similar to the following example:

```
Router# show interface loopback 0
Loopback0 is up, line protocol is up
  Hardware is Loopback
  Internet address is 200.200.100.1/24
  MTU 1514 bytes, BW 8000000 Kbit, DLY 5000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation LOOPBACK, loopback not set
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/0, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
```

Alternatively, use the **ping** command to verify the loopback interface, as shown in the following example:

```
Router# ping 192.0.2.0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.0.2.0, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

Configuring Module Interfaces

For detailed information about configuring service modules, see "Service Modules" in the "Service Module Management" section of the Cisco Service Module Configuration Guide.

Enabling Cisco Discovery Protocol

Cisco Discovery Protocol (CDP) is enabled by default on the router.

For more information on using CDP, see Cisco Discovery Protocol Configuration Guide.

Configuring Command-Line Access

To configure parameters to control access to the router, follow these steps.

SUMMARY STEPS

1. **line** [| **console** | **tty** | **vty**] *line-number*
2. **password** *password*

3. **login**
4. **exec-timeout** *minutes* [*seconds*]
5. **exit**
6. **line** [| **console** | **tty** | **vty**] *line-number*
7. **password** *password*
8. **login**
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**line** [| **console**	**tty**	**vty**] *line-number* **Example:** `Router(config)# line console 0`	Enters line configuration mode, and specifies the type of line. The example provided here specifies a console terminal for access.
Step 2	**password** *password* **Example:** `Router(config-line)# password 5dr4Hepw3`	Specifies a unique password for the console terminal line.
Step 3	**login** **Example:** `Router(config-line)# login`	Enables password checking at terminal session login.

Step 4	**exec-timeout** *minutes* [*seconds*]
	Example:
	`Router(config-line)# exec-timeout 5 30`
	`Router(config-line)#`
		Sets the interval during which the EXEC command interpreter waits until user input is detected. The default is 10 minutes. Optionally, adds seconds to the interval value.
		The example provided here shows a timeout of 5 minutes and 30 seconds. Entering a timeout of **0 0** specifies never to time out.

Step 5	**exit** **Example:** `Router(config-line)# exit`	Exits line configuration mode to re-enter global configuration mode.

Step 6	**line** [| **console**	**tty**	**vty**] *line-number*
			Example:
			`Router(config)# line vty 0 4`
			`Router(config-line)#`
				Specifies a virtual terminal for remote console access.

Step 7	**password** *password* **Example:** `Router(config-line)# password aldf2ad1`	Specifies a unique password for the virtual terminal line.

	Command or Action	Purpose
Step 8	**login** **Example:** `Router(config-line)# login`	Enables password checking at the virtual terminal session login.

Step 9	**end**
	Example:
	`Router(config-line)# end`
		Exits line configuration mode, and returns to privileged EXEC mode.

Example

The following configuration shows the command-line access commands.

You do not have to input the commands marked **default**. These commands appear automatically in the configuration file that is generated when you use the **show running-config** command.

```
!
line console 0
exec-timeout 10 0
password 4youreyesonly
login
transport input none (default)
stopbits 1 (default)
line vty 0 4
password secret
login
!
```

Configuring Static Routes

Static routes provide fixed routing paths through the network. They are manually configured on the router. If the network topology changes, the static route must be updated with a new route. Static routes are private routes unless they are redistributed by a routing protocol.

To configure static routes, follow these steps.

SUMMARY STEPS

1. (Option 1) **ip route** *prefix mask* {*ip-address* | *interface-type interface-number* [*ip-address*]}
2. (Option 2) **ipv6 route** *prefix/mask* {*ipv6-address* | *interface-type interface-number* [*ipv6-address*]}
3. **end**

DETAILED STEPS

	Command or Action	Purpose

Step 1	(Option 1) **ip route** *prefix mask* {*ip-address* | *interface-type interface-number* [*ip-address*]}
	Example:
	`Router(config)# ip route 192.168.1.0 255.255.0.0 10.10.10.2`
		Specifies a static route for the IP packets. (If you are configuring an IPv6 address, use the **ipv6 route** command described below.)

Step 2	(Option 2) **ipv6 route** *prefix/mask* {*ipv6-address* | *interface-type interface-number* [*ipv6-address*]}
	Example:
	`Router(config)# ipv6 route 2001:db8:2::/64`
		Specifies a static route for the IP packets.

Step 3	**end**
	Example:
	`Router(config)# end`
		Exits global configuration mode and enters privileged EXEC mode.

Verifying Configuration

In the following configuration example, the static route sends out all IP packets with a destination IP address of 192.168.1.0 and a subnet mask of 255.255.255.0 on the Gigabit Ethernet interface to another device with an IP address of 10.10.10.2. Specifically, the packets are sent to the configured PVC.

You do not have to enter the command marked **default**. This command appears automatically in the configuration file generated when you use the **running-config** command.

```
!
ip classless (default)
ip route 192.168.1.0 255.255.255.0
```

To verify that you have configured static routing correctly, enter the **show ip route** command (or **show ipv6 route** command) and look for static routes marked with the letter S.

When you use an IPv4 address, you should see verification output similar to the following:

```
Router# show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 1 subnets
C       10.108.1.0 is directly connected, Loopback0
S*   0.0.0.0/0 is directly connected, FastEthernet0
```

When you use an IPv6 address, you should see verification output similar to the following:

```
Router# show ipv6 route
IPv6 Routing Table - default - 5 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, R - RIP, H - NHRP, I1 - ISIS L1
       I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary, D - EIGRP
       EX - EIGRP external, ND - ND Default, NDp - ND Prefix, DCE -
Destination
       NDr - Redirect, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
       OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
       ls - LISP site, ld - LISP dyn-EID, a - Application

C   2001:DB8:3::/64 [0/0]
       via GigabitEthernet0/0/2, directly connected
S   2001:DB8:2::/64 [1/0]
       via 2001:DB8:3::1
```

Configuring Dynamic Routes

In dynamic routing, the network protocol adjusts the path automatically, based on network traffic or topology. Changes in dynamic routes are shared with other routers in the network.

A router can use IP routing protocols, such as Routing Information Protocol (RIP) or Enhanced Interior Gateway Routing Protocol (EIGRP), to learn about routes dynamically.

- Configuring Routing Information Protocol, on page 38
- Configuring Enhanced Interior Gateway Routing Protocol, on page 41

Configuring Routing Information Protocol

To configure the RIP on a router, follow these steps.

SUMMARY STEPS

1. **router rip**
2. **version** {**1** | **2**}
3. **network** *ip-address*
4. **no auto-summary**
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**router rip** **Example:** `Router(config)# router rip`	Enters router configuration mode, and enables RIP on the router.

	Command or Action	Purpose

Step 2	**version** {**1** | **2**}
	Example:
	`Router(config-router)# version 2`
		Specifies use of RIP version 1 or 2.

Step 3	**network** *ip-address*
	Example:
	`Router(config-router)# network 192.168.1.1`
	`Router(config-router)# network 10.10.7.1`
		Specifies a list of networks on which RIP is to be applied, using the address of the network of each directly connected network.

Step 4	**no auto-summary** **Example:** `Router(config-router)# no auto-summary`	Disables automatic summarization of subnet routes into network-level routes. This allows subprefix routing information to pass across classful network boundaries.

Step 5	**end**
	Example:
	`Router(config-router)# end`
		Exits router configuration mode, and enters privileged EXEC mode.

Example

Verifying Configuration

The following configuration example shows RIP Version 2 enabled in IP networks 10.0.0.0 and 192.168.1.0. To see this configuration, use the **show running-config** command from privileged EXEC mode.

```
!
Router# show running-config
Building configuration... Current configuration : 977 bytes !
                   version 15.3
                   service timestamps debug datetime msec
                   service timestamps log datetime msec
                   no platform punt-keepalive disable-kernel-core
                   !
page21image1612800
hostname Router
!
boot-start-marker
boot-end-marker
!
!
vrf definition Mgmt-intf
!
address-family ipv4
exit-address-family
!
address-family ipv6
exit-address-family
!
```

```
!
no aaa new-model
!
ipv6 multicast rpf use-bgp
!
!
multilink bundle-name authenticated
!
!
redundancy
mode none
!
interface GigabitEthernet0/0/0
no ip address
negotiation auto
!
interface GigabitEthernet0/0/1
no ip address
negotiation auto
!
interface GigabitEthernet0/0/2
no ip address
negotiation auto
!
interface GigabitEthernet0/0/3
no ip address
negotiation auto
!
interface GigabitEthernet0/0/4
no ip address
negotiation auto
interface GigabitEthernet0/0/5
no ip address
negotiation auto

!

ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
control-plane
!
!
line con 0
stopbits 1
line vty 0 4
login

end
```

To verify that you have configured RIP correctly, enter the **show ip route** command and look for RIP routes marked with the letter R. You should see an output similar to the one shown in the following example:

```
Router# show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 1 subnets
C       10.108.1.0 is directly connected, Loopback0
R    3.0.0.0/8 [120/1] via 2.2.2.1, 00:00:02, Ethernet0/0/0
```

Configuring Enhanced Interior Gateway Routing Protocol

To configure Enhanced Interior Gateway Routing Protocol (EIGRP), follow these steps.

SUMMARY STEPS

1. **router eigrp** *as-number*
2. **network** *ip-address*
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**router eigrp** *as-number* **Example:** `Router(config)# router eigrp 109`	Enters router configuration mode, and enables EIGRP on the router. The autonomous-system number identifies the route to other EIGRP routers and is used to tag the EIGRP information.

Step 2	**network** *ip-address*
	Example:
	`Router(config)# network 192.168.1.0`
	`Router(config)# network 10.10.12.115`
		Specifies a list of networks on which EIGRP is to be applied, using the IP address of the network of directly connected networks.

Step 3	**end**
	Example:
	`Router(config-router)# end`
		Exits router configuration mode, and enters privileged EXEC mode.

Example

Verifying the Configuration

The following configuration example shows the EIGRP routing protocol enabled in IP networks 192.168.1.0 and 10.10.12.115. The EIGRP autonomous system number is 109. To see this configuration, use the **show running-config** command.

```
Router# show running-config
.
.
.
!
```

```
router eigrp 109
 network 192.168.1.0
  network 10.10.12.115
!
.
.
.
```

To verify that you have configured IP EIGRP correctly, enter the **show ip route** command, and look for EIGRP routes marked by the letter D. You should see verification output similar to the following:

```
Router# show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 1 subnets
C       10.108.1.0 is directly connected, Loopback0
D      3.0.0.0/8 [90/409600] via 2.2.2.1, 00:00:02, Ethernet0/0
```

CHAPTER 4

Accessing the CLI Using a Router Console

Before you begin

Use the console (CON) port to access the command-line interface (CLI) directly or when using Telnet.

The following sections describe the main methods of accessing the router:

- Accessing the CLI Using a Directly-Connected Console, on page 43
- Using SSH to Access Console, on page 44
- Accessing the CLI from a Remote Console Using Telnet, on page 45

- Accessing the CLI Using a Directly-Connected Console, on page 43
- Using SSH to Access Console, on page 44
- Accessing the CLI from a Remote Console Using Telnet, on page 45

Accessing the CLI Using a Directly-Connected Console

The CON port is an EIA/TIA-232 asynchronous, serial connection with no-flow control and an RJ-45 connector. The CON port is located on the front panel of the chassis.

The following sections describe the procedure to access the control interface:

- Connecting to the Console Port, on page 44
- Using the Console Interface, on page 44

Connecting to the Console Port

Step 1 Configure your terminal emulation software with the following settings:

- 9600 bits per second (bps)
- 8 data bits
- No parity
- No flow control

Step 2 Connect to the CON port using the RJ-45-to-RJ-45 cable and the RJ-45-to-DB-25 DTE adapter or the RJ-45-to-DB-9 DTE adapter (labeled Terminal).

Using the Console Interface

Step 1 Enter the following command:

```
Router> enable
```

Step 2 (Go to Step 3 if the enable password has not been configured.) At the password prompt, enter your system password:

```
Password: enablepass
```

When your password is accepted, the privileged EXEC mode prompt is displayed.

```
Router#
```

You now have access to the CLI in privileged EXEC mode and you can enter the necessary commands to complete your desired tasks.

Step 3 If you enter the **setup** command, see “Using Cisco Setup Command Facility” in the “Initial Configuration” section of the Hardware Installation Guide for the Cisco 1100 Terminal Gateway.

Step 4 To exit the console session, enter the **quit** command:

```
Router# quit
```

Using SSH to Access Console

Secure Shell (SSH) is a protocol which provides a secure remote access connection to network devices. To enable SSH support on the device:

Step 1 Configure the hostname:

```
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#hostname xxx_lab
```

Here, *host name* is the router hostname or IP address.

Step 2 Configure the DNS domain of the router:

```
xxx_lab(config)# xxx.cisco.com
```

Step 3 Generate an SSH key to be used with SSH:

```
xxx_lab(config)#  crypto key generate rsa
The name for the keys will be: xxx_lab.xxx.cisco.com Choose the size of the key modulus in the range

of 360 to 4096 for your General Purpose Keys. Choosing a key modulus greater than 512 may take a few
minutes.
How many bits in the modulus [512]: 1024 % Generating 1024 bit RSA keys, keys will be non-exportable...
[OK] (elapsed time was 0 seconds)
xxx_lab(config)#
```

Step 4 By default, the vtys? transport is Telnet. In this case, Telnet is disabled and only SSH is supported:

```
xxx_lab(config)#line vty 0 4
xxx_lab(config-line)#transport input SSH
```

Step 5 Create a username for SSH authentication and enable login authentication:

```
xxx_lab(config)# username jsmith privilege 15 secret 0 p@ss3456
xxx_lab(config)#line vty 0 4
xxx_lab(config-line)# login local
```

Step 6 Verify remote connection to the device using SSH.

Accessing the CLI from a Remote Console Using Telnet

The following topics describe the procedure to access the CLI from a remote console using Telnet:

- Preparing to Connect to the Router Console Using Telnet, on page 45
- Using Telnet to Access a Console Interface, on page 46

Preparing to Connect to the Router Console Using Telnet

To access the router remotely using Telnet from a TCP/IP network, configure the router to support virtual terminal lines using the **line vty** global configuration command. Configure the virtual terminal lines to require users to log in and specify a password.

See the Cisco IOS Terminal Services Command Reference document for more information about the line **vty global** configuration command.

To prevent disabling login on a line, specify a password with the **password** command when you configure the **login** command.

If you are using authentication, authorization, and accounting (AAA), configure the **login authentication** command. To prevent disabling login on a line for AAA authentication when you configure a list with the login authentication command, you must also configure that list using the **aaa authentication login** global configuration command.

For more information about AAA services, see the Cisco IOS XE Security Configuration Guide: Secure Connectivity and the Cisco IOS Security Command Reference documents. For more information about the **login line-configuration** command, see the Cisco IOS Terminal Services Command Reference document.

In addition, before you make a Telnet connection to the router, you must have a valid hostname for the router or have an IP address configured on the router. For more information about the requirements for connecting to the router using Telnet, information about customizing your Telnet services, and using Telnet key sequences, see the Cisco IOS Configuration Fundamentals Configuration Guide.

Using Telnet to Access a Console Interface

Step 1 From your terminal or PC, enter one of the following commands:

- **connect** **host** [*port*] [*keyword*]
- **telnet** **host** [*port*] [*keyword*]

Here, *host* is the router hostname or IP address, *port* is a decimal port number (23 is the default), and *keyword* is a supported keyword. For more information about these commands, see the Cisco IOS Terminal Services Command Reference document.

Note If you are using an access server, specify a valid port number, such as **telnet 172.20.52.40 2004**, in addition to the hostname or IP address.

The following example shows how to use the **telnet** command to connect to a router named **router**:

```
unix_host% telnet router
Trying 172.20.52.40...
Connected to 172.20.52.40.
Escape character is '^]'.
unix_host% connect
```

Step 2 Enter your login password:

```
User Access Verification
Password: mypassword
```

Note If no password has been configured, press **Return**.

Step 3 From user EXEC mode, enter the **enable** command:

```
Router> enable
```

Step 4 At the password prompt, enter your system password:

```
Password: enablepass
```

Step 5 When the **enable** password is accepted, the privileged EXEC mode prompt is displayed:

```
Router#
```

Step 6 You now have access to the CLI in privileged EXEC mode and you can enter the necessary commands to complete your desired tasks.

Step 7 To exit the Telnet session, use the **exit** or **logout** command.

```
Router# logout
```

Using Keyboard Shortcuts

Commands are not case sensitive. You can abbreviate commands and parameters if the abbreviations contain enough letters to be different from any other currently available commands or parameters.

The following table lists the keyboard shortcuts for entering and editing commands.

Table 3: Keyboard Shortcuts

Key Name	Purpose
Ctrl-B or the **Left Arrow** key[1]	Move the cursor back one character.
Ctrl-F or the **Right Arrow** key[1]	Move the cursor forward one character.
Ctrl-A	Move the cursor to the beginning of the command line.
Ctrl-E	Move the cursor to the end of the command line.
Esc B	Move the cursor back one word.
Esc F	Move the cursor forward one word.

Using the History Buffer to Recall Commands

The history buffer stores the last 20 commands you entered. History substitution allows you to access these commands without retyping them, by using special abbreviated commands.

The following table lists the history substitution commands.

Table 4: History Substitution Commands

Command	Purpose
Ctrl-P or the **Up Arrow** key[1]	Recalls commands in the history buffer, beginning with the most recent command. Repeat the key sequence to recall successively older commands.
Ctrl-N or the **Down Arrow** key[1]	Returns to more recent commands in the history buffer after recalling commands with **Ctrl-P** or the **Up Arrow** key.
Router# show history	While in EXEC mode, lists the last few commands you entered.

[1] The arrow keys function only on ANSI-compatible terminals such as VT100s.

Understanding Command Modes

The command modes available in Cisco IOS XE are the same as those available in traditional Cisco IOS. Use the CLI to access Cisco IOS XE software. Because the CLI is divided into many different modes, the commands available to you at any given time depend on the mode that you are currently in. Entering a question mark (**?**) at the CLI prompt allows you to obtain a list of commands available for each command mode.

When you log in to the CLI, you are in user EXEC mode. User EXEC mode contains only a limited subset of commands. To have access to all commands, you must enter privileged EXEC mode, normally by using a password. From privileged EXEC mode, you can issue any EXEC command—user or privileged mode—or you can enter global configuration mode. Most EXEC commands are one-time commands. For example, **show** commands show important status information, and **clear** commands clear counters or interfaces. The EXEC commands are not saved when the software reboots.

Configuration modes allow you to make changes to the running configuration. If you later save the running configuration to the startup configuration, these changed commands are stored when the software is rebooted. To enter specific configuration modes, you must start at global configuration mode. From global configuration mode, you can enter interface configuration mode and a variety of other modes, such as protocol-specific modes.

ROM monitor mode is a separate mode used when the Cisco IOS XE software cannot load properly. If a valid software image is not found when the software boots or if the configuration file is corrupted at startup, the software might enter ROM monitor mode.

The following table describes how to access and exit various common command modes of the Cisco IOS XE software. It also shows examples of the prompts displayed for each mode.

Table 5: Accessing and Exiting Command Modes

Command Mode	Access Method	Prompt	Exit Method
User EXEC	Log in.	`Router>`	Use the **logout** command.
Privileged EXEC	From user EXEC mode, use the **enable** command.	`Router#`	To return to user EXEC mode, use the **disable** command.
Global configuration	From privileged EXEC mode, use the **configure terminal** command.	`Router(config)#`	To return to privileged EXEC mode from global configuration mode, use the **exit** or **end** command.
Interface configuration	From global configuration mode, specify an interface using an **interface** command.	`Router(config-if)#`	To return to global configuration mode, use the **exit** command. To return to privileged EXEC mode, use the **end** command.

Command Mode	Access Method	Prompt	Exit Method
Diagnostic	The router boots up or accesses diagnostic mode in the following scenarios: • In some cases, diagnostic mode will be reached when the Cisco IOS process or processes fail. In most scenarios, however, the router will reload. • A user-configured access policy is configured using the **transport-map** command that directs a user into diagnostic mode. • A break signal (**Ctrl-C**, **Ctrl-Shift-6**, or the **send break** command) is entered and the router is configured to go to diagnostic mode when the break signal is received.	`Router(diag)#`	If failure of the Cisco IOS process is the reason for entering diagnostic mode, the Cisco IOS problem must be resolved and the router rebooted to get out of diagnostic mode. If the router is in diagnostic mode because of a transport-map configuration, access the router through another port or by using a method that is configured to connect to the Cisco IOS CLI.
ROM monitor	From privileged EXEC mode, use the **reload** EXEC command. Press the **Break** key during the first 60 seconds while the system is booting.	`rommon#>`	To exit ROM monitor mode, manually boot a valid image or perform a reset with autoboot set so that a valid image is loaded.

Understanding Diagnostic Mode

The router boots up or accesses diagnostic mode in the following scenarios:

- The IOS process or processes fail, in some scenarios. In other scenarios, the system resets when the IOS process or processes fail.
- A user-configured access policy was configured using the **transport-map** command that directs the user into the diagnostic mode.

- A send break signal (**Ctrl-C** or **Ctrl-Shift-6**) was entered while accessing the router, and the router was configured to enter diagnostic mode when a break signal was sent.

In the diagnostic mode, a subset of the commands that are available in user EXEC mode are made available to the users. Among other things, these commands can be used to:

- Inspect various states on the router, including the IOS state.
- Replace or roll back the configuration.
- Provide methods of restarting the IOS or other processes.
- Reboot hardware, such as the entire router, a module, or possibly other hardware components.
- Transfer files into or off of the router using remote access methods such as FTP, TFTP, and SCP.

The diagnostic mode provides a more comprehensive user interface for troubleshooting than previous routers, which relied on limited access methods during failures, such as ROMMON, to diagnose and troubleshoot Cisco IOS problems. The diagnostic mode commands can work when the Cisco IOS process is not working properly. These commands are also available in privileged EXEC mode on the router when the router is working normally.

Getting Help

Entering a question mark (**?**) at the CLI prompt displays a list of commands available for each command mode. You can also get a list of keywords and arguments associated with any command by using the context-sensitive help feature.

To get help that is specific to a command mode, a command, a keyword, or an argument, use one of the following commands.

Command	Purpose
`help`	Provides a brief description of the help system in any command mode.
`abbreviated-command-entry?`	Provides a list of commands that begin with a particular character string. **Note** There is no space between the command and the question mark.
`abbreviated-command-entry<Tab>`	Completes a partial command name.
`?`	Lists all the commands that are available for a particular command mode.
`command ?`	Lists the keywords or arguments that you must enter next on the command line. **Note** There is a space between the command and the question mark.

Finding Command Options: Example

This section provides information about how to display the syntax for a command. The syntax can consist of optional or required keywords and arguments. To display keywords and arguments for a command, enter a question mark (**?**) at the configuration prompt or after entering a part of a command followed by a space. The Cisco IOS XE software displays a list and brief descriptions of the available keywords and arguments. For example, if you are in global configuration mode and want to see all the keywords and arguments for the **arap** command, you should type **arap ?**.

The <cr> symbol in command help output stands for carriage return. On older keyboards, the carriage return key is the **Return** key. On most modern keyboards, the carriage return key is the **Enter** key. The <cr> symbol at the end of command help output indicates that you have the option to press **Enter** to complete the command and that the arguments and keywords in the list preceding the <cr> symbol are optional. The <cr> symbol by itself indicates that no more arguments or keywords are available, and that you must press **Enter** to complete the command.

The following table shows examples of using the question mark (**?**) to assist you in entering commands.

Table 6: Finding Command Options

Command	Comment

`Router> enable`
`Password: <password>`
`Router#`
	Enter the **enable** command and password to access privileged EXEC commands. You are in privileged EXEC mode when the prompt changes to a “ # ” from the “ > ”, for example, `Router>` to `Router#`

`Router# configure terminal`
`Enter configuration commands, one per line. End with CNTL/Z.`
`Router(config)#`
	Enter the **configure terminal** privileged EXEC command to enter global configuration mode. You are in global configuration mode when the prompt changes to `Router (config)#`

`Router(config)# interface GigabitEthernet ?`
`  <0-0>  GigabitEthernet interface number`
`  <0-2>  GigabitEthernet interface number`
`Router(config)# interface GigabitEthernet 1/?`
`  <0-4>  Port Adapter number`
`Router (config)# interface GigabitEthernet 1/3/?`
`  <0-15>  GigabitEthernet interface number`
`Router (config)# interface GigabitEthernet 1/3/8?`
`.  <0-3>`
`Router (config)# interface GigabitEthernet 1/3/8.0`
`Router(config-if)#`
	Enter interface configuration mode by specifying the interface that you want to configure, using the **interface GigabitEthernet** global configuration command.
	Enter **?** to display what you must enter next on the command line.
	When the <cr> symbol is displayed, you can press **Enter** to complete the command.
	You are in interface configuration mode when the prompt changes to `Router(config-if)#`

<table>
<tr><th>Command</th><th>Comment</th></tr>
<tr><td>

```
Router(config-if)# ?
Interface configuration commands:
  .
  .
  .
  ip                   Interface Internet
Protocol
                       config commands
  keepalive            Enable keepalive
  lan-name             LAN Name command
  llc2                LLC2 Interface Subcommands

  load-interval       Specify interval for load
 calculation
                       for an interface
  locaddr-priority     Assign a priority group
  logging              Configure logging for
interface
  loopback             Configure internal
loopback on an
                       interface
  mac-address          Manually set interface
MAC address
  mls                  mls router sub/interface
 commands
  mpoa                 MPOA interface
configuration commands
  mtu                  Set the interface
                      Maximum Transmission Unit
 (MTU)
  netbios              Use a defined NETBIOS
access list
                       or enable
                       name-caching
  no                   Negate a command or set
its defaults
  nrzi-encoding        Enable use of NRZI
encoding
  ntp                  Configure NTP
  .
  .
  .
Router(config-if)#
```

</td><td>Enter **?** to display a list of all the interface configuration commands available for the interface. This example shows only some of the available interface configuration commands.</td></tr>
</table>

Command	Comment

`Router(config-if)# ip ?`
`Interface IP configuration subcommands:`
`  access-group        Specify access control`
`for packets`
`  accounting          Enable IP accounting on`
`this interface`
`  address             Set the IP address of an`
` interface`
`  authentication     authentication subcommands`
 	
`  bandwidth-percent   Set EIGRP bandwidth limit`
 	
`  broadcast-address   Set the broadcast address`
` of an interface`
`  cgmp                Enable/disable CGMP`
`  directed-broadcast  Enable forwarding of`
`directed broadcasts`
`  dvmrp               DVMRP interface commands`
`  hello-interval     Configures IP-EIGRP hello`
` interval`
`  helper-address      Specify a destination`
`address for UDP broadcasts`
`  hold-time           Configures IP-EIGRP hold`
` time`
`  .`
`  .`
`  .`
`Router(config-if)# ip`
	Enter the command that you want to configure for the interface. This example uses the **ip** command.
	Enter **?** to display what you must enter next on the command line. This example shows only some of the available interface IP configuration commands.

`Router(config-if)# ip address ?`
`  A.B.C.D             IP address`
`  negotiated         IP Address negotiated over`
` PPP`
`Router(config-if)# ip address`
	Enter the command that you want to configure for the interface. This example uses the **ip address** command.
	Enter **?** to display what you must enter next on the command line. In this example, you must enter an IP address or the **negotiated** keyword.
	A carriage return (<cr>) is not displayed. Therefore, you must enter additional keywords or arguments to complete the command.

`Router(config-if)# ip address 172.16.0.1 ?`
`  A.B.C.D             IP subnet mask`
`Router(config-if)# ip address 172.16.0.1`
	Enter the keyword or argument that you want to use. This example uses the 172.16.0.1 IP address.
	Enter **?** to display what you must enter next on the command line. In this example, you must enter an IP subnet mask.
	<cr> is not displayed. Therefore, you must enter additional keywords or arguments to complete the command.

Command	Comment

`Router(config-if)#` **`ip address 172.16.0.1 255.255.255.0 ?`**
`  secondary           Make this IP address a secondary address`
`  <cr>`
`Router(config-if)#` **`ip address 172.16.0.1 255.255.255.0`**
	Enter the IP subnet mask. This example uses the 255.255.255.0 IP subnet mask.
	Enter **?** to display what you must enter next on the command line. In this example, you can enter the **secondary** keyword, or you can press **Enter**.
	<cr> is displayed. Press **Enter** to complete the command, or enter another keyword.

`Router(config-if)#` **`ip address 172.16.0.1 255.255.255.0`**
`Router(config-if)#`
	Press **Enter** to complete the command.

Using the no and default Forms of Commands

Almost every configuration command has a **no** form. In general, use the **no** form to disable a function. Use the command without the **no** keyword to re-enable a disabled function or to enable a function that is disabled by default. For example, IP routing is enabled by default. To disable IP routing, use the **no ip routing** command; to re-enable IP routing, use the **ip routing** command. The Cisco IOS software command reference publications provide the complete syntax for the configuration commands and describe what the **no** form of a command does.

Many CLI commands also have a **default** form. By issuing the <*command*> **default** command-name, you can configure the command to its default setting. The Cisco IOS software command reference publications describe the function from a **default** form of the command when the **default** form performs a different function than the plain and **no** forms of the command. To see what default commands are available on your system, enter **default ?** in the appropriate command mode.

Saving Configuration Changes

Use the **copy running-config startup-config** command to save your configuration changes to the startup configuration so that the changes will not be lost if the software reloads or a power outage occurs. For example:

```
Router# copy running-config startup-config
Building configuration...
```

It may take a few minutes to save the configuration. After the configuration has been saved, the following output is displayed:

```
[OK]
Router#
```

This task saves the configuration to the NVRAM.

Managing Configuration Files

The startup configuration file is stored in the nvram: file system and the running configuration files are stored in the system: file system. This configuration file storage setup is also used on several other Cisco router platforms.

As a matter of routine maintenance on any Cisco router, users should back up the startup configuration file by copying the startup configuration file from NVRAM to one of the router's other file systems and, additionally, to a network server. Backing up the startup configuration file provides an easy method of recovering the startup configuration file if the startup configuration file in NVRAM becomes unusable for any reason.

The **copy** command can be used to back up startup configuration files.

Examples of backing up the startup configuration file in NVRAM are shown in the Backing Up Cofiguration Files section.

For more detailed information on managing configuration files, see the "Managing Configuration Files" section in the Cisco IOS XE Configuration Fundamentals Configuration Guide.

Filtering Output from the show and more Commands

You can search and filter the output of **show** and **more** commands. This functionality is useful if you need to sort through large amounts of output or if you want to exclude output that you need not see.

To use this functionality, enter a **show** or **more** command followed by the "pipe" character (|); one of the keywords **begin**, **include**, or **exclude**; and a regular expression on which you want to search or filter (the expression is case sensitive):

show *command* | {**append** | **begin** | **exclude** | **include** | **redirect** | **section** | **tee**} *regular-expression*

The output matches certain lines of information in the configuration file.

Example

In this example, a modifier of the **show interface** command (**include protocol**) is used to provide only the output lines in which the expression **protocol** is displayed:

```
Router# show interface | include protocol
GigabitEthernet0/0/0 is administratively down, line protocol is down
     0 unknown protocol drops
GigabitEthernet0/0/1 is administratively down, line protocol is down
     0 unknown protocol drops
GigabitEthernet0/0/2 is administratively down, line protocol is down
     0 unknown protocol drops
GigabitEthernet0/0/3 is administratively down, line protocol is down
     0 unknown protocol drops
GigabitEthernet0 is up, line protocol is up
     0 unknown protocol drops
Loopback0 is up, line protocol is up
     0 unknown protocol drops
```

Powering Off a Router

The router can be safely turned off at any time by moving the router's power supply switch to the Off position. However, any changes to the running config since the last WRITE of the config to the NVRAM is lost.

Ensure that any configuration needed after startup is saved before powering off the router. The copy running-config startup-config command saves the configuration in NVRAM and after the router is powered up, the router initializes with the saved configuration.

Finding Support Information for Platforms and Cisco Software Images

The Cisco IOS XE software is packaged in feature sets consisting of software images that support specific platforms. The group of feature sets that are available for a specific platform depends on which Cisco software images are included in a release. To identify the set of software images available in a specific release or to find out if a feature is available in a given Cisco IOS XE software image, you can use Cisco Feature Navigator or see the Release Notes for Cisco IOS XE.

Using Cisco Feature Navigator

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator is a tool that enables you to determine which Cisco IOS XE software images support a specific software release, feature set, or platform. To use the navigator tool, an account on Cisco.com is not required.

Using Software Advisor

Cisco maintains the Software Advisor tool. See Tools and Resources. Use the Software Advisor tool to see if a feature is supported in a Cisco IOS XE release, to locate the software document for that feature, or to check the minimum software requirements of Cisco IOS XE software with the hardware installed on your router. You must be a registered user on Cisco.com to access this tool.

Using Software Release Notes

See the Release Notes document for Cisco Terminal Gateway for information about the following:

- Memory recommendations
- Open and resolved severity 1 and 2 caveats

Release notes are intended to be release-specific for the most current release, and the information provided in these documents may not be cumulative in providing information about features that first appeared in previous releases. For cumulative feature information, refer to the Cisco Feature Navigator at: http://www.cisco.com/go/cfn/.

CLI Session Management

An inactivity timeout is configurable and can be enforced. Session locking provides protection from two users overwriting changes that the other has made. To prevent an internal process from using all the available capacity, some spare capacity is reserved for CLI session access. For example, this allows a user to remotely access a router.

Information About CLI Session Management

An inactivity timeout is configurable and can be enforced. Session locking provides protection from two users overwriting changes that each other has made. To prevent an internal process from using all the available capacity, some spare capacity is reserved for CLI session access. For example, this allows a user to remotely access the router.

Changing the CLI Session Timeout

Step 1 `configure terminal`

Enters global configuration mode

Step 2 `line console 0`

Step 3 `session-timeout` *`minutes`*

The value of *`minutes`* sets the amount of time that the CLI waits before timing out. Setting the CLI session timeout increases the security of a CLI session. Specify a value of 0 for *`minutes`* to disable session timeout.

Step 4 `show line console 0`

Verifies the value to which the session timeout has been set, which is shown as the value for `" Idle Session "`.

Locking a CLI Session

Before you begin

To configure a temporary password on a CLI session, use the **lock** command in EXEC mode. Before you can use the **lock** command, you need to configure the line using the **lockable** command. In this example the line is configured as **lockable**, and then the **lock** command is used and a temporary password is assigned.

Step 1 `Router# configure terminal`

Enters global configuration mode.

Step 2 Enter the line upon which you want to be able to use the **lock** command.

```
Router(config)# line console 0
```

Step 3

```
Router(config)# lockable
```

Enables the line to be locked.

Step 4

```
Router(config)# exit
```

Step 5

```
Router# lock
```

The system prompts you for a password, which you must enter twice.

```
Password: <password>
Again: <password>
Locked
```

CHAPTER 5

Licenses and Licensing Models

This chapter provides information about the licenses that are available on Cisco 1100 Terminal Services Gateway and outlines the licensing models available on the platform.

For an overview on Cisco Licensing, go to https://cisco.com/go/licensingguide.

Available Licenses

Cisco 1100 Terminal Server Gateway platforms support the following licenses:

- Appx (`appxk9`)
- Security (`securityk9`)
- IP Base (`ipbasek9`)

  This license is enabled by default.
- Booster Performance (`booster_performance`)

  This license is available from Cisco IOS XE Cupertino 17.8.1a only. You must enable it for unthrottled throughput of unencrypted traffic. By default (If the Booster Performance license is not enabled), unencrypted traffic is throttled at 500 Mbps.

How to Configure Available Licenses

Configuring a Boot Level License

This task shows you how to enable a boot level license. The available boot level licenses include: Appx and Security licenses.

Device reload is required before the configured changes are effective.

Before you begin

You can use this task to configure a boot level license in the Smart Licensing (Cisco IOS XE Amsterdam 17.2.x, Cisco IOS XE Amsterdam 17.3.x) and the Smart Licensing Using Policy environment (Cisco IOS XE Bengaluru 17.4.1 and later).

Note If the software version running on the device is one that supports *Smart Licensing*, you must register the device as per: Cisco Smart Licensing Guide for Cisco Enterprise Routing Platforms.

If the software version running on the device is one that supports *Smart Licensing Using Policy*, you can purchase and use the licenses you want and complete reporting (if applicable) at a later date, as per Smart Licensing Using Policy for Cisco Enterprise Routing Platforms.

Step 1 **show version**

Example:

```
Device# show version
<output truncated>

Technology Package License Information:

-----------------------------------------------------------------
Technology    Technology-package                      Technology-package
              Current                Type             Next reboot
------------------------------------------------------------------
appxk9        None                   Smart License    None
securityk9    None                   Smart License    None
ipbase        ipbasek9               Smart License    ipbasek9

The current throughput level is unthrottled

<output truncated>
```

Displays the currently configured boot level license. In the accompanying example, a boot level license is not configured yet.

Step 2 **configure terminal**

Example:

```
Device# configure terminal
```

Enters global configuration mode.

Step 3 **license boot level** { **appxk9** | **securityk9** }

Example:

```
Device(config)# license boot level ?
  appxk9      Appx License Level
  securityk9  Security License Level

Device(config)# license boot level securityk9
```

Configures a boot level license.

Step 4 **exit**

Example:

```
Device(config)# exit
```

Exits global configuration mode and returns to privileged EXEC mode.

Step 5 **copy running-config startup-config**

Example:

```
Device# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
<output truncated>
```

Saves your entries in the configuration file.

Step 6 **reload**

Example:

```
Device# reload
Proceed with reload? [confirm]
<output truncated>
```

Reloads the device. License levels configured in Step 2 are effective and displayed only after this reload.

Step 7 **show version**

Example:

```
Device# show version
 <output truncated>

Technology Package License Information:

-----------------------------------------------------------------
Technology    Technology-package           Technology-package
              Current       Type           Next reboot
------------------------------------------------------------------
appxk9        None          Smart License    None
securityk9    securityk9    Smart License    securityk9
ipbase        ipbasek9      Smart License    ipbasek9

The current throughput level is unthrottled
<output truncated>
```

Reloads the device. License levels configured in Step 3 are effective and displayed only after this reload.

Step 8 Complete license usage reporting - if required.

Note This step is applicable only if the software version running on the device is Cisco IOS XE Bengaluru 17.4.1 and later.

After you configure a license level, you may have to send a RUM report (Resource Utilization Measurement Report) to CSSM to report license usage information. To know if reporting is required, you can wait for a system message or refer to the policy using **show** commands.

- The system message, which indicates that reporting is required: `%SMART_LIC-6-REPORTING_REQUIRED: A Usage report acknowledgement will be required in [dec] days.`

  `[dec]` is the amount of time (in days) left to meet reporting requirements.

- If using **show** commands, refer to the output of the show license status privileged EXEC command and check the `Next ACK deadline` field. This means a RUM report must be sent and the acknolwedgement (ACK) from CSSM must be installed by this date.

How you send the RUM report, depends on the topology you have implemented in the Smart Licensing Using Policy environment. For more information, see How to Configure Smart Licensing Using Policy: Workflows by Topology

Enabling the Booster Performance License

This task shows you how enable the Booster Performance license. This license enables *unthrottled* throughput for unencrypted traffic. Without it, unencrypted traffic is restricted to 500 Mbps.

Note Enabling this license does not change the *cryptographic* throughput level. Cryptographic throughput is restricted to 100 Mbps on Cisco 1100 Terminal Services Gateway platforms.

Before you begin

The Booster Performance license is available on all Cisco 1100 Terminal Services Gateway platforms from Cisco IOS XE Cupertino 17.8.1a. Ensure that the software version running on the device is a supported version.

Step 1 **show platform hardware throughput level**

Displays the currently configured throughput level.

In the accompanying example, the throughput level is currently 500 Mbps.

Example:

```
Device# show platform hardware throughput level
The current throughput level is 500000 kb/s
```

Step 2 **configure terminal**

Enters the global configuration mode.

Example:

```
Device# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
```

Step 3 **platform hardware throughput level boost**

Enables unthrottled throughput for unencrypted traffic.

Example:

```
Device(config)# platform hardware throughput level boost
% The config will take effect on next reboot
```

Step 4 **end**

Exits the global configuration mode and returns to the privileged EXEC mode.

Example:

```
Device# end
```

Step 5 **copy running-config startup-config**

Saves changes in the configuration file.

Example:

```
Device# copy running-config startup-config
Building configuration...
[OK]
```

Step 6 **reload**

Reloads the device.

Example:

```
Device# reload
Proceed with reload? [confirm]
Mar 17 17:04:01.704: %PMAN-5-EXITACTION: R0/0: pvp: Process manager is exiting: process exit with
reload chassis code

Initializing Hardware …
<output truncated>
```

Step 7 **show platform hardware throughput level**

Displays currently configured throughput level.

Example:

```
Device# show platform hardware throughput level
The current throughput level is unthrottled
```

Step 8 **show license summary**

Displays a summary of the licenses being used. In the accompanying example, the Booster Performance license is displayed as IN USE.

Example:

```
Device# show license summary
Account Information:
  Smart Account: Eg-SA As of Feb 26 20:57:30 2022 CST
  Virtual Account: Eg-VA

License Usage:
  License                 Entitlement Tag               Count Status
  -----------------------------------------------------------------------------
  booster_performance     (ISR_1100TG_BOOST)                1 IN USE
  securityk9              (SL_1100TG_SEC_K9)                1 IN USE
```

Step 9 **show license status**

Displays currently configured transport settings, applicable policy information, and reporting requirements.

After you configure a license level, you may have to send a RUM report (Resource Utilization Measurement Report) to CSSM to report license usage information. To know if reporting is required, you can wait for a system message or refer to the policy using **show** commands.

- The system message, which indicates that reporting is required: %SMART_LIC-6-REPORTING_REQUIRED: A Usage report acknowledgement will be required in [dec] days. [dec] is the amount of time (in days) left to meet reporting requirements.

- If using **show** commands, refer to the output of the show license status privileged EXEC command and check the `Next ACK deadline` field. This means a RUM report must be sent and the acknolwedgement (ACK) from CSSM must be installed by this date.

How you send the RUM report, depends on the topology you have implemented in the Smart Licensing Using Policy environment. For more information, see How to Configure Smart Licensing Using Policy: Workflows by Topology

In the accompanying example, the device is connected directly to CSSM and is using Smart transport for communication with CSSM. The device is configured to send a Resource Utilization Measurement report (RUM report) every 30 days. It will automatically send the next RUM report on Mar 17 17:07:41 2022 CST.

Example:

```
Device# show license status
<output truncated>

Transport:
  Type: Smart
  URL: https://smartreceiver.cisco.com/licservice/license
  Proxy:
    Not Configured
  VRF:
    Not Configured

Policy:
  Policy in use: Installed On Jan 27 18:47:22 2021 CST
  Policy name: SLE Policy
  Reporting ACK required: yes (Customer Policy)
  Unenforced/Non-Export Perpetual Attributes:
    First report requirement (days): 30 (Customer Policy)
    Reporting frequency (days): 60 (Customer Policy)
    Report on change (days): 60 (Customer Policy)
  Unenforced/Non-Export Subscription Attributes:
    First report requirement (days): 120 (Customer Policy)
    Reporting frequency (days): 150 (Customer Policy)
    Report on change (days): 120 (Customer Policy)
  Enforced (Perpetual/Subscription) License Attributes:
    First report requirement (days): 30 (Customer Policy)
    Reporting frequency (days): 90 (Customer Policy)
    Report on change (days): 60 (Customer Policy)
  Export (Perpetual/Subscription) License Attributes:
    First report requirement (days): 30 (Customer Policy)
    Reporting frequency (days): 30 (Customer Policy)
    Report on change (days): 30 (Customer Policy)

Miscellaneous:
  Custom Id: <empty>

Usage Reporting:
  Last ACK received: Feb 26 21:25:57 2022 CST
  Next ACK deadline: Apr 27 21:25:57 2022 CST
  Reporting push interval: 30  days
  Next ACK push check: Feb 26 21:05:37 2022 CST
  Next report push: Mar 17 17:07:41 2022 CST
  Last report push: Feb 26 20:55:56 2022 CST
  Last report file write: <none>

Trust Code Installed: Nov 10 16:35:47 2021 CST
```

Supported Licensing Models

The licensing model defines *how* you account for or report the licenses that you use, to Cisco. The licensing model supported on Cisco 1100 Terminal Services Gateway platforms depends on the Cisco IOS XE software version running on the device.

- Cisco IOS XE Amsterdam 17.2.x to 17.3.x supports Smart Licensing.
- Cisco IOS XE Bengaluru 17.4.1 and later supports Smart Licensing Using Policy.

Refer to the corresponding section for more information about the licensing model.

Smart Licensing Using Policy

Smart Licensing Using Policy is an enhanced version of Smart Licensing.

With this licensing model, you purchase the licenses you want to use, configure them on the device, and then report license usage – as required. You do not have to complete any licensing-specific operations, such as registering or generating keys before you start using the software and the licenses that are tied to it - unless you are using export-controlled and enforced licenses.

Multiple options are available for license usage reporting. You can use the Cisco Smart Licensing Utility (CSLU), report usage information directly to CSSM, use a Controller (like Cisco DNA Center or Cisco vManage), deploy Smart Software Manager On-Prem (SSM On-Prem) to administer products and licenses on your premises. A provision for offline reporting for air-gapped networks, where you download usage information and upload to CSSM, is also available.

You can also migrate from an existing licensing model, to Smart Licensing Using Policy. To migrate, you must upgrade the software version (image) on the product instance to a supported version.

For more information, see Smart Licensing Using Policy for Cisco Enterprise Routing Platforms.

Smart Licensing

Cisco Smart Licensing is a flexible licensing model that provides you with an easier, faster, and more consistent way to purchase and manage software across the Cisco portfolio and across your organization. And it’s secure – you control what users can access. With Smart Licensing, you get:

- Easy Activation: Smart Licensing establishes a pool of software licenses that can be used across the entire organization—no more PAKs (Product Activation Keys).
- Unified Management: My Cisco Entitlements (MCE) provides a complete view into all of your Cisco products and services in an easy-to-use portal, so you always know what you have and what you are using.
- License Flexibility: Your software is not node-locked to your hardware, so you can easily use and transfer licenses as needed.

To use Smart Licensing, you must first set up a Smart Account on Cisco Software Central (http://software.cisco.com/).

For a more detailed overview on Cisco Licensing, go to https://cisco.com/go/licensingguide.

For Smart Licensing configuration information for access and edge routers, see the https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/smart-licensing/qsg/b_Smart_Licensing_QuickStart/b_Smart_Licensing_QuickStart_chapter_01.html.

- Smart Licensing feature provides users an experience of a single, standardized licensing solution for all Cisco products. Adding support for CiscoONE suites in the Cisco IOS Software License (CISL) and Smart Licensing mode, including the Foundation Suite and Active Directory Users and Computers (ADUC) Suite.
- Smart Licensing provides the ability to switch between traditional licensing (CSL) and Smart Licensing mode.
- Smart Licensing supports four software universal images NPE, NO-LI, NPE-NO-LI, and Non-NPE images.

Prerequisites for Smart Licensing

- Ensure that the software version running on the device is one that supports Smart Licensing. Smart Licensing is supported from Cisco IOS XE Amsterdam 17.2.x to 17.3.x.
- Ensure that Call Home is enabled before using Smart Licensing.

  The Smart Call Home Transport Gateway helps to complete product registration and authorization based on the desired performance and technology levels of Cisco products. To know more about Call Home, refer to *Call Home* .

Transitioning from CSL to Smart Licensing

In the Smart Licensing Model, customers can activate licensed objects without the use of a special software key or upgrade license file. Customers simply activate the new functionality using the appropriate product commands and configurations and the functionality is activated. A software reboot may or may not be required depending on the product capabilities and requirements.

Similarly, downgrading or removing an advanced feature, performance, or functionality would require removal of the configuration or command.

After either of the above actions has been taken, the change in license state is noted by the Smart Software Manager upon next synchronization and an appropriate action is taken.

Cisco ONE Suites

Cisco ONE Suites is a new way for customers to purchase infrastructure software. Cisco ONE offers a simplified purchasing model, centered on common customer scenarios in the data center, wide area network, and local access networks.

Smart Licensing supports Smart License Cisco ONE suite level licenses and image licenses, such as ipbase, Advanced IP Services (AIS), Advanced Enterprise Services (AES) and feature license and throughput performance, crypto throughput and port licensing on ASR 1000 Aggregation Series Routers.

To know more about Cisco One Suites, please refer to Cisco ONE Suites.

Troubleshooting for Cisco Smart Licensing Client

You can troubleshoot Smart Licensing enabling issues using the following commands on the device:

- **show version**

- **show running-config**
- **show license summary**
- **show license all**
- **show license tech support**
- **debug smart_lic error**
- **debug smart_lic trace**

Example: Displays summary information about all licenses

The following example shows how to use the **show license all** command to display summary information about all licenses.

```
Device#show license all
Smart Licensing Status
======================

Smart Licensing is ENABLED

Registration:
Status: REGISTERED
Smart Account: BU Production Test
Virtual Account: ISR4K
Export-Controlled Functionality: Allowed
Initial Registration: SUCCEEDED on Sep 04 15:40:03 2015 PDT
Last Renewal Attempt: None
Next Renewal Attempt: Mar 02 15:40:02 2016 PDT
Registration Expires: Sep 03 15:34:53 2016 PDT

License Authorization:
Status: AUTHORIZED on Sep 04 15:40:09 2015 PDT
Last Communication Attempt: SUCCEEDED on Sep 04 15:40:09 2015 PDT
Next Communication Attempt: Oct 04 15:40:08 2015 PDT
Communication Deadline: Dec 03 15:35:01 2015 PDT

License Usage
==============

ISR_4400_FoundationSuite (ISR_4400_FoundationSuite):
Description: Cisco ONE Foundation Perpetual License ISR 4400
Count: 1
Version: 1.0
Status: AUTHORIZED

ISR_4400_AdvancedUCSuite (ISR_4400_AdvancedUCSuite):
Description: Cisco ONE Advanced UC Perpetual License ISR 4400
Count: 1
Version: 1.0
Status: AUTHORIZED

ISR_4451_2G_Performance (ISR_4451_2G_Performance):
Description: Performance on Demand License for 4450 Series
Count: 1
Version: 1.0
Status: AUTHORIZED

Product Information
===================
UDI: PID:ISR4451-X/K9,SN:FOC17042FJ9

Agent Version
=============
Smart Agent for Licensing: 1.4.0_rel/16
Component Versions: SA:(1_4_rel)1.0.15, SI:(dev22)1.2.6, CH:(dev5)1.0.32, PK:(dev18)1.0.17


Device#
```

CHAPTER 6

Managing the Device Using Web User Interface

The Web User Interface (Web UI) is an embedded GUI-based device-management tool that provides the ability to provision the device, to simplify device deployment and manageability, and to enhance the user experience. It comes with the default image, so there is no need to enable anything or install any license on the device. You can use WebUI to build configurations, and to monitor and troubleshoot the device without having CLI expertise. This chapter includes the these sections:

Setting Up Factory Default Device Using Web UI

Quick Setup Wizard allows you perform the basic router configuration. To configure the router:

Note Before you access the Web UI, you need to have the basic configuration on the device.

Step 1 Connect the RJ-45 end of a serial cable to the RJ-45 console port on the router.

Step 2 After the device initial configuration wizard appears, enter **No** to get into the device prompt when the following system message appears on the router.

Would you like to enter the initial configuration dialog? [yes/no]: no

Step 3 From the configuration mode, enter the following configuration parameters.

```
!
ip dhcp pool WEBUIPool
network 192.168.1.0 255.255.255.0
default-router 192.168.1.1

username admin privilege 15 password 0 default
!
interface gig 0/0/1
ip address 192.168.1.1 255.255.255.0
!
```

Step 4 Connect the PC to the router using an Ethernet cable to the gig 0/0/1 interface.

Step 5 Set up your PC as a DHCP client to obtain the IP address of the router automatically.

Step 6 Launch the browser and enter the device IP address in your browser's address line. For a secure connection, type https://192.168.1.1/#/dayZeroRouting. For a less secure connection, enter http://192.168.1.1/#/dayZeroRouting.

Step 7 Enter the default username (admin) and the password as default.

Using Basic or Advanced Mode Setup Wizard

To configure the router using the basic or advanced mode setup:

Step 1 Choose the **Basic Mode** or **Advanced Mode** and click **Go To Account Creation Page**.

Step 2 Enter the username and password. Reenter the password to confirm.

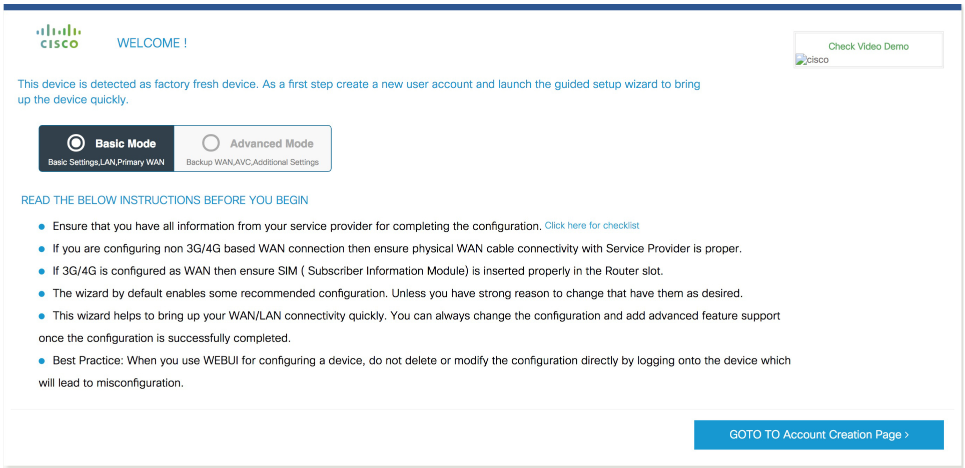
Step 3 Click **Create and Launch Wizard**.

Step 4 Enter the device name and domain name.

Step 5 Select the appropriate time zone from the **Time Zone** drop-down list.

Step 6 Select the appropriate date and time mode from the **Date and Time** drop-down list.

Step 7 Click **LAN Settings**.



This device is detected as factory fresh device. As a first step create a new user account and launch the guided setup wizard to bring up the device quickly.

● Basic Mode
Basic Settings,LAN,Primary WAN

○ Advanced Mode
Backup WAN,AVC,Additional Settings

READ THE BELOW INSTRUCTIONS BEFORE YOU BEGIN

- Ensure that you have all information from your service provider for completing the configuration. Click here for checklist
- If you are configuring non 3G/4G based WAN connection then ensure physical WAN cable connectivity with Service Provider is proper.
- If 3G/4G is configured as WAN then ensure SIM (Subscriber Information Module) is inserted properly in the Router slot.
- The wizard by default enables some recommended configuration. Unless you have strong reason to change that have them as desired.
- This wizard helps to bring up your WAN/LAN connectivity quickly. You can always change the configuration and add advanced feature support once the configuration is successfully completed.
- Best Practice: When you use WEBUI for configuring a device, do not delete or modify the configuration directly by logging onto the device which will lead to misconfiguration.

Configure LAN Settings

Step 1 Choose the **Web DHCP Pool/DHCP Pool** name or the **Create and Associate Access VLAN** option.

a) If you choose the Web DHCP Pool, specify the following:

Pool Name—Enter the DHCP Pool Name.

Network—Enter network address and the subnet mask.

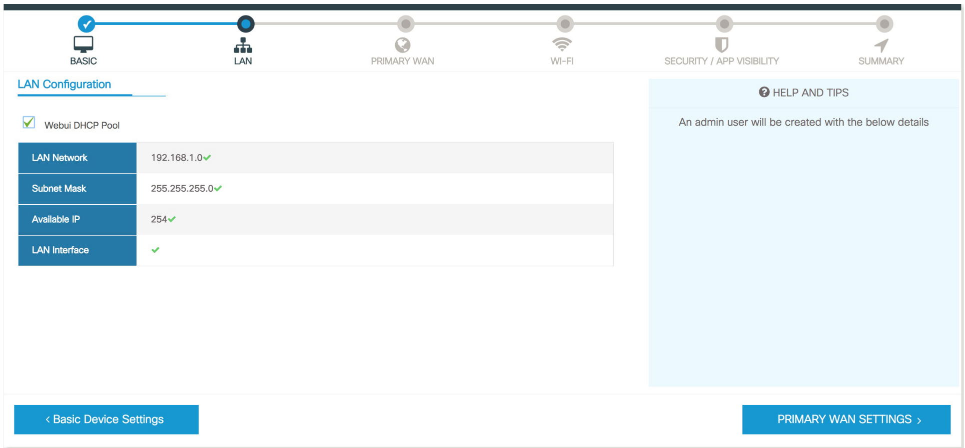
b) If you choose the Create and Associate Access VLAN option, specify the following:

Access VLAN—Enter the Access VLAN identification number. The range is from 1 to 4094.

Network—Enter the IP address of the VLAN.

Management Interfaces—Select the interface and move to the selected list box using the right and left arrows. You can also double click or drag and drop to move the interface to the selected list box.

Step 2 Click **Primary WAN Settings**.



LAN Configuration

☑ Webui DHCP Pool

LAN Network	192.168.1.0✓
Subnet Mask	255.255.255.0✓
Available IP	254✓
LAN Interface	✓

HELP AND TIPS

An admin user will be created with the below details

Configure Primary WAN Settings

Step 1 Select the primary WAN type. You con configure Serial, 3G/4G, Ethernet, or Broadband (xDSL) as primary WAN depending on the WAN types supported by the router.

Step 2 Select the interface from the drop-down list.

Step 3 Check the **Get DNS Server info directly from ISP** check box to get the DNS server information directly from the service provider. You can also manually enter the Primary DNS and Secondary DNS.

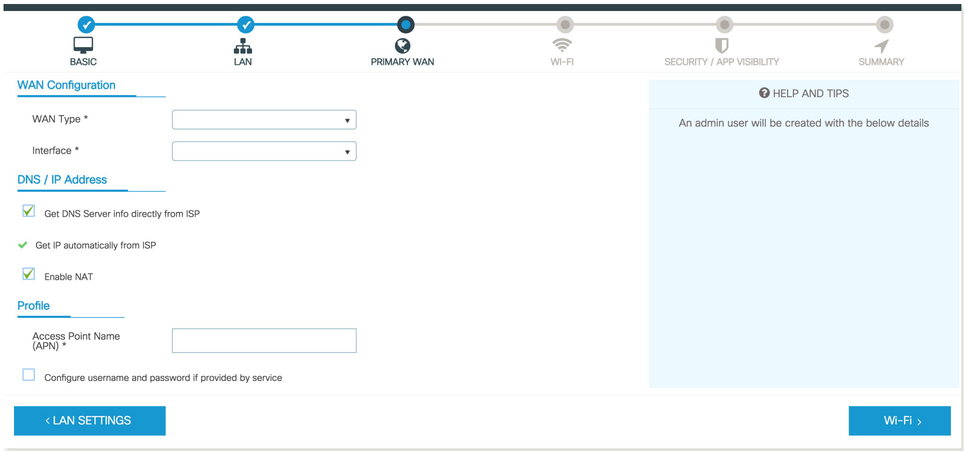
Step 4 Check the **Get IP automatically from ISP** check box to get the IP address information directly from the service provider. You can also manually enter the IP address and subnet mask.

Step 5 Check the **Enable NAT** check box to enable NAT. It is recommended to enable NAT.

Step 6 Check the **Enable PPPOE** check box to enable PPPoE. If you have enabled PPPoE, select the required authentication mode. The options are: **PAP** and **CHAP**.

Step 7 Enter the user name and password provided by the service provider.

Step 8 Click **Security / APP Visibility WAN Settings**.



WAN Configuration

WAN Type *

Interface *

DNS / IP Address

☑ Get DNS Server info directly from ISP

✓ Get IP automatically from ISP

☑ Enable NAT

Profile

Access Point Name (APN) *

□ Configure username and password if provided by service

HELP AND TIPS

An admin user will be created with the below details

Configure Secondary WAN Settings

For advanced configuration, you should configure the secondary WAN connection.

Step 1 Select the secondary WAN type. You con configure Serial, 3G/4G, Ethernet, or Broadband (xDSL) as a secondary WAN depending on the WAN types supported by the router.

Step 2 Select the interface from the drop-down list.

Step 3 Check the **Get DNS Server info directly from ISP** check box to get the DNS server information directly from the service provider. You can also manually enter the Primary DNS and Secondary DNS.

Step 4 Check the **Get IP automatically from ISP** check box to get the IP address information directly from the service provider. You can also manually enter the IP address and subnet mask.

Step 5 Check the **Enable NAT** check box to enable NAT. It is recommended to enable NAT.

Step 6 Check the **Enable PPPOE** check box to enable PPPoE. If you have enabled PPPoE, select the required authentication mode. The options are **PAP** and **CHAP** .

Step 7 Enter the user name and password provided by the service provider.

Step 8 Click **Security / APP Visibility WAN Settings**.

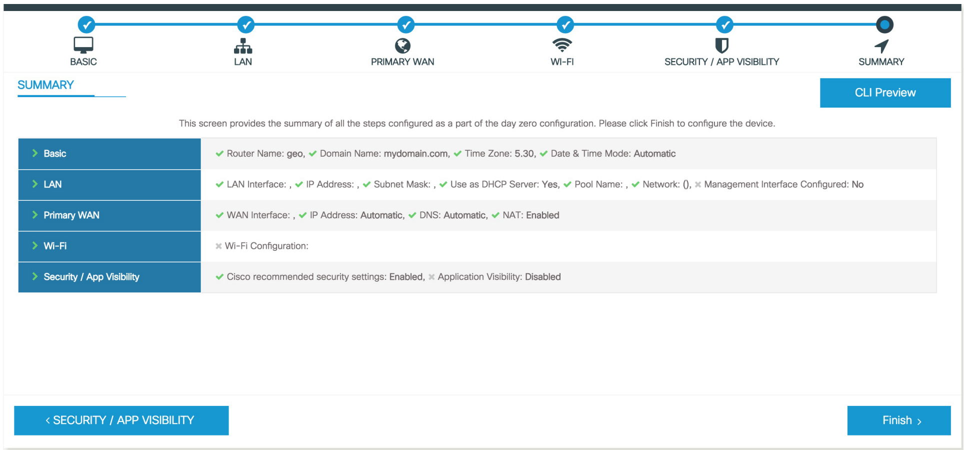
Configure Security Settings

Step 1 Check the **Enable Cisco Recommended Security Settings** check box to ensure that all passwords are not shown in plain text. The passwords are encrypted.

Step 2 Click **Day 0 Config Summary**.

Step 3 To preview the configuration, click **CLI Preview** to preview the configuration.

Step 4 Click **Finish** to complete the Day Zero setup.



This screen provides the summary of all the steps configured as a part of the day zero configuration. Please click Finish to configure the device.

› Basic	✓ Router Name: geo, ✓ Domain Name: mydomain.com, ✓ Time Zone: 5.30, ✓ Date & Time Mode: Automatic
› LAN	✓ LAN Interface: , ✓ IP Address: , ✓ Subnet Mask: , ✓ Use as DHCP Server: Yes, ✓ Pool Name: , ✓ Network: (), ✗ Management Interface Configured: No
› Primary WAN	✓ WAN Interface: , ✓ IP Address: Automatic, ✓ DNS: Automatic, ✓ NAT: Enabled
› Wi-Fi	✗ Wi-Fi Configuration:
› Security / App Visibility	✓ Cisco recommended security settings: Enabled, ✗ Application Visibility: Disabled

Using Web User Interface for Day One Setup

To configure the Web user interface:

Step 1 Configure the HTTP server. By default, the HTTP server configuration should be present on the device. Ensure the configuration by checking if the **ip http server** and **ip http secure-server** commands are present in the running configuration.

```
Device #configure terminal
Device (config)#ip http server
Device (config)#ip http secure-server
```

Step 2 Set up the authentication options to log into Web UI. You can use one of these methods to authenticate:

a) You can authenicate using local database. To use a local database for Web UI authentication, ensure to have the **ip http authentication local** command in the running configuration. This command is preconfigured on the device. If the command is not present, configure the device as shown in this example:

```
Device #configure terminal
Device (config)#ip http authentication local
```

Note You need a user with privilege 15 to access the configuration screens on Web UI. If the privilege is less than 15, you can access only the Dashboard and Monitoring screens on Web UI.

To create a user account, use the **username** <username> **privilege** <privilege> **password 0** <passwordtext>

```
Device #configure terminal
Device (config)# username <username> privilege <privilege> password 0 <passwordtext>
```

b) Authenticate using AAA options. To use AAA authentication for Web UI, ensure to configure ‘ip http authentication aaa’ on the device. Also, ensure that the required AAA server configuration is present on the device.

```
Device #configure terminal
Device (config)#ip http authentication local
```

Step 3 Launch the browser. In the address bar, type the IP address of the device. For a secure connection, type https://ip-address.

Step 4 Enter the default username (cisco) and password provided with the device

Step 5 Click **Log In**.

CHAPTER 7

Console Port, Telnet, and SSH Handling

This chapter includes the following sections:

Notes and Restrictions for Console Port, Telnet, and SSH

- Telnet and Secure Shell (SSH) settings configured in the transport map override any other Telnet or SSH settings when the transport map is applied to the Ethernet management interface.
- Only local usernames and passwords can be used to authenticate users entering a Ethernet management interface. AAA authentication is not available for users accessing the router through a Ethernet management interface using persistent Telnet or persistent SSH.
- Applying a transport map to a Ethernet management interface with active Telnet or SSH sessions can disconnect the active sessions. Removing a transport map from an interface, however, does not disconnect any active Telnet or SSH session.
- Configuring the diagnostic and wait banners is optional, but recommended. The banners are especially useful as indicators to users about the status of their Telnet or SSH attempts.

Console Port Overview

The console port on the router is an EIA/TIA-232 asynchronous, serial connection with no flow control and an RJ-45 connector. The console port is used to access the router and is located on the front panel of the Route Processor.

For information on accessing the router using the console port, see the Using Cisco IOS XE Software section.

Console Port Handling Overview

If you are using the console port to access the router, you are automatically directed to the Cisco IOS command-line interface (CLI).

If you are trying to access the router through the console port and send a break signal (by entering **Ctrl-C** or **Ctrl-Shift-6**, or by entering the **send break** command at the Telnet prompt) before connecting to the CLI, you are directed to a diagnostic mode if the non-RPIOS subpackages are accessible. These settings can be changed by configuring a transport map for the console port and applying that transport map to the console interface.

Telnet and SSH Overview

Telnet and SSH on the router can be configured and handled like Telnet and SSH on other Cisco platforms. For information on traditional Telnet, see the line command in the Cisco IOS Terminal Services Command Reference, Release 12.2 document. For more information on AAA authentiction methods, see the line command in the Authentication Commands chapter.

For information on configuring traditional SSH, see the “Configuring Secure Shell” chapter in the Cisco IOS Terminal Services Command Reference, Release 12.2 document.

On the router, persistent Telnet and persistent SSH allow network administrators to more clearly define the treatment of incoming traffic when users access the router through the management ethernet port using Telnet or SSH. Notably, persistent Telnet and persistent SSH provide more robust network access by allowing the router to be configured to be accessible through the Ethernet management port using Telnet or SSH even when the Cisco IOS process has failed.

Persistent Telnet and Persistent SSH Overview

In traditional Cisco routers, accessing the router using Telnet or SSH is not possible if the Cisco IOS software fails. When Cisco IOS fails on a traditional Cisco router, the only method of accessing the router is through the console port. Similarly, if all the active Cisco IOS processes have failed on a router that is not using persistent Telnet or persistent SSH, the only method of accessing the router is through the console port.

However, with persistent Telnet and persistent SSH, you can configure a transport map that defines the treatment of incoming Telnet or SSH traffic on the Ethernet management interface. Among the many configuration options, a transport map can be configured to direct all traffic to the Cisco IOS CLI, diagnostic mode, or to wait for a Cisco IOS VTY line to become available and then direct users to diagnostic mode when a user sends a break signal while waiting for the IOS VTY line to become available. If a user uses Telnet or SSH to access diagnostic mode, that Telnet or SSH connection will be usable even in scenarios when no Cisco IOS process is active. Therefore, persistent Telnet and persistent SSH introduce the ability to access the router via diagnostic mode when the Cisco IOS process is not active. For information on diagnostic mode, see Using Cisco IOS XE Software. For information on the options that are can be configured using persistent Telnet or persistent SSH transport maps, see Configuring Persistent Telnet, on page 79 and Configuring Persistent SSH, on page 81.

Configuring a Console Port Transport Map

This task describes how to configure a transport map for a console port interface on the router.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **transport-map type console** *transport-map-name*
4. **connection wait** [**allow** [**interruptible**] | **none** [**disconnect**]]
5. (Optional) **banner** [**diagnostic** | **wait**] *banner-message*
6. **exit**
7. **transport type console** *console-line-number* **input** *transport-map-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	**transport-map type console** *transport-map-name* **Example:** `Router(config)# transport-map type console consolehandler`	Creates and names a transport map for handling console connections, and enters transport map configuration mode.
Step 4	**connection wait** [**allow** [**interruptible**]	**none** [**disconnect**]] **Example:** `Router(config-tmap)# connection wait none`	Specifies how a console connection will be handled using this transport map. • **allow interruptible**—The console connection waits for a Cisco IOS VTY line to become available, and also allows users to enter diagnostic mode by interrupting a console connection that is waiting for a Cisco IOS VTY line to become available. This is the default setting. **Note** Users can interrupt a waiting connection by entering **Ctrl-C** or **Ctrl-Shift-6**. • **none**—The console connection immediately enters diagnostic mode.

	Command or Action	Purpose

Step 5	(Optional) **banner** [**diagnostic** | **wait**] *banner-message*
	Example:
	`Router(config-tmap)# banner diagnostic X`
	`Enter TEXT message. End with the character 'X'.`
	`--Welcome to Diagnostic Mode--`
	`X`
	`Router(config-tmap)#`
		(Optional) Creates a banner message that will be seen by users entering diagnostic mode or waiting for the Cisco IOS VTY line because of the console transport map configuration.
		• **diagnostic**—Creates a banner message seen by users directed to diagnostic mode because of the console transport map configuration.
		Note Users can interrupt a waiting connection by entering **Ctrl-C** or **Ctrl-Shift-6**.
		• **wait**—Creates a banner message seen by users waiting for Cisco IOS VTY to become available.
		• *banner-message*—Banner message, which begins and ends with the same delimiting character.

Step 6	**exit** **Example:** `Router(config-tmap)# exit`	Exits transport map configuration mode to re-enter global configuration mode.
Step 7	**transport type console** *console-line-number* **input** *transport-map-name* **Example:** `Router(config)# transport type console 0 input consolehandler`	Applies the settings defined in the transport map to the console interface. The *transport-map-name* for this command must match the *transport-map-name* defined in the **transport-map type console** command.

Examples

The following example shows how to create a transport map to set console port access policies and attach to console port 0:

```
Router(config)# transport-map type console consolehandler
Router(config-tmap)# connection wait allow interruptible
Router(config-tmap)# banner diagnostic X
Enter TEXT message. End with the character 'X'.
--Welcome to diagnostic mode--
X
Router(config-tmap)# banner wait X
Enter TEXT message. End with the character 'X'.
Waiting for IOS vty line
X
Router(config-tmap)# exit
Router(config)# transport type console 0 input consolehandler
```

Configuring Persistent Telnet

For a persistent Telnet connection to access an Cisco IOS vty line on the router, local login authentication must be configured for the vty line (the **login** command in line configuration mode). If local login authentication is not configured, users will not be able to access Cisco IOS using a Telnet connection into the management Ethernet interface with an applied transport map. Diagnostic mode will still be accessible in this scenario.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **transport-map type persistent telnet** *transport-map-name*
4. **connection wait** [**allow** [**interruptible**] | **none** [**disconnect**]]
5. (Optional) **banner** [**diagnostic** | **wait**] *banner-message*
6. **transport interface**
7. **exit**
8. **transport type persistent telnetinput** *transport-map-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	**transport-map type persistent telnet** *transport-map-name* **Example:** `Router(config)# transport-map type persistent telnet telnethandler`	Creates and names a transport map for handling persistent Telnet connections, and enters transport map configuration mode.
Step 4	**connection wait** [**allow** [**interruptible**] | **none** [**disconnect**]] **Example:** `Router(config-tmap)# connection wait none`	Specifies how a persistent Telnet connection will be handled using this transport map: • **allow**—The Telnet connection waits for a Cisco IOS vty line to become available, and exits the router if interrupted. • **allow interruptible**—The Telnet connection waits for the Cisco IOS vty line to become available, and also allows user to enter diagnostic mode by interrupting

	Command or Action	Purpose
		a Telnet connection waiting for the Cisco IOS vty line to become available. This is the default setting. **Note** Users can interrupt a waiting connection by entering **Ctrl-C** or **Ctrl-Shift-6**. • **none**—The Telnet connection immediately enters diagnostic mode. • **none disconnect**—The Telnet connection does not wait for the Cisco IOS vty line and does not enter diagnostic mode, so all Telnet connections are rejected if no vty line is immediately available in the Cisco IOS software.

Step 5	(Optional) **banner** [**diagnostic** | **wait**] *banner-message*
	Example:
	`Router(config-tmap)# banner diagnostic X`
	`Enter TEXT message. End with the character 'X'.`
	`--Welcome to Diagnostic Mode--`
	`X`
	`Router(config-tmap)#`
		(Optional) Creates a banner message that will be seen by users entering diagnostic mode or waiting for the Cisco IOS vty line because of the persistent Telnet configuration.
		• **diagnostic**—Creates a banner message seen by users directed into diagnostic mode because of the persistent Telnet configuration.
		Note Users can interrupt a waiting connection by entering **Ctrl-C** or **Ctrl-Shift-6**.
		• **wait**—Creates a banner message seen by users waiting for the vty line to become available.
		• *banner-message*—The banner message, which begins and ends with the same delimiting character.

Step 6	**transport interface** **Example:** `Router(config-tmap)# transport interface gigabitethernet 0`	Applies the transport map settings to the management Ethernet interface (interface gigabitethernet 0). Persistent Telnet can be applied only to the management Ethernet interface on the router. This step must be taken before applying the transport map to the management Ethernet interface.
Step 7	**exit** **Example:** `Router(config-tmap)# exit`	Exits transport map configuration mode to re-enter global configuration mode.
Step 8	**transport type persistent telnetinput** *transport-map-name* **Example:** `Router(config)# transport type persistent telnet input telnethandler`	Applies the settings defined in the transport map to the management Ethernet interface. The *transport-map-name* for this command must match the *transport-map-name* defined in the **transport-map type persistent telnet** command.

Examples

In the following example, a transport map that will make all Telnet connections wait for a Cisco IOS XE vty line to become available before connecting to the router, while also allowing the user to interrupt the process and enter diagnostic mode, is configured and applied to the management Ethernet interface (**interface gigabitethernet 0**).

A diagnostic and a wait banner are also configured.

The transport map is then applied to the interface when the **transport type persistent telnet input** command is entered to enable persistent Telnet.

```
Router(config)# transport-map type persistent telnet telnethandler
Router(config-tmap)# connection wait allow interruptible
Router(config-tmap)# banner diagnostic X
Enter TEXT message. End with the character 'X'.
--Welcome to diagnostic mode--
X
Router(config-tmap)# banner wait X
Enter TEXT message. End with the character 'X'.
Waiting for IOS IOS Process--
X
Router(config-tmap)# transport interface gigabitethernet 0
Router(config-tmap)# exit
Router(config)# transport type persistent telnet input telnethandler
```

Configuring Persistent SSH

This task describes how to configure persistent SSH on the router.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **transport-map type persistent ssh** *transport-map-name*
4. **connection wait** [**allow** [**interruptible**] | **none** [**disconnect**]]
5. **rsa keypair-name** *rsa-keypair-name*
6. (Optional) **authentication-retries** *number-of-retries*
7. (Optional) **banner** [**diagnostic** | **wait**] *banner-message*
8. (Optional) **time-out** *timeout-interval*
9. **transport interface gigabitethernet 0**
10. **exit**
11. **transport type persistent ssh input** *transport-map-name*

DETAILED STEPS

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

	Command or Action	Purpose
	`Router> enable`	
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**transport-map type persistent ssh** *transport-map-name* **Example:** `Router(config)# transport-map type persistent telnet telnethandler`	Creates and names a transport map for handling persistent SSH connections, and enters transport map configuration mode.
Step 4	**connection wait** [**allow** [**interruptible**] | **none** [**disconnect**]] **Example:** `Router(config-tmap)# connection wait interruptible`	Specifies how a persistent SSH connection will be handled using this transport map: • **allow**—The SSH connection waits for a Cisco IOS VTY line to become available, and exits the router if interrupted. • **allow interruptible**—The SSH connection waits for the VTY line to become available, and also allows a user to enter diagnostic mode by interrupting an SSH connection waiting for the VTY line to become available. This is the default setting. **Note** Users can interrupt a waiting connection by entering **Ctrl-C** or **Ctrl-Shift-6**. • **none**—The SSH connection immediately enters diagnostic mode. • **none disconnect**—The SSH connection does not wait for the VTY line and does not enter diagnostic mode. Therefore, all SSH connections are rejected if no VTY line is immediately available.
Step 5	**rsa keypair-name** *rsa-keypair-name* **Example:** `Router(config)# rsa keypair-name sshkeys`	Names the RSA keypair to be used for persistent SSH connections. For persistent SSH connections, the RSA keypair name must be defined using this command in transport map configuration mode. The RSA keypair definitions defined elsewhere on the router, such as through the use of the **ip ssh rsa keypair-name** command, do not apply to persistent SSH connections. No *rsa-keypair-name* is defined by default.

	Command or Action	Purpose
Step 6	(Optional) **authentication-retries** *number-of-retries* **Example:** `Router(config-tmap)# authentication-retries 4`	(Optional) Specifies the number of authentication retries before dropping the connection. The default *number-of-retries* is 3.

Step 7	(Optional) **banner** [**diagnostic** | **wait**] *banner-message*
	Example:
	`Router(config-tmap)# banner diagnostic X`
	`Enter TEXT message. End with the character 'X'.`
	`--Welcome to Diagnostic Mode--`
	`X`
	`Router(config-tmap)#`
		(Optional) Creates a banner message that will be seen by users entering diagnostic mode or waiting for the VTY line because of the persistent SSH configuration.
		• **diagnostic**—Creates a banner message seen by users directed to diagnostic mode because of the persistent SSH configuration.
		• **wait**—Creates a banner message seen by users waiting for the VTY line to become available.
		• *banner-message*—The banner message, which begins and ends with the same delimiting character.

Step 8	(Optional) **time-out** *timeout-interval* **Example:** `Router(config-tmap)# time-out 30`	(Optional) Specifies the SSH time-out interval, in seconds. The default *timeout-interval* is 120 seconds.
Step 9	**transport interface gigabitethernet 0** **Example:** `Router(config-tmap)# transport interface gigabitethernet 0`	Applies the transport map settings to the Ethernet management interface (interface gigabitethernet 0). Persistent SSH can be applied only to the Ethernet management interface on the router.
Step 10	**exit** **Example:** `Router(config-tmap)# exit`	Exits transport map configuration mode to re-enter global configuration mode.
Step 11	**transport type persistent ssh input** *transport-map-name* **Example:** `Router(config)# transport type persistent ssh input sshhandler`	Applies the settings defined in the transport map to the Ethernet management interface. The *transport-map-name* for this command must match the *transport-map-name* defined in the **transport-map type persistent ssh** command.

Examples

The following example shows a transport map that will make all SSH connections wait for the VTY line to become active before connecting to the router being configured and applied to the Ethernet management interface (interface gigabitethernet 0). The RSA keypair is named `sshkeys`.

This example only uses the commands required to configure persistent SSH.

```
Router(config)# transport-map type persistent ssh sshhandler
Router(config-tmap)# connection wait allow
Router(config-tmap)# rsa keypair-name sshkeys
Router(config-tmap)# transport interface gigabitethernet 0
Enter TEXT message. End with the character 'X'.
--Welcome to diagnostic mode--
X
Router(config-tmap)# banner wait X
Enter TEXT message. End with the character 'X'.
--Waiting for IOS IOS Process--
X
Router(config-tmap)# transport interface gigabitethernet 0
Router(config-tmap)# exit
Router(config)# transport type persistent telnet input telnethandler
```

In the following example, a transport map is configured and will apply the following settings to users attempting to access the Ethernet management port via SSH:

- SSH users will wait for the VTY line to become active, but will enter diagnostic mode if the attempt to access the Cisco IOS software through the VTY line is interrupted.
- The RSA keypair name is sshkeys.
- The connection allows one authentication retry.
- The banner `--Welcome to Diagnostic Mode--` will appear if diagnostic mode is entered as a result of SSH handling through this transport map.
- The banner `--Waiting for vty line--` will appear if the connection is waiting for the VTY line to become active.
- The transport map is then applied to the interface when the **transport type persistent ssh input** command is entered to enable persistent SSH:

```
Router(config)# transport-map type persistent ssh sshhandler
Router(config-tmap)# connection wait allow interruptible
Router(config-tmap)# rsa keypair-name sshkeys
Router(config-tmap)# authentication-retries 1
Router(config-tmap)# banner diagnostic X
Enter TEXT message. End with the character 'X'.
--Welcome to diagnostic mode--
X
Router(config-tmap)# banner wait X
Enter TEXT message. End with the character 'X'.
--Waiting for vty line--
X
Router(config-tmap)# time-out 30
Router(config-tmap)# transport interface gigabitethernet 0
Router(config-tmap)# exit
Router(config)# transport type persistent ssh input sshhandler
```

Viewing Console Port, SSH, and Telnet Handling Configurations

Use the following commands to view console port, SSH, and Telnet handling configurations:

- **show transport-map**
- **show platform software configuration access policy**

Use the **show transport-map** command to view transport map configurations.

show transport-map [**all** | **name** *transport-map-name* | **type** [**console** | **persistent** [**ssh** | **telnet**]]]

This command can be used either in user EXEC mode or privileged EXEC mode.

Example

The following example shows transport maps that are configured on the router: a console port (`consolehandler`), persistent SSH (`sshhandler`), and persistent Telnet transport (`telnethandler`):

```
Router# show transport-map all
Transport Map:
Name: consolehandler
Type: Console Transport

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for the IOS CLI

bshell banner:

Welcome to Diagnostic Mode


Transport Map:
Name: sshhandler
Type: Persistent SSH Transport

Interface:
GigabitEthernet0

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for IOS prompt

Bshell banner:
Welcome to Diagnostic Mode


SSH:
Timeout: 120
Authentication retries: 5
RSA keypair: sshkeys

Transport Map:
Name: telnethandler
Type: Persistent Telnet Transport

Interface:
GigabitEthernet0

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for IOS process

Bshell banner:
```

```
Welcome to Diagnostic Mode


Transport Map:
Name: telnethandling1
Type: Persistent Telnet Transport

Connection:
Wait option: Wait Allow


Router# show transport-map type console
Transport Map:
Name: consolehandler
Type: Console Transport

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for the IOS CLI

Bshell banner:

Welcome to Diagnostic Mode


Router# show transport-map type persistent ssh
Transport Map:
Name: sshhandler
Type: Persistent SSH Transport

Interface:
GigabitEthernet0

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for IOS prompt

Bshell banner:

Welcome to Diagnostic Mode


SSH:
Timeout: 120
Authentication retries: 5
RSA keypair: sshkeys

Router# show transport-map type persistent telnet
Transport Map:
Name: telnethandler
Type: Persistent Telnet Transport

Interface:
GigabitEthernet0

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for IOS process
```

```
Bshell banner:

Welcome to Diagnostic Mode


Transport Map:
Name: telnethandling1
Type: Persistent Telnet Transport

Connection:
Wait option: Wait Allow


Router# show transport-map name telnethandler
Transport Map:
Name: telnethandler
Type: Persistent Telnet Transport

Interface:
GigabitEthernet0

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for IOS process

Bshell banner:

Welcome to Diagnostic Mode


Router# show transport-map name consolehandler
Transport Map:
Name: consolehandler
Type: Console Transport

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for the IOS CLI

Bshell banner:

Welcome to Diagnostic Mode


Router# show transport-map name sshhandler
Transport Map:
Name: sshhandler
Type: Persistent SSH Transport

Interface:
GigabitEthernet0

Connection:
Wait option: Wait Allow Interruptable
Wait banner:

Waiting for IOS prompt

Bshell banner:
```

```
Welcome to Diagnostic Mode


SSH:
Timeout: 120
Authentication retries: 5
RSA keypair: sshkeys

Router#
```

Use the **show platform software configuration access policy** command to view the current configurations for handling the incoming console port, SSH, and Telnet connections. The output of this command provides the current wait policy for each type of connection (Telnet, SSH, and console), as well as information on the currently configured banners.

Unlike the **show transport-map** command, the **show platform software configuration access policy** command is available in diagnostic mode so that it can be entered in scenarios where you need transport map configuration information, but cannot access the Cisco IOS CLI.

Example

```
Router# show platform software configuration access policy
The current access-policies

Method : telnet
Rule : wait
Shell banner:
Wait banner :

Method : ssh
Rule : wait
Shell banner:
Wait banner :

Method : console
Rule : wait with interrupt
Shell banner:
Wait banner :
```

Example

The following example shows the **show platform software configuration access policy** command being issued both before and after a new transport map for SSH are configured. During the configuration, the connection policy and banners are set for a persistent SSH transport map, and the transport map for SSH is enabled.

```
Router# show platform software configuration access policy
The current access-policies

Method : telnet
Rule : wait with interrupt
Shell banner:
Welcome to Diagnostic Mode

Wait banner :
Waiting for IOS Process
```

```
Method : ssh
Rule : wait
Shell banner:
Wait banner :

Method : console
Rule : wait with interrupt
Shell banner:
Wait banner :

Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# transport-map type persistent ssh sshhandler
Router(config-tmap)# connection wait allow interruptible
Router(config-tmap)# banner diagnostic X
Enter TEXT message. End with the character 'X'.
Welcome to Diag Mode
X
Router(config-tmap)# banner wait X
Enter TEXT message. End with the character 'X'.
Waiting for IOS
X
Router(config-tmap)# rsa keypair-name sshkeys
Router(config-tmap)# transport interface gigabitethernet 0
Router(config-tmap)# exit
Router(config)# transport type persistent ssh input sshhandler
Router(config)# exit

Router# show platform software configuration access policy
The current access-policies

Method : telnet
Rule : wait with interrupt
Shell banner:
Welcome to Diagnostic Mode

Wait banner :
Waiting for IOS process


Method : ssh
Rule : wait with interrupt
Shell banner:
Welcome to Diag Mode

Wait banner :
Waiting for IOS


Method : console
Rule : wait with interrupt
Shell banner:
Wait banner :
```

Configuring Auxiliary Port for Modem Connection

Cisco 1100 Terminal Server Gateway supports connecting a modem to the router auxiliary port for EXEC dial in connectivity. When a modem is connected to the auxiliary port, a remote user can dial in to the router and configure it. To configure a modem on the auxiliary port, perform these steps:

Step 1 Connect the RJ-45 end of the adapter cable to the black AUX port on the router.

Step 2 Use the **show line** command to determine the async interface of the AUX port:

```
Router# show  line

 Tty Typ     Tx/Rx    A Modem  Roty AccO AccI   Uses   Noise  Overruns   Int
*     0 CTY             -   -   -  - -   0   0   0/0    -
      1 AUX   9600/9600 -   -   -  - -   0   0   0/0    -
      2 VTY             -   -   -  - -   0   0   0/0    -
      3 VTY             -   -   -  - -   0   0   0/0    -
      4 VTY             -   -   -  - -   0   0   0/0    -
      5 VTY             -    -  -  - -   0   0   0/0    -
      6 VTY             -    -  -  - -   0   0   0/0    -
```

Step 3 Use the following commands to configure the router AUX line::

```
Router(config)# line 1

Router(config-line)#modem inOut
Router(config-line)#modem autoconfigure type usr_sportster
Router(config-line)#speed 115200  [Speed to be set according to the modem manual]
Router(config-line)#stopbits 1 [Stopbits to be set according to the modem manual]
Router(config-line)#transport input all
Router(config-line)#flowcontrol hardware [flowcontrol to be set according to the modem manual]
Router(config-line)#password cisco
Router(config-line)#login
Router(config-line)#end
Router(config)#enable password lab
```

Step 4 Use the reverse telnet method on the modem to verify the modem connectivity and configuration string:

```
Router(config)#int loopback 0
Router(config-if)#ip add 1.1.1.1 255.255.255.0
Router(config-if)#end
Router#telnet 1.1.1.1 2001
Trying 1.1.1.1, 2001 ... Open

User Access Verification

Password: <enter the password given under line configuration>

at    <<<=== Modem command
OK  <<<=== This OK indicates that the modem is connected successully to the AUX port.
```

Step 5 Use an analog phone to verify that the phone line is active and functions properly. Then, connect the analog phone line to the modem.

Step 6 Initialize an EXEC modem call to the router from another device (PC) to test the modem connection.

Step 7 When the connection is established, the dial in client is prompted for a password. Enter the correct password.

Note: This password should match the one that is configured on the auxiliary port line.

CHAPTER 8

Installing the Software

This chapter includes the following sections:

Overview

Installing software on the router involves installing a consolidated package (bootable image). This consists of a bundle of subpackages (modular software units), with each subpackage controlling a different set of functions.

These are the two main methods to install the software:

- Managing and Configuring a Router to Run Using a Consolidated Package, on page 95—This method allows for individual upgrade of subpackages and generally has reduced boot times compared to the method below. Use this method if you want to individually upgrade a module's software.

- Managing and Configuring a Router to Run Using Individual Packages, on page 100—This a simple method that is similar to a typical Cisco router image installation and management that is supported across Cisco routers.

It is better to upgrade software in a planned period of maintenance when an interruption in service is acceptable. The router needs to be rebooted for a software upgrade to take effect.

ROMMON Images

A ROMMON image is a software package used by ROM Monitor (ROMMON) software on a router. The software package is separate from the consolidated package normally used to boot the router.

An independent ROMMON image (software package) may occasionally be released and the router can be upgraded with the new ROMMON software.

Note A new version of the ROMMON image is not necessarily released at the same time as a consolidated package for a router.

Provisioning Files

This section provides background information about the files and processes used in Managing and Configuring a Router to Run Using Individual Packages, on page 100.

The consolidated package on a router consists of a collection of subpackages and a provisioning file titled `packages.conf`. To run the software, the usual method used is to boot the consolidated package, which is copied into memory, expanded, mounted, and run within memory. The provisioning file's name can be renamed but subpackage file's names cannot be renamed. The provisioning file and subpackage files must be kept in the same directory. The provisioning file does not work properly if any individual subpackage file is contained within a different directory.

Note An exception to this is that if a new or upgraded module firmware package is subsequently installed, it need not be in the same directory as the provisioning file.

Configuring a router to boot, using the provisioning file packages.conf, is beneficial because no changes have to be made to the boot statement after the Cisco IOS XE software is upgraded.

File Systems

The following table provides a list of file systems that can be seen on the Cisco Terminal Gateway.

Table 7: Router File Systems

File System	Description
bootflash:	Boot flash memory file system.
flash:	Alias to the boot flash memory file system above.

File System	Description
harddisk:	Hard disk file system (if NIM-SSD, NIM-HDD, or internal M.2 flash device is present in the router). **Note** The internal M.2 flash device is supported only on Cisco 1100 Terminal Server Gateway.
cns:	Cisco Networking Services file directory.
nvram:	Router NVRAM. You can copy the startup configuration to NVRAM or from NVRAM.
obfl:	File system for Onboard Failure Logging (OBFL) files.
system:	System memory file system, which includes the running configuration.
tar:	Archive file system.
tmpsys:	Temporary system files file system.
usb0: USB 3.0 Type-A usb1: USB 3.0 Type-B	The Universal Serial Bus (USB) flash drive file systems. **Note** The USB flash drive file system is visible only if a USB drive is installed in usb0: or usb1: ports.

Use the **?** help option, or use the **copy** command in command reference guides, if you find a file system that is not listed in the table above.

Autogenerated File Directories and Files

This section discusses the autogenerated files and directories that can be created, and how the files in these directories can be managed.

Table 8: Autogenerated Files

File or Directory	Description
crashinfo files	Crashinfo files may appear in the bootflash: file system. These files provide descriptive information of a crash and may be useful for tuning or troubleshooting purposes. However, the files are not part of router operations, and can be erased without impacting the functioning of the router.
core directory	The storage area for .core files. If this directory is erased, it will automatically regenerate itself at bootup. The .core files in this directory can be erased without impacting any router functionality, but the directory itself should not be erased.
lost+found directory	This directory is created on bootup if a system check is performed. Its appearance is completely normal and does not indicate any issues with the router.

File or Directory	Description
tracelogs directory	The storage area for trace files. Trace files are useful for troubleshooting. If the Cisco IOS process fails, for instance, users or troubleshooting personnel can access trace files using diagnostic mode to gather information related to the Cisco IOS failure. Trace files, however, are not a part of router operations, and can be erased without impacting the router's performance.

Important Notes About Autogenerated Directories

Important information about autogenerated directories include:

- Autogenerated files on the bootflash: directory should not be deleted, renamed, moved, or altered in any way unless directed by Cisco customer support.

Note Altering autogenerating files on the bootflash: may have unpredictable consequences for system performance.

- Crashinfo, core, and trace files can be deleted.

Flash Storage

Subpackages are installed to local media storage, such as flash. For flash storage, use the **dir bootflash:** command to list the file names.

Note Flash storage is required for successful operation of a router.

Configuring the Configuration Register for Autoboot

The configuration register can be used to change router behavior. This includes controlling how the router boots. Set the configuration register to 0x0 to boot into ROM, by using one of the following commands:

- In Cisco IOS configuration mode, use the **config-reg** 0x0 command.
- From the ROMMON prompt, use the **confreg** 0x0 command.

For more information about the configuration register, see Use of the Configuration Register on All Cisco Routers.

Note Setting the configuration register to 0x2102 will set the router to autoboot the Cisco IOS XE software.

Note The console baud rate is set to 9600 after changing the **confreg** to 0x2102 or 0x0. If you cannot establish a console session after setting **confreg**, or garbage output appears, change the setting on your terminal emulation software to 9600.

How to Install and Upgrade the Software

To install or upgrade the software, use one of the following methods to use the software from a consolidated package or an individual package. Also see the overview section.

- Managing and Configuring a Router to Run Using a Consolidated Package, on page 95
- Managing and Configuring a Router to Run Using Individual Packages, on page 100

Managing and Configuring a Router to Run Using a Consolidated Package

Note Do not use these procedures if you also need to install any optional subpackages or plan to upgrade individual subpackages. See Managing and Configuring a Router to Run Using Individual Packages, on page 100.

- Managing and Configuring a Consolidated Package Using copy and boot Commands, on page 95
- Configuring a Router to Boot the Consolidated Package via TFTP Using the boot Command: Example, on page 96

Managing and Configuring a Consolidated Package Using copy and boot Commands

To upgrade a consolidated package, copy the consolidated package to the **bootflash:** directory on the router using the **copy** command. After making this copy of the consolidated package, configure the router to boot using the consolidated package file.

The following example shows the consolidated package file being copied to the **bootflash:** file system via TFTP. The config register is then set to boot using **boot system** commands, and the **boot system** commands instruct the router to boot using the consolidated package stored in the **bootflash:** file system. The new configuration is then saved using the **copy running-config startup-config** command, and the system is then reloaded to complete the process.

```
Router# dir bootflash:
Directory of bootflash:/
11 drwx 16384 Dec 4 2007 04:32:46 -08:00 lost+found
86401 drwx 4096 Dec 4 2007 06:06:24 -08:00 .ssh
14401 drwx 4096 Dec 4 2007 06:06:36 -08:00 .rollback_timer
28801 drwx 4096 Mar 18 2008 17:31:17 -07:00 .prst_sync
43201 drwx 4096 Dec 4 2007 04:34:45 -08:00 .installer

928862208 bytes total (712273920 bytes free)

Router# copy tftp: bootflash:
Address or name of remote host []? 172.17.16.81
Source filename []? /auto/tftp-users/user/isr4400-universalk9.03.10.00.S.153-3.S-ext.SPA.bin
```

```
Destination filename [isr4400-universalk9.03.10.00.S.153-3.S-ext.SPA.bin]?
Accessing
tftp://172.17.16.81//auto/tftp-users/user/isr4400-universalk9.03.10.00.S.153-3.S-ext.SPA.bin
...
Loading /auto/tftp-users/user/isr4400-universalk9.03.10.00.S.153-3.S-ext.SPA.bin from
172.17.16.81 (via GigabitEthernet0):
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!
[OK - 208904396 bytes]
208904396 bytes copied in 330.453 secs (632176 bytes/sec)
Router# dir bootflash:
Directory of bootflash:/
11 drwx 16384 Dec 4 2007 04:32:46 -08:00 lost+found
86401 drwx 4096 Dec 4 2007 06:06:24 -08:00 .ssh
14401 drwx 4096 Dec 4 2007 06:06:36 -08:00 .rollback_timer
28801 drwx 4096 Mar 18 2008 17:31:17 -07:00 .prst_sync
43201 drwx 4096 Dec 4 2007 04:34:45 -08:00 .installer
12 -rw- 208904396 May 28 2008 16:17:34 -07:00
isr4400-universalk9.03.10.00.S.153-3.S-ext.SPA.bin
928862208 bytes total (503156736 bytes free)
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# boot system flash bootflash:isr4400-universalk9.03.10.00.S.153-3.S-ext.SPA.bin
Router(config)# config-reg 0x2102
Router(config)# exit
Router# show run | include boot
boot-start-marker
boot system flash bootflash:isr4400-universalk9.03.10.00.S.153-3.S-ext.SPA.bin
boot-end-marker
Router# copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
Router# reload
```

Configuring a Router to Boot the Consolidated Package via TFTP Using the boot Command: Example

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#boot system tftp://10.74.48.3/c1100tg-universalk9.17.02.01r.SPA.bin
Router(config)#config-register 0x2102
Router(config)#exit

Router#show run | include boot
boot-start-marker
boot system bootflash:c1100tg-universalk9.BLD_POLARIS_DEV_LATEST_20200506_055739.SSA.bin
boot system tftp://10.74.48.3/c1100tg-universalk9.17.02.01r.SPA.bin
boot-end-marker
diagnostic bootup level minimal
Router# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
Router# reload
Proceed with reload? [confirm]
May 15 17:42:54.445 R0/0: %PMAN-5-EXITACTION: Process manager is exiting: process exit with
```

```
reload chassis code


Initializing Hardware ...

ECC Support : NO

Checking for PCIe device presence...done
System integrity status: 0x610
Rom image verified correctly

System BootStrap, Version 17.2.1, 1913f73a, Tue 11/26/2019
Copyright (c) 1994-2019  by cisco Systems, Inc.


Current image running: Boot ROM1

Last reset cause: LocalSoft
C1100TG-1N24P32A platform with 4194304 Kbytes of main memory


........

          IP_ADDRESS: 10.75.163.169
      IP_SUBNET_MASK: 255.255.255.0
     DEFAULT_GATEWAY: 10.75.163.1
         TFTP_SERVER: 10.74.48.3
           TFTP_FILE: c1100tg-universalk9.17.02.01r.SPA.bin
        TFTP_MACADDR: 00:A0:C9:00:00:00
          ETHER_PORT: 0


Validating dev_mode signature

dev_mode validation succeeded for token 00A0C9000000 (0)
DevMode is enabled
Package header rev 3 structure detected
IsoSize = 543461376
Calculating SHA-1 hash...Validate package: SHA-1 hash:
        calculated 9FA1303E:AA3924C8:DE4A7528:F89D6172:D7BD4201
        expected   9FA1303E:AA3924C8:DE4A7528:F89D6172:D7BD4201
RSA Signed RELEASE Image Signature Verification Successful.
Image validated
.

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responsibility to monitor your usage of any such term Software feature to
ensure that your systems and networks are prepared for a shutdown of the
Software feature.




All TCP AO KDF Tests Pass
cisco C1100TG-1N24P32A (1RU) processor with 1392289K/6147K bytes of memory.
Processor board ID PSZ23461E0E
Router operating mode: Autonomous
1 Virtual Ethernet interface
26 Gigabit Ethernet interfaces
64 terminal lines
8192K bytes of non-volatile configuration memory.
4194304K bytes of physical memory.
6565887K bytes of flash memory at bootflash:.

no device-tracking logging theft
     ^
% Invalid input detected at '^' marker.



Press RETURN to get started!

Router>
Router>
Router>enable
Router# show version
Cisco IOS XE Software, Version 17.02.01r
Cisco IOS Software [Amsterdam], ISR Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version
17.2.1r, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2020 by Cisco Systems, Inc.
Compiled Thu 09-Apr-20 23:27 by mcpre


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```

```
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GPL code under the terms of GPL Version 2.0.  For more details, see the
documentation or "License Notice" file accompanying the IOS-XE software,
or the applicable URL provided on the flyer accompanying the IOS-XE
software.


ROM: IOS-XE ROMMON

RSBL uptime is 5 minutes
Uptime for this control processor is 7 minutes
System returned to ROM by Reload Command
System image file is "tftp://10.74.48.3/c1100tg-universalk9.17.02.01r.SPA.bin"
Last reload reason: Reload Command



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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.



Suite License Information for Module:'esg'

--------------------------------------------------------------------------------
Suite                 Suite Current         Type           Suite Next reboot
--------------------------------------------------------------------------------

Technology Package License Information:

-----------------------------------------------------------------
Technology    Technology-package           Technology-package
              Current       Type           Next reboot
------------------------------------------------------------------
appxk9           None             Smart License    None
securityk9       None             Smart License    None
ipbase           ipbasek9         Smart License    ipbasek9

The current throughput level is 500000 kbps


Smart Licensing Status: UNREGISTERED/No Licenses in Use

cisco C1100TG-1N24P32A (1RU) processor with 1392289K/6147K bytes of memory.
Processor board ID PSZ23461E0E
Router operating mode: Autonomous
1 Virtual Ethernet interface
26 Gigabit Ethernet interfaces
64 terminal lines
8192K bytes of non-volatile configuration memory.
```

```
4194304K bytes of physical memory.
6565887K bytes of flash memory at bootflash:.

Configuration register is 0x2102
```

Managing and Configuring a Router to Run Using Individual Packages

To choose between running individual packages or a consolidated package, see Overview section.

The following topics are included in this section:

- Installing a Firmware Subpackage, on page 105
- Installing Subpackages from a Consolidated Package on a Flash Drive, on page 105

Installing Subpackages from a Consolidated Package

Perform the following procedure to obtain the consolidated package from a TFTP server.

Another variation of this procedure obtains the consolidated package from a USB flash drive. This is described in Installing Subpackages from a Consolidated Package on a Flash Drive.

Before you begin

Copy the consolidated package to the TFTP server.

SUMMARY STEPS

1. **show version**
2. **dir bootflash:**
3. **show platform**
4. **mkdir bootflash:** *URL-to-directory-name*
5. **request platform software package expand file** *URL-to-consolidated-package* **to** *URL-to-directory-name*
6. **reload**
7. **boot** *URL-to-directory-name*/**packages.conf**
8. **show version installed**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**show version**
	Example:
	`Router# show version`
	`Cisco IOS XE Software, Version 17.02.01r`
	`Cisco IOS Software [Amsterdam], ISR Software`
	`(X86_64_LINUX_IOSD-UNIVERSALK9-M), Version 17.2.1r,`
		Shows the version of software running on the router. This can later be compared with the version of software to be installed.

	Command or Action	Purpose

	`RELEASE SOFTWARE (fc2)`
	`Technical Support: http://www.cisco.com/techsupport`
	`Copyright (c) 1986-2020 by Cisco Systems, Inc.`
	`Compiled Thu 09-Apr-20 23:27 by mcpre`
	`.`
	`.`
	`.`	

Step 2	**dir bootflash:** **Example:** `Router# dir bootflash:`	Displays the previous version of software and that a package is present.

Step 3	**show platform**
	Example:
	`Router# show platform`
	`Chassis type: C1100TG-1N24P32A`
		Displays the inventory.

Step 4	**mkdir bootflash:** *URL-to-directory-name* **Example:** `Router# mkdir bootflash:mydir`	Creates a directory to save the expanded software image. You can use the same name as the image to name the directory.
Step 5	**request platform software package expand file** *URL-to-consolidated-package* **to** *URL-to-directory-name* **Example:** `Router#  request platform software package expand file bootflash:c1100tg-universalk9.17.02.01r.SPA.bin to bootflash:mydir`	Expands the software image from the TFTP server (*URL-to-consolidated-package*) into the directory used to save the image (*URL-to-directory-name*), which was created in Step 4.

Step 6	**reload**
	Example:
	`Router# reload`
	`rommon >`
		Enables ROMMON mode, which allows the software in the consolidated file to be activated.

Step 7	**boot** *URL-to-directory-name/***packages.conf** **Example:** `rommon 1 > boot bootflash:mydir/packages.conf`	Boots the consolidated package, by specifying the path and name of the provisioning file: packages.conf.

Step 8	**show version installed**
	Example:
	`Router# show version installed`
	`Package: Provisioning File, version: n/a, status: active`
		Displays the version of the newly installed software.

Examples

The initial part of the example shows the consolidated package, c1100tg-universalk9.17.02.01r.SPA.bin, being copied to the TFTP server. This is a prerequisite step. The remaining part of the example shows the consolidated file, packages.conf, being booted.

```
Router# copy tftp:c1100tg-universalk9.17.02.01r.SPA.bin bootflash:
Address or name of remote host []? 1.1.1.1
Destination filename [c1100tg-universalk9.17.02.01r.SPA.bin]?
Accessing tftp://1.1.1.1/c1100tg-universalk9.17.02.01r.SPA.bin...
Loading /c1100tg-universalk9.17.02.01r.SPA.bin from 1.1.1.1 (via GigabitEthernet0): !!!!!!!!
[OK - 410506248 bytes]

410506248 bytes copied in 338.556 secs (1212521 bytes/sec)


Router# show version
Cisco IOS XE Software, Version 17.02.01r
Cisco IOS Software [Amsterdam], ISR Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version
17.2.1r, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
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Compiled Thu 09-Apr-20 23:27 by mcpre


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documentation or "License Notice" file accompanying the IOS-XE software,
or the applicable URL provided on the flyer accompanying the IOS-XE
software.


ROM: IOS-XE ROMMON

RSBL uptime is 5 minutes
Uptime for this control processor is 7 minutes
System returned to ROM by Reload Command
System image file is "tftp://10.74.48.3/c1100tg-universalk9.17.02.01r.SPA.bin"
Last reload reason: Reload Command



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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.
```

```
Suite License Information for Module:'esg'

--------------------------------------------------------------------------------
Suite                 Suite Current         Type           Suite Next reboot
--------------------------------------------------------------------------------

Technology Package License Information:

-----------------------------------------------------------------
Technology    Technology-package           Technology-package
              Current       Type           Next reboot
------------------------------------------------------------------
appxk9           None             Smart License    None
securityk9       None             Smart License    None
ipbase           ipbasek9         Smart License    ipbasek9

The current throughput level is 500000 kbps


Smart Licensing Status: UNREGISTERED/No Licenses in Use

cisco C1100TG-1N24P32A (1RU) processor with 1392289K/6147K bytes of memory.
Processor board ID PSZ23461E0E
Router operating mode: Autonomous
1 Virtual Ethernet interface
26 Gigabit Ethernet interfaces
64 terminal lines
8192K bytes of non-volatile configuration memory.
4194304K bytes of physical memory.
6565887K bytes of flash memory at bootflash:.

Configuration register is 0x2102

Router# dir bootflash:
Directory of bootflash:/

11 drwx 16384 May 3 2012 19:58:37 +00:00 lost+found
178465 drwx 4096 Jun 6 2012 15:20:20 +00:00 core
584065 drwx 4096 Jul 13 2012 19:19:00 +00:00 .prst_sync
405601 drwx 4096 May 3 2012 19:59:30 +00:00 .rollback_timer
113569 drwx 40960 Jul 13 2012 19:19:32 +00:00 tracelogs
64897 drwx 4096 May 3 2012 19:59:42 +00:00 .installer
13 -rw- 1305 May 7 2012 17:43:42 +00:00 startup-config
14 -rw- 1305 May 7 2012 17:43:55 +00:00 running-config
15 -r-- 1541 Jun 4 2012 18:32:41 +00:00 debug.conf
16 -rw- 1252 May 22 2012 19:58:39 +00:00 running-config-20120522
519169 drwx 4096 Jun 4 2012 15:29:01 +00:00 vman_fdb

7451738112 bytes total (7067635712 bytes free)



Router# show platform
Chassis type: C1100TG-1N24P32A

Slot      Type                State                 Insert time (ago)
--------- ------------------- --------------------- -----------------
0         C1100TG-1N24P32A    ok                    00:13:53
 0/0      C1100TG-2x1GE       ok                    00:12:31
 0/1      C1100TG-A-48        ok                    00:12:31
 0/2      C1100TG-ES-24       ok                    00:12:31
 0/3      NIM-16A             ok                    00:12:31
R0        C1100TG-1N24P32A    ok, active            00:13:53
```

```
F0        C1100TG-1N24P32A    ok, active            00:13:53
P0        PWR-12V             empty                 never
P2        C1100TG-FANASSY     ok                    00:13:23

Slot      CPLD Version        Firmware Version
--------- ------------------- ---------------------------------------
0         2004172A            17.2.1, 1913f73a
R0        2004172A            17.2.1, 1913f73a
F0        2004172A            17.2.1, 1913f73a

Router# mkdir bootflash:c1100tg-universalk9.17.02.01r.dir1
Create directory filename [c1100tg-universalk9.17.02.01r.dir1]?
Created dir bootflash:/c1100tg-universalk9.17.02.01r.dir1
Router# request platform software package expand file bootflash:c1100tg-universalk9.NIM.bin

to bootflash:c1100tg-universalk9.17.02.01r.dir1
Verifying parameters
Validating package type
Copying package files
SUCCESS: Finished expanding all-in-one software package.

Router# reload
Proceed with reload? [confirm]

*May 15 19:39:06.354: %SYS-5-RELOAD: Reload requested by console.Reload Reason: Reload
Command.

rommon 1 > boot bootflash:c1100tg-universalk9.17.02.01r.dir1/packages.conf

File size is 0x00002836
Located c1100tg-universalk9.17.02.01r.dir1/packages.conf
Image size 10294 inode num 324484, bks cnt 3 blk size 8*512
#
File is comprised of 1 fragments (33%)

is_valid_sha1hash: SHA-1 hash:
calculated 62f6235a:fc98eb3a:85ce183e:834f1cb3:8a1f71d1
expected 62f6235a:fc98eb3a:85ce183e:834f1cb3:8a1f71d1
File size is 0x04b3dc00
Located c1100tg-universalk9.17.02.01r.dir1/c1100tg-mono-universalk9-build_164422SSA.pkg
Image size 78896128 inode num 324491, bks cnt 19262 blk size 8*512
##########################################################################################
File is comprised of 21 fragments (0%)
.....



Router# show version installed
Package: Provisioning File, version: n/a, status: active
File: bootflash:ic1100tg-universalk9.17.02.01r9.dir1/packages.conf, on: RP0
Built: n/a, by: n/a
File SHA1 checksum: ad09affd3f8820f4844f27acc1add502e0b8f459
 Cisco IOS XE Software, Version 17.02.01r
Cisco IOS Software [Amsterdam], ISR Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version
17.2.1r, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2020 by Cisco Systems, Inc.
Compiled Thu 09-Apr-20 23:27 by mcpre
File SHA1 checksum: 5e95c9cbc4eaf5a4a5a1ac846ee2d0f41d1a026b
```

Installing Subpackages from a Consolidated Package on a Flash Drive

The steps for installing subpackages from a consolidated package on a USB flash drive are similar to those described in Installing Subpackages from a Consolidated Pacakage section .

Step 1 **show version**

Step 2 **dir usb***n***:**

Step 3 **show platform**

Step 4 **mkdir bootflash:***URL-to-directory-name*

Step 5 **request platform software package expand fileusb***n***:** ***package-name to URL-to-directory-name***

Step 6 **reload**

Step 7 **boot** *URL-to-directory-name/***packages.conf**

Step 8 **show version installed**

Installing a Firmware Subpackage

Before you begin

Obtain a consolidated package that contains your required firmware package and expand the package. (See Managing and Configuring a Router to Run Using Individual Packages, on page 100.) Make a note of the location and name of the firmware package and use this information in the steps below for *URL-to-package-name*.

You can install a firmware subpackage if the router has been configured using, for example, Managing and Configuring a Router to Run Using Individual Packages, on page 100.

Firmware subpackages are not released individually. You can select a firmware package from within a consolidated package after expanding the consolidated package. The firmware package can then be installed as shown in the procedure below.

Note Read the Release Notes document pertaining to the consolidated package to verify that the firmware within the consolidated package is compatible with the version of Cisco IOS XE software that is currently installed on a router.

SUMMARY STEPS

1. **show version**
2. **dir bootflash:**
3. **show platform**
4. **mkdir bootflash:** *URL-to-directory-name*
5. **request platform software package expand file** *URL-to-consolidated-package* **to** *URL-to-directory-name*
6. **reload**

7. **boot** *URL-to-directory-name* **/packages.conf**
8. **show version installed**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**show version**
	Example:
	`Router# show version`
	`Cisco IOS Software, IOS-XE Software`
	`(X86_64_LINUX_IOSD-UNIVERSALK9-M), Experimental`
	`Version 15.3(20120627:221639) [build_151722 111]`
	`Copyright (c) 1986-2012 by Cisco Systems, Inc.`
	`Compiled Thu 28-Jun-12 15:17 by mcpre`
	`.`
	`.`
	`.`
		Shows the version of software running on the router. This can later be compared with the version of software to be installed.

Step 2	**dir bootflash:** **Example:** `Router# dir bootflash:`	Displays the previous version of software and that a package is present.

Step 3	**show platform**
	Example:
	`Router# show platform`
	`Chassis type: ISR4451/K9`
		Checks the inventory.
		Also see the example in Installing Subpackages from a Consolidated Package section.

Step 4	**mkdir bootflash:** *URL-to-directory-name* **Example:** `Router# mkdir bootflash:mydir`	Creates a directory to save the expanded software image. You can use the same name as the image to name the directory.

Step 5	**request platform software package expand file** *URL-to-consolidated-package* **to** *URL-to-directory-name*
	Example:
	`Router#   request platform software package expand`
	` file`
	`bootflash:c1100tg-universalk9-NIM.bin to`
	`bootflash:mydir`
		Expands the software image from the TFTP server (*URL-to-consolidated-package*) into the directory used to save the image (*URL-to-directory-name*), which was created in the Step 4.

Step 6	**reload**
	Example:
	`Router# reload`
	`rommon >`
		Enables ROMMON mode, which allows the software in the consolidated file to be activated.

Step 7	**boot** *URL-to-directory-name* **/packages.conf** **Example:** `rommon 1 > boot bootflash:mydir/packages.conf`	Boots the consolidated package by specifying the path and name of the provisioning file: packages.conf.

	Command or Action	Purpose

Step 8	**show version installed**
	Example:
	`Router# show version installed`
	`Package: Provisioning File, version: n/a, status: active`
		Displays the version of the newly installed software.

Examples

The initial part of the following example shows the consolidated package, isr4400-universalk9.164422SSA.bin, being copied to the TFTP server. This is a prerequisite step. The remaining part of the example shows the consolidated file, packages.conf, being booted.

```
Router# tftp:isr4400/isr4400-universalk9.164422SSA.bin bootflash:
Address or name of remote host []? 1.1.1.1
Destination filename [isr4400-universalk9.164422SSA.bin]?
Accessing tftp://1.1.1.1/isr4400/isr4400-universalk9.164422SSA.bin...
Loading isr4400/isr4400-universalk9.164422SSA.bin from 1.1.1.1 (via GigabitEthernet0):
!!!!!!!!
[OK - 410506248 bytes]

410506248 bytes copied in 338.556 secs (1212521 bytes/sec)


Router# show version
Cisco IOS Software, IOS-XE Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Experimental Version

15.3(20120627:221639) [build_151722 111]
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Thu 28-Jun-12 15:17 by mcpre

IOS XE Version: 2012-06-28_15.31_mcpre

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GPL code under the terms of GPL Version 2.0. For more details, see the
documentation or "License Notice" file accompanying the IOS-XE software,
or the applicable URL provided on the flyer accompanying the IOS-XE
software.


ROM: IOS-XE ROMMON

Router uptime is 0 minutes
Uptime for this control processor is 3 minutes
System returned to ROM by reload
System image file is "tftp:isr4400/isr4400.bin"
Last reload reason: Reload Command

This product contains cryptographic features and is subject to United
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third-party authority to import, export, distribute or use encryption.
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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.

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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.

License Level: adventerprise
License Type: EvalRightToUse
Next reload license Level: adventerprise
cisco ISR4451/K9 (2RU) processor with 1136676K/6147K bytes of memory.
Processor board ID FGL161611AB
4 Gigabit Ethernet interfaces
32768K bytes of non-volatile configuration memory.
4194304K bytes of physical memory.
7393215K bytes of Compact flash at bootflash:.

Configuration register is 0x8000

Router# dir bootflash:
Directory of bootflash:/

11 drwx 16384 May 3 2012 19:58:37 +00:00 lost+found
178465 drwx 4096 Jun 6 2012 15:20:20 +00:00 core
584065 drwx 4096 Jul 13 2012 19:19:00 +00:00 .prst_sync
405601 drwx 4096 May 3 2012 19:59:30 +00:00 .rollback_timer
113569 drwx 40960 Jul 13 2012 19:19:32 +00:00 tracelogs
64897 drwx 4096 May 3 2012 19:59:42 +00:00 .installer
13 -rw- 1305 May 7 2012 17:43:42 +00:00 startup-config
14 -rw- 1305 May 7 2012 17:43:55 +00:00 running-config
15 -r-- 1541 Jun 4 2012 18:32:41 +00:00 debug.conf
16 -rw- 1252 May 22 2012 19:58:39 +00:00 running-config-20120522
519169 drwx 4096 Jun 4 2012 15:29:01 +00:00 vman_fdb

7451738112 bytes total (7067635712 bytes free)



Router# show platform
Chassis type: ISR4451/K9

Slot Type State Insert time (ago)
--------- ------------------- --------------------- -----------------
0 ISR4451/K9 ok 15:57:33
0/0 ISR4451-6X1GE ok 15:55:24
1 ISR4451/K9 ok 15:57:33
1/0 SM-1T3/E3 ok 15:55:24
2 ISR4451/K9 ok 15:57:33
2/0 SM-1T3/E3 ok 15:55:24
R0 ISR4451/K9 ok, active 15:57:33
F0 ISR4451-FP ok, active 15:57:33
P0 Unknown ps, fail never
P1 XXX-XXXX-XX ok 15:56:58
P2 ACS-4450-FANASSY ok 15:56:58

Slot CPLD Version Firmware Version
--------- ------------------- ---------------------------------------
0 12090323 15.3(01r)S [ciscouser-ISRRO...
1 12090323 15.3(01r)S [ciscouser-ISRRO...
2 12090323 15.3(01r)S [ciscouser-ISRRO...
R0 12090323 15.3(01r)S [ciscouser-ISRRO...
F0 12090323 15.3(01r)S [ciscouser-ISRRO...
```

```
Router# mkdir bootflash:isr4400-universalk9.dir1
Create directory filename [isr4400-universalk9.dir1]?
Created dir bootflash:/isr4400-universalk9.dir1
Router# request platform software package expand file bootflash:isr4400-universalk9.NIM.bin
 to
 bootflash:isr4400-universalk9.dir1
Verifying parameters
Validating package type
Copying package files
SUCCESS: Finished expanding all-in-one software package.

Router# reload
Proceed with reload? [confirm]

*Jul 13 19:39:06.354: %SYS-5-RELOAD: Reload requested by console. Reload Reason: Reload
Command.

rommon 1 > boot bootflash:isr4400-universalk9.dir1/packages.conf

File size is 0x00002836
Located isr4400-universalk9.dir1/packages.conf
Image size 10294 inode num 324484, bks cnt 3 blk size 8*512
#
File is comprised of 1 fragments (33%)

is_valid_sha1hash: SHA-1 hash:
calculated 62f6235a:fc98eb3a:85ce183e:834f1cb3:8a1f71d1
expected 62f6235a:fc98eb3a:85ce183e:834f1cb3:8a1f71d1
File size is 0x04b3dc00
Located isr4400-universalk9.dir1/isr4400-mono-universalk9-build_164422SSA.pkg
Image size 78896128 inode num 324491, bks cnt 19262 blk size 8*512
############################################################################################
File is comprised of 21 fragments (0%)
.....



Router# show version installed
Package: Provisioning File, version: n/a, status: active
File: bootflash:isr4400-universalk9.dir1/packages.conf, on: RP0
Built: n/a, by: n/a
File SHA1 checksum: ad09affd3f8820f4844f27acc1add502e0b8f459

Package: rpbase, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:isr4400-universalk9.dir1/isr4400-mono-universalk9-build_164422SSA.pkg, on:
 RP0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 5e95c9cbc4eaf5a4a5a1ac846ee2d0f41d1a026b

Package: firmware_attributes, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:isr4400-universalk9.dir1/isr4400-firmware_attributes_164422SSA.pkg, on:
RP0/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 71614f2d9cbe7f96d3c6e99b67d514bd108c6c99

Package: firmware_dsp_sp2700, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:isr4400-universalk9.dir1/isr4400-firmware_dsp_164422SSA.pkg, on: RP0/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 8334565edf7843fe246783b1d5c6ed933d96d79e
Package: firmware_fpge, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:isr4400-universalk9.dir1/isr4400-firmware_fpge_164422SSA.pkg, on: RP0/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: eb72900ab32c1c50652888ff486cf370ac901dd7
```

```
Package: firmware_sm_1t3e3, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:isr4400-universalk9.dir1/isr4400-firmware_sm_1t3e3_164422SSA.pkg, on: RP0/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 803005f15d8ea71ab088647e2766727ac2269871

Package: rpcontrol, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:isr4400-universalk9.dir1/isr4400-mono-universalk9_164422SSA.pkg, on: RP0/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 980fd58fe581e9346c44417b451d1c09ebb640c2

Package: rpios-universalk9, version: dir1, status: active
File: bootflash:isr4400-universalk9.dir1/isr4400-mono-universalk9_164422SSA.pkg, on: RP0/0
Built: 2012-07-10_16.23, by: mcpre
File SHA1 checksum: 27084f7e30a1d69d45a33e05d1b00345040799fb
Package: rpaccess, version: 2012-07-10_16.22_mcpre, status: active
File: bootflash:isr4400-universalk9.dir1/isr4400-mono-universalk9_164422SSA.pkg, on: RP0/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 0119802deda2da91c38473c47a998fb3ed423448

Package: firmware_attributes, version: 2012-07-10_16.22_mcpre, status: n/a
File: bootflash:isr4400-universalk9.dir1/isr4400-firmware_attributes_164422SSA.pkg, on:
RP0/1
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 71614f2d9cbe7f96d3c6e99b67d514bd108c6c99

Package: firmware_dsp_sp2700, version: 2012-07-10_16.22_mcpre, status: n/a
File: bootflash:isr4400-universalk9.dir1/isr4400-firmware_dsp_164422SSA.pkg, on: RP0/1
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 8334565edf7843fe246783b1d5c6ed933d96d79e

Package: firmware_fpge, version: 2012-07-10_16.22_mcpre, status: n/a
File: bootflash:isr4400-universalk9.dir1/isr4400-firmware_fpge-BLD-BLD_MCP_DEV_LATEST_
20120710_164422SSA.pkg, on: RP0/1
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: eb72900ab32c1c50652888ff486cf370ac901dd7

Package: firmware_sm_1t3e3, version: 2012-07-10_16.22_mcpre, status: n/a
File: bootflash:isr4400-universalk9.dir1/isr4400-firmware_sm_1t3e3-BLD-BLD_MCP_DEV_LATEST_
20120710_164422SSA.pkg, on: RP0/1
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 803005f15d8ea71ab088647e2766727ac2269871

Package: rpcontrol, version: 2012-07-10_16.22_mcpre, status: n/a
File: bootflash:isr4400-universalk9.dir1/isr4400-rpcontrol-BLD-BLD_MCP_DEV_LATEST_20120710_
164422SSA.pkg, on: RP0/1
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 980fd58fe581e9346c44417b451d1c09ebb640c2

Package: rpios-universalk9, version: 2012-07-10_16.23_mcpre, status: n/a
File: bootflash:isr4400-universalk9.dir1/isr4400-rpios-universalk9-BLD-BLD_MCP_DEV_LATEST_
20120710_164422SSA.pkg, on: RP0/1
Built: 2012-07-10_16.23, by: mcpre
File SHA1 checksum: 27084f7e30a1d69d45a33e05d1b00345040799fb

Package: rpaccess, version: 2012-07-10_16.22_mcpre, status: n/a
File: bootflash:isr4400-universalk9.dir1/isr4400-rpaccess-BLD-BLD_MCP_DEV_LATEST_20120710_
164422SSA.pkg, on: RP0/1
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 0119802deda2da91c38473c47a998fb3ed423448

Package: rpbase, version: 2012-07-10_16.22_mcpre, status: n/a
File: bootflash:isr4400-universalk9.dir1/isr4400-rpbase-BLD-BLD_MCP_DEV_LATEST_20120710_
164422SSA.pkg, on: RP1
Built: 2012-07-10_16.22, by: mcpre
```

```
File SHA1 checksum: 5e95c9cbc4eaf5a4a5a1ac846ee2d0f41d1a026b

Package: firmware_attributes, version: 2012-07-10_16.22_mcpre, status: n/a
File: bootflash:isr4400-universalk9.dir1/isr4400-firmware_attributes-BLD-BLD_MCP_DEV_LATEST_
20120710_164422SSA.pkg, on: RP1/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 71614f2d9cbe7f96d3c6e99b67d514bd108c6c99

Package: firmware_dsp_sp2700, version: 2012-07-10_16.22_mcpre, status: n/a
File: bootflash:isr4400-universalk9.dir1/isr4400-firmware_dsp_sp2700-BLD-BLD_MCP_DEV_LATEST_
20120710_164422SSA.pkg, on: RP1/0
Built: 2012-07-10_16.22, by: mcpre
File SHA1 checksum: 8334565edf7843fe246783b1d5c6ed933d96d79e

Package: firmware_fpge, version: 2012-07-10_16.22_mcpre, status: n/a
```

Configuring No Service Password-Recovery

The Cisco IOS password recovery procedure allows you to to gain access, using the console, to the ROMMON mode by using the Break key during system startup and reload. When the router software is loaded from ROMMON mode, the configuration is updated with the new password. The password recovery procedure makes anyone with console access have the ability to access the router and its network.

The No Service Password-Recovery feature is designed to prevent the service password-recovery procedure from being used to gain access to the router and network.

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 register boot field value to form a default boot filename for autobooting from a network server.

Bit 8, when set to 1, ignores the startup configuration. Bit 6, when set to 1, enables break key detection. You must set the configuration register to autoboot to enable this feature. Any other configuration register setting will prevent the feature from being enabled.

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

How to Enable No Service Password-Recovery

You can enable the No Service Password-Recovery in the following two ways:

- Using the **no service password-recovery** command. This option allows password recovery once it is enabled.
- Using the **no service password-recovery strict** command. This option does not allow for device recovery once it is enabled.

Note As a precaution, a valid Cisco IOS image should reside in the bootflash: 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 router.

Befor you beging, ensure that this feature is disabled before making any change to the router regardless of the significance of the change—such as a configuration, module, software version, or ROMMON version change.

The configuration register boot bit must be enabled to load the startup configuration by setting bit-8 to 0, to ignore the break key in Cisco IOS XE by setting bit-6 to 0, and to auto boot a Cisco IOS XE image by setting the lowest four bits 3-0, to any value from 0x2 to 0xF. Changes to the configuration register are not saved after the No Service Password-Recovery feature is enabled.

Note If Bit-8 is set to 1, the startup configuration is ignored. If Bit-6 is set to 1, break key detection is enabled in Cisco IOS XE. If both Bit-6 and Bit-8 are set to 0, the No Service Password-Recovery feature is enabled.

This example shows how to enable the No Service Password-Recovery feature:

```
Router> enable
Router# show version
Router# configure terminal
Router(config)# config-register 0x2012
Router(config)# no service password-recovery
Router(config)# exit
```

Recovering a Device with the No Service Password-Recovery Feature Enabled

To recover a device after the no service password-recovery feature is enabled using the **no service password-recovery** command, look out for the following message that appears during the boot: “PASSWORD RECOVERY FUNCTIONALITY IS DISABLED.” As soon as “.. ” appears, press the Break key. You are then prompted to confirm the Break key action:

- If you confirm the action, the startup configuration is erased and the router boots with the factory default configuration with the No Service Password-Recovery enabled.
- If you do not confirm the Break key action, the router boots normally with the No Service Password-Recovery feature enabled.

Note You cannot recover a device if the No Service Password-Recovery feature was enabled using the **no service password-recovery strict** command.

This example shows a Break key action being entered during boot up, followed by confirmation of the break key action. The startup configuration is erased and the device then boots with the factory default configuration with the No Service Password-Recovery feature enabled.

```
Initializing Hardware...

System integrity status: 00000610
```

```
Rom image verified correctly

System Bootstrap, Version 15.3(3r)S, RELEASE SOFTWARE

Copyright (c) 1994-2013 by cisco Systems, Inc.

Current image running: Boot ROM1

Last reset cause: LocalSoft

Cisco ASR 1000 platform with 4194304 Kbytes of main memory

PASSWORD RECOVERY FUNCTIONALITY IS DISABLED

..

telnet> send brk

..

PASSWORD RECOVERY IS DISABLED.

Do you want to reset the router to the factory default
configuration and proceed [y/n] ? y

Router clearing configuration. Please wait for ROMMON prompt...

File size is 0x17938a80

Located isr4400-universalk9.BLD_V153_3_S_XE310_THROTTLE_LATEST_20130623_234109.SSA.bin

Image size 395545216 inode num 26, bks cnt 96569 blk size 8*512
```

This example shows a Break key action being entered during boot up, followed by the non-confirmation of the break key action. The device then boots normally with the No Service Password-Recovery feature enabled.

```
Initializing Hardware...

System integrity status: 00000610

Rom image verified correctly

System Bootstrap, Version 15.3(3r)S, RELEASE SOFTWARE

Copyright (c) 1994-2013 by cisco Systems, Inc.

Current image running: Boot ROM1

Last reset cause: LocalSoft

Cisco ASR 1000 platform with 4194304 Kbytes of main memory

PASSWORD RECOVERY FUNCTIONALITY IS DISABLED

..

telnet> send brk

...

PASSWORD RECOVERY IS DISABLED.

Do you want to reset the router to the factory default
configuration and proceed [y/n] ? n
```

```
Router continuing with existing configuration...
File size is 0x17938a80
Located isr4400-universalk9.BLD_V153_3_S_XE310_THROTTLE_LATEST_20130623_234109.SSA.bin
Image size 395545216 inode num 26, bks cnt 96569 blk size 8*512
######################################################################## …
```

Configuration Examples for No Service Password-Recovery

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]: 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

...
```

The following example shows how to disable password recovery capability using the no service password-recovery strict command:

```
Router# configure terminal

Router(config)# no service password-recovery strict

WARNING:

Do not execute this command without another plan for password recovery.

Are you sure you want to continue? [yes]: yes

..
```

CHAPTER 9

Slot and Subslot Configuration

This chapter contains information on slots and subslots. Slots specify the chassis slot number in your router and subslots specify the slot where the service modules are installed.

For further information on the slots and subslots, see the "About Slots and Interfaces" section in the Cisco 1100 Terminal Server Gateway .

The following section is included in this chapter:

- Configuring the Interfaces, on page 117

Configuring the Interfaces

The following sections describe how to configure Gigabit interfaces and also provide examples of configuring the router interfaces:

- Configuring Gigabit Ethernet Interfaces, on page 117
- Configuring the Interfaces: Example, on page 119
- Viewing a List of All Interfaces: Example, on page 119
- Viewing Information About an Interface: Example, on page 119

Configuring Gigabit Ethernet Interfaces

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface GigabitEthernet** *slot/subslot/port*
4. **ip address** *ip-address mask* [**secondary**] **dhcp pool**
5. **negotiation auto**
6. **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	**interface GigabitEthernet** *slot/subslot/port* **Example:** `Router(config)# interface GigabitEthernet 0/0/1`	Configures a GigabitEthernet interface. • **GigabitEthernet**—Type of interface. • *slot*—Chassis slot number. • */subslot*—Secondary slot number. The slash (/) is required. • /port—Port or interface number. The slash (/) is required.
Step 4	**ip address** *ip-address mask* [**secondary**] **dhcp pool** **Example:** `Router(config-if)# ip address 10.0.0.1 255.255.255.0 dhcp pool`	Assigns an IP address to the GigabitEthernet • **ip address** *ip-address*—IP address for the interface. • *mask*—Mask for the associated IP subnet. • **secondary** (optional)—Specifies that the configured address is a secondary IP address. If this keyword is omitted, the configured address is the primary IP address. • **dhcp**—IP address negotiated via DHCP. • **pool**—IP address autoconfigured from a local DHCP pool.
Step 5	**negotiation auto** **Example:** `Router(config-if)# negotiation auto`	Selects the negotiation mode. • **auto**—Performs link autonegotiation.

Step 6	**end**
	Example:
	`Router(config-if)# end`
		Ends the current configuration session and returns to privileged EXEC mode.

Configuring the Interfaces: Example

The following example shows the **interface gigabitEthernet** command being used to add the interface and set the IP address. **0/0/0** is the slot/subslot/port. The ports are numbered 0 to 3.

```
Router# show running-config interface gigabitEthernet 0/0/0
Building configuration...
Current configuration : 71 bytes
!
interface gigabitEthernet0/0/0
no ip address
negotiation auto
end

Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface gigabitEthernet 0/0/0
```

Viewing a List of All Interfaces: Example

In this example, the **show platform software interface summary** and **show interfaces summary** commands are used to display all the interfaces:

```
Router# show platform software interface summary
  Interface                 IHQ  IQD  OHQ  OQD  RXBS  RXPS  TXBS  TXPS  TRTL
-----------------------------------------------------------------------------
* GigabitEthernet0/0/0        0    0    0    0     0     0     0     0     0
* GigabitEthernet0/0/1        0    0    0    0     0     0     0     0     0
* GigabitEthernet0/0/2        0    0    0    0     0     0     0     0     0
* GigabitEthernet0/0/3        0    0    0    0     0     0     0     0     0
* GigabitEthernet0            0    0    0    0     0     0     0     0     0


Router# show interfaces summary
   *: interface is up
 IHQ: pkts in input hold queue     IQD: pkts dropped from input queue
 OHQ: pkts in output hold queue    OQD: pkts dropped from output queue
 RXBS: rx rate (bits/sec)          RXPS: rx rate (pkts/sec)
 TXBS: tx rate (bits/sec)          TXPS: tx rate (pkts/sec)
 TRTL: throttle count

Interface             IHQ  IQD    OHQ    OQD    RXBS    RXPS    TXBS    TXPS    TRTL
------------------------------------------------------------------------------------------

* GigabitEthernet0/0/0 0    0      0      0      0       0       0       0       0
* GigabitEthernet0/0/1 0    0      0      0      0       0       0       0       0
* GigabitEthernet0/0/2 0    0      0      0      0       0       0       0       0
* GigabitEthernet0/0/3 0    0      0      0      0       0       0       0       0
* GigabitEthernet      0    0      0      0      0       0       0       0       0
```

Viewing Information About an Interface: Example

The following example shows how to display a brief summary of an interface's IP information and status, including the virtual interface bundle information, by using the **show ip interface brief** command:

```
Router# show ip interface brief
Interface              IP-Address      OK?  Method  Status                 Protocol
GigabitEthernet0/0/0    10.0.0.1       YES  manual  down                   down
GigabitEthernet0/0/1    unassigned     YES  NVRAM   administratively down  down
```

```
GigabitEthernet0/0/2    10.10.10.1     YES  NVRAM   up                      up
GigabitEthernet0/0/3    8.8.8.1        YES  NVRAM   up                      up
GigabitEthernet0        172.18.42.33   YES  NVRAM   up                      up
```

CHAPTER 10

Support for Security-Enhanced Linux

This chapter describes the SELinux feature, and includes the following sections:

Overview

Security-Enhanced Linux (SELinux) is a solution composed of Linux kernel security module and system utilities to incorporate a strong, flexible Mandatory Access Control (MAC) architecture into Cisco IOS-XE platforms.

SELinux provides an enhanced mechanism to enforce the separation of information, based on confidentiality and integrity requirements, which addresses threats of tampering and bypassing of application security mechanisms and enables the confinement of damage that malicious or flawed applications can cause.

Prerequisites for SELinux

There are no specific prerequisites for this feature.

Restrictions for SELinux

There are no specific restrictions for this feature.

Information About SELinux

SELinux enforces mandatory access control policies that confine user programs and system services to the minimum privilege required to perform their assigned functionality. This reduces or eliminates the ability of these programs and daemons to cause harm when compromised (for example, through buffer overflows or misconfigurations). This is a practical implementation of principle of least privilege by enforcing MAC on Cisco IOS-XE platforms. This confinement mechanism works independently of the traditional Linux access control mechanisms. SELinux provides the capability to define policies to control the access from an application process to any resource object, thereby allowing for the clear definition and confinement of process behavior.

SELinux can operate either in **Permissive mode** or **Enforcing mode** when enabled on a system.

- In Permissive mode, SELinux does not enforce the policy, and only generates system logs for any denials caused by violation of the resource access policy. The operation is not denied, but only logged for resource access policy violation.
- In Enforcing mode, the SELinux policy is enabled and enforced. It denies resource access based on the access policy rules, and generates system logs.

From Cisco IOS XE 17.13.1a, SELinux is enabled in Enforcing mode by default on supported Cisco IOS XE platforms. In the Enforcing mode, any system resource access that does not have the necessary allow policy is treated as a violation, and the operation is denied. The violating operation fails when a denial occurs, and system logs are generated. In Enforcing mode, the solution works in access-violation prevention mode.

Supported Platforms

From Cisco IOS XE 17.13.1a, SELinux is enabled on the following platforms:

- Cisco 1000 Series Aggregation Services Routers
- Cisco 1000 Series Integrated Services Routers
- Cisco 4000 Series Integrated Services Routers
- Cisco Catalyst 8000v Edge Software
- Cisco Catalyst 8200 Series Edge Platforms
- Cisco Catalyst 8300 Series Edge Platforms
- Cisco Catalyst 8500 and 8500L Series Edge Platforms
- Cisco VG Series Gateways: VG400, VG410, VG420, and VG450
- Cisco 1100 Terminal Services Gateway

Configuring SELinux

The are no additional requirements or configuration steps needed to enable or use the SELinux feature in Enforcing mode.

The following commands are introduced as part of the SELinux feature:

```
set platform software selinux {default | enforcing | permissive}
```

```
platform security selinux {enforcing | permissive}
```

```
show platform software selinux
```

Note These new commands are implemented as **service internal** commands.

Configuring SELinux (EXEC Mode)

Use the **set platform software selinux** command to configure SELinux in EXEC mode.

The following example shows SELinux configuration in EXEC mode:

```
Device# set platform software selinux ?

default  Set SELinux mode to default
enforcing  Set SELinux mode to enforcing
permissive  Set SELinux mode to permissive
```

Configuring SELinux (CONFIG Mode)

Use the **platform security selinux** command to configure SELinux in configuration mode.

The following example shows SELinux configuration in CONFIG mode:

```
Device(config)# platform security selinux

enforcing  Set SELinux policy to Enforcing mode
permissive  Set SELinux policy to Permissive mode

Device(config)# platform security selinux permissive

Device(config)#
*Oct 20 21:52:45.155: %IOSXE-1-PLATFORM: R0/0:
SELINUX_MODE_PROG: Platform Selinux confinement mode downgraded to permissive!

Device(config)#
```

Examples for SELinux

The following example shows the output for changing the mode from Enforcing to Permissive:

```
“*Oct 20 21:44:03.609: %IOSXE-1-PLATFORM: R0/0:
SELINUX_MODE_PROG: Platform Selinux confinement mode downgraded to permissive!”
```

The following example shows the output for changing the mode from Permissive to Enforcing:

```
“*Oct 20 21:44:34.160: %IOSXE-1-PLATFORM: R0/0:
SELINUX_MODE_PROG: Platform Selinux confinement mode upgraded to enforcing!”
```

Note If the SELinux mode is changed, this change is considered a system security event, and a system log message is generated.

SysLog Message Reference

Facility-Severity-Mnemonic	**%SELINUX-1-VIOLATION**
Severity-Meaning	Alert Level Log
Message	N/A
Message Explanation	Resource access was made by the process for which a resource access policy does not exist. The operation was flagged, and resource access was denied. A system log was generated with information that process resource access has been denied.
Component	SELINUX
Recommended Action	Contact Cisco TAC with the following relevant information as attachments: • The exact message as it appears on the console or in the system • Output of the **show tech-support** command (text file) • Archive of Btrace files from the box using the following command: **request platform software trace archive target <URL>** • Output of the **show platform software selinux** command

The following examples demonstrate sample syslog messages:

Example 1:

```
*Nov 14 00:09:04.943: %SELINUX-1-VIOLATION: R0/0: audispd: type=AVC
msg=audit(1699927057.934:129): avc: denied { getattr } for pid=5899 comm="ls"
path="/root/test" dev="rootfs" ino=25839
scontext=system_u:system_r:polaris_iosd_t:s0
tcontext=system_u:object_r:admin_home_t:s0 tclass=file permissive=0
```

Example 2:

```
*Nov 14 00:09:04.947: %SELINUX-1-VIOLATION: R0/0: audispd: t type=AVC
msg=audit(1699927198.486:130): avc: denied { write } for pid=6012 comm="echo"
path="/root/test" dev="rootfs" ino=25839
scontext=system_u:system_r:polaris_iosd_t:s0
tcontext=system_u:object_r:admin_home_t:s0 tclass=file permissive= 0
```

Verifying SELinux Enablement

Use the **show platform software selinux** command to view the SELinux configuration mode:

```
Device# show platform software selinux
=========================================
IOS-XE SELINUX STATUS
=========================================
SElinux Status :    Enabled
Current Mode :      Enforcing
Config file Mode :  Enforcing
```

Troubleshooting SELinux

If there is an instance of an SELinux violation on your device or network, please reach out to Cisco TAC with the following details:

- The message exactly as it appears on the console or in the system log. For example:

  ```
  device#request platform software trace archive target
      flash:selinux_btrace_logs
  ```

- Output of the **show tech-support** command (text file)
- Archive of Btrace files from the box using the following command:

  request platform software trace archive target <URL>

- Output of the **show platform software selinux** command

CHAPTER 11

System Messages

System messages are saved in a log file or directed to other devices from the software running on a router. These messages are also known as syslog messages. System messages provide you with logging information for monitoring and troubleshooting purposes.

The following sections are included in this chapter:

- Information About Process Management, on page 127
- How to Find Error Message Details, on page 127

Information About Process Management

You can access system messages by logging in to the console through Telnet protocol and monitoring your system components remotely from any workstation that supports the Telnet protocol.

Starting and monitoring software is referred to as process management. The process management infrastructure for a router is platform independent, and error messages are consistent across platforms running on Cisco IOS XE. You do not have to be directly involved in process management, but we recommend that you read the system messages that refer to process failures and other issues.

How to Find Error Message Details

To see further details about a process management or a syslog error message, see the System Error Messages Guide For Access and Edge Routers Guide.

The following are examples of the description and the recommended action displayed by the error messages.

Error Message: `%PMAN-0-PROCESS_NOTIFICATION : The process lifecycle notification component failed because [chars]`

Explanation	**Recommended Action**

The process lifecycle notification component failed, preventing proper detection of a process start and stop. This problem is likely the result of a software defect in the software subpackage.	Note the time of the message and investigate the kernel error message logs to learn more about the problem and see if it is correctable. If the problem cannot be corrected or the logs are not helpful, copy the error message exactly as it appears on the console along with the output of the **show tech-support** command and provide the gathered information to a Cisco technical support representative.

Error Message: `%PMAN-0-PROCFAILCRIT A critical process [chars] has failed (rc [dec])`

Explanation	**Recommended Action**
A process important to the functioning of the router has failed.	Note the time of the message and investigate the error message logs to learn more about the problem. If the problem persists, copy the message exactly as it appears on the console or in the system log. Research and attempt to resolve the issue using the tools and utilities provided at: http://www.cisco.com/tac. With some messages, these tools and utilities will supply clarifying information. Search for resolved software issues using the Bug Search Tool at: http://www.cisco.com/cisco/psn/bssprt/bss. If you still require assistance, open a case with the Technical Assistance Center at: http://tools.cisco.com/ServiceRequestTool/create/, or contact your Cisco technical support representative and provide the representative with the information you have gathered. Attach the following information to your case in nonzipped, plain-text (.txt) format: the output of the **show logging** and **show tech-support** commands and your pertinent troubleshooting logs.

Error Message: `%PMAN-3-PROCFAILOPT An optional process [chars] has failed (rc [dec])`

Explanation	**Recommended Action**

A process that does not affect the forwarding of traffic has failed.	Note the time of the message and investigate the kernel error message logs to learn more about the problem. Although traffic will still be forwarded after receiving this message, certain functions on the router may be disabled because of this message and the error should be investigated. If the logs are not helpful or indicate a problem you cannot correct, copy the message exactly as it appears on the console or in the system log. Research and attempt to resolve the issue using the tools and utilities provided at http://www.cisco.com/tac. With some messages, these tools and utilities will supply clarifying information. Search for resolved software issues using the Bug Search Tool at: http://www.cisco.com/cisco/psn/bssprt/bss. If you still require assistance, open a case with the Technical Assistance Center at: http://tools.cisco.com/ServiceRequestTool/create/, or contact your Cisco technical support representative and provide the representative with the information you have gathered. Attach the following information to your case in nonzipped, plain-text (.txt) format: the output of the **show logging** and **show tech-support** commands and your pertinent troubleshooting logs.

Error Message: `%PMAN-3-PROCFAIL The process [chars] has failed (rc [dec])`

Explanation	**Recommended Action**
The process has failed as the result of an error.	This message will appear with other messages related to the process. Check the other messages to determine the reason for the failures and see if corrective action can be taken. If the problem persists, copy the message exactly as it appears on the console or in the system log. Research and attempt to resolve the issue using the tools and utilities provided at: http://www.cisco.com/tac. With some messages, these tools and utilities will supply clarifying information. Search for resolved software issues using the Bug Search Tool at: http://www.cisco.com/cisco/psn/bssprt/bss. If you still require assistance, open a case with the Technical Assistance Center at: http://tools.cisco.com/ServiceRequestTool/create/, or contact your Cisco technical support representative and provide the representative with the information you have gathered. Attach the following information to your case in nonzipped, plain-text (.txt) format: the output of the **show logging** and **show tech-support** commands and your pertinent troubleshooting logs.

Error Message: `%PMAN-3-PROCFAIL_IGNORE [chars] process exits and failures are being ignored due to debug settings. Normal router functionality will be affected. Critical router functions like RP switchover, router reload, FRU resets, etc. may not function properly.`

Explanation	Recommended Action
A process failure is being ignored due to the user-configured debug settings.	If this behavior is desired and the debug settings are set according to a user's preference, no action is needed. If the appearance of this message is viewed as a problem, change the debug settings. The router is not expected to behave normally with this debug setting. Functionalities such as SSO switchover, router reloads, FRU resets, and so on will be affected. This setting should only be used in a debug scenario. It is not normal to run the router with this setting.

Error Message: `%PMAN-3-PROCHOLDDOWN The process [chars] has been helddown (rc [dec])`

Explanation	Recommended Action
The process was restarted too many times with repeated failures and has been placed in the hold-down state.	This message will appear with other messages related to the process. Check the other messages to determine the reason for the failures and see if corrective action can be taken. If the problem persists, copy the message exactly as it appears on the console or in the system log. Research and attempt to resolve the issue using the tools and utilities provided at: http://www.cisco.com/tac. With some messages, these tools and utilities will supply clarifying information. Search for resolved software issues using the Bug Search Tool at: http://www.cisco.com/cisco/psn/bssprt/bss. If you still require assistance, open a case with the Technical Assistance Center at: http://tools.cisco.com/ServiceRequestTool/create/, or contact your Cisco technical support representative and provide the representative with the information you have gathered. Attach the following information to your case in nonzipped, plain-text (.txt) format: the output of the **show logging** and **show tech-support** commands and your pertinent troubleshooting logs.

Error Message: `%PMAN-3-RELOAD_RP_SB_NOT_READY : Reloading: [chars]`

Explanation	Recommended Action
The route processor is being reloaded because there is no ready standby instance.	Ensure that the reload is not due to an error condition.

Error Message: `%PMAN-3-RELOAD_RP : Reloading: [chars]`

Explanation	Recommended Action

The RP is being reloaded.	Ensure that the reload is not due to an error condition. If it is due to an error condition, collect information requested by the other log messages.

Error Message: `%PMAN-3-RELOAD_SYSTEM : Reloading: [chars]`

Explanation	**Recommended Action**
The system is being reloaded.	Ensure that the reload is not due to an error condition. If it is due to an error condition, collect information requested by the other log messages.

Error Message: `%PMAN-3-PROC_BAD_EXECUTABLE : Bad executable or permission problem with process [chars]`

Explanation	**Recommended Action**
The executable file used for the process is bad or has permission problem.	Ensure that the named executable is replaced with the correct executable.

Error Message: `%PMAN-3-PROC_BAD_COMMAND:Non-existent executable or bad library used for process <process name>`

Explanation	**Recommended Action**
The executable file used for the process is missing, or a dependent library is bad.	Ensure that the named executable is present and the dependent libraries are good.

Error Message: `%PMAN-3-PROC_EMPTY_EXEC_FILE : Empty executable used for process [chars]`

Explanation	**Recommended Action**
The executable file used for the process is empty.	Ensure that the named executable is non-zero in size.

Error Message: `%PMAN-5-EXITACTION : Process manager is exiting: [chars]`

Explanation	**Recommended Action**
The process manager is exiting.	Ensure that the process manager is not exiting due to an error condition. If it is due to an error condition, collect information requested by the other log messages.

Error Message: `%PMAN-6-PROCSHUT : The process [chars] has shutdown`

Explanation	**Recommended Action**
The process has gracefully shut down.	No user action is necessary. This message is provided for informational purposes only.

Error Message: `%PMAN-6-PROCSTART : The process [chars] has started`

Explanation	**Recommended Action**

The process has launched and is operating properly.	No user action is necessary. This message is provided for informational purposes only.

Error Message: `%PMAN-6-PROCSTATELESS : The process [chars] is restarting stateless`

Explanation	Recommended Action
The process has requested a stateless restart.	No user action is necessary. This message is provided for informational purposes only.

CHAPTER 12

Trace Management

The following sections are included in this chapter:

Tracing Overview

Tracing is a function that logs internal events. Trace files containing trace messages are automatically created and saved to the tracelogs directory on the hard disk: file system on the router, which stores tracing files in bootflash.

The contents of trace files are useful for the following purposes:

- Troubleshooting—Helps to locate and solve an issue with a router. The trace files can be accessed in diagnostic mode even if other system issues are occurring simultaneously.
- Debugging—Helps to obtain a detailed view of system actions and operations.

How Tracing Works

Tracing logs the contents of internal events on a router. Trace files containing all the trace output pertaining to a module are periodically created and updated and stored in the tracelog directory. Trace files can be erased from this directory to recover space on the file system without impacting system performance. The files can be copied to other destinations using file transfer functions (such as FTP and TFTP) and opened using a plain text editor.

Note Tracing cannot be disabled on a router.

Use the following commands to view trace information and set tracing levels:

- **show logging process module**—Shows the most recent trace information for a specific module. This command can be used in privileged EXEC and diagnostic modes. When used in diagnostic mode, this command can gather trace log information during a Cisco IOS XE failure.
- **set platform software trace**—Sets a tracing level that determines the types of messages that are stored in the output. For more information on tracing levels, see Tracing Levels, on page 134.

Tracing Levels

Tracing levels determine how much information should be stored about a module in the trace buffer or file.

The following table shows all the tracing levels that are available and provides descriptions of what types of messages are displayed with each tracing level.

Table 9: Tracing Levels and Descriptions

Tracing Level	Level Number	Description
Emergency	0	The message is regarding an issue that makes the system unusable.
Alert	1	The message is regarding an action that must be taken immediately.
Critical	2	The message is regarding a critical condition. This is the default setting for every module on the router.
Error	3	The message is regarding a system error.
Warning	4	The message is regarding a system warning.
Notice	5	The message is regarding a significant issue, but the router is still working normally.
Informational	6	The message is useful for informational purposes only.
Debug	7	The message provides debug-level output.
Verbose	8	All possible tracing messages are sent.

Tracing Level	Level Number	Description
Noise	—	All possible trace messages pertaining to a module are logged. The noise level is always equal to the highest possible tracing level. Even if a future enhancement to tracing introduces a higher tracing level than verbose level, the noise level will become equal to the level of the newly introduced tracing level.

If a tracing level is set, messages are collected from both lower tracing levels and from its own level.

For example, setting the tracing level to 3 (error) means that the trace file will contain output messages for levels: 0 (emergencies), 1 (alerts), 2 (critical), and 3 (error).

If you set the trace level to 4 (warning), it results in output messages for levels: 0 (emergencies), 1 (alerts), 2 (critical), 3 (error), and 4 (warning).

The default tracing level for every module on the router is 5 (notice).

A tracing level is not set in a configuration mode, which results in tracing-level settings being returned to default values after the router reloads.

Caution Setting the tracing level of a module to debug level or higher can have a negative impact on the performance.

Caution Setting high tracing levels on a large number of modules can severely degrade performance. If a high tracing level is required in a specific context, it is almost always preferable to set the tracing level of a single module to a higher level rather than setting multiple modules to high levels.

Viewing a Tracing Level

By default, all the modules on a router are set to 5 (notice). This setting is maintained unless changed by a user.

To see the tracing level for a module on a router, enter the **show logging process** command in privileged EXEC mode or diagnostic mode.

The following example shows how the **show logging process** command is used to view the tracing levels of the forwarding manager processes on an active RP:

```
Router# showlogging process forwarding-manager rp active
Module Name                     Trace Level
-----------------------------------------------
acl                             Notice
binos                           Notice
binos/brand                     Notice
bipc                            Notice
```

```
bsignal                         Notice
btrace                          Notice
cce                             Notice
cdllib                          Notice
cef                             Notice
chasfs                          Notice
chasutil                        Notice
erspan                          Notice
ess                             Notice
ether-channel                   Notice
evlib                           Notice
evutil                          Notice
file_alloc                      Notice
fman_rp                         Notice
fpm                             Notice
fw                              Notice
icmp                            Notice
interfaces                      Notice
iosd                            Notice
ipc                             Notice
ipclog                          Notice
iphc                            Notice
IPsec                           Notice
mgmte-acl                       Notice
mlp                             Notice
mqipc                           Notice
nat                             Notice
nbar                            Notice
netflow                         Notice
om                              Notice
peer                            Notice
qos                             Notice
route-map                       Notice
sbc                             Notice
services                        Notice
sw_wdog                         Notice
tdl_acl_config_type             Notice
tdl_acl_db_type                 Notice
tdl_cdlcore_message             Notice
tdl_cef_config_common_type      Notice
tdl_cef_config_type             Notice
tdl_dpidb_config_type           Notice
tdl_fman_rp_comm_type           Notice
tdl_fman_rp_message             Notice
tdl_fw_config_type              Notice
tdl_hapi_tdl_type               Notice
tdl_icmp_type                   Notice
tdl_ip_options_type             Notice
tdl_ipc_ack_type                Notice
tdl_IPsec_db_type               Notice
tdl_mcp_comm_type               Notice
tdl_mlp_config_type             Notice
tdl_mlp_db_type                 Notice
tdl_om_type                     Notice
tdl_ui_message                  Notice
tdl_ui_type                     Notice
tdl_urpf_config_type            Notice
tdllib                          Notice
trans_avl                       Notice
uihandler                       Notice
uipeer                          Notice
uistatus                        Notice
urpf                            Notice
vista                           Notice
```

```
wccp                                Notice
```

Setting a Tracing Level

To set a tracing level for a module on a router, or for all the modules within a process on a router, enter the **set platform software trace** command in the privileged EXEC mode or diagnostic mode.

The following example shows the tracing level for the ACL module in the Forwarding Manager of the ESP processor in slot 0 set to `info`:

```
set platform software trace forwarding-manager F0 acl info
```

Viewing the Content of the Trace Buffer

To view the trace messages in the trace buffer or file, enter the **show logging process** command in privileged EXEC or diagnostic mode. In the following example, the trace messages for the Host Manager process in Route Processor slot 0 are viewed using the **show logging process command**:

```
Router# show logging process host-manager R0
08/23 12:09:14.408 [uipeer]: (info): Looking for a ui_req msg
08/23 12:09:14.408 [uipeer]: (info): Start of request handling for con 0x100a61c8
08/23 12:09:14.399 [uipeer]: (info): Accepted connection for 14 as 0x100a61c8
08/23 12:09:14.399 [uipeer]: (info): Received new connection 0x100a61c8 on descriptor 14
08/23 12:09:14.398 [uipeer]: (info): Accepting command connection on listen fd 7
08/23 11:53:57.440 [uipeer]: (info): Going to send a status update to the shell manager in
 slot 0
08/23 11:53:47.417 [uipeer]: (info): Going to send a status update to the shell manager in
 slot 0
```

CHAPTER 13

Environmental Monitoring and PoE Management

The Cisco 1100 Terminal Gateway have hardware and software features that periodically monitor the router's environment. This chapter provides information on the environmental monitoring features on your router that allow you to monitor critical events and generate statistical reports on the status of various router components. This chapter includes the following sections:

Environmental Monitoring

The Cisco 1100 Terminal Gateway provides a robust environment-monitoring system with several sensors that monitor the system temperatures. Microprocessors generate interrupts to the HOST CPU for critical events and generate a periodic status and statistics report. The following are some of the key functions of the environmental monitoring system:

- Monitoring temperature of CPUs, motherboard, and midplane
- Monitoring fan speed
- Recording abnormal events and generating notifications
- Monitoring Simple Network Management Protocol (SNMP) traps
- Generating and collecting Onboard Failure Logging (OBFL) data
- Sending call home event notifications
- Logging system error messages
- Displaying present settings and status

Environmental Monitoring and Reporting Functions

Monitoring and reporting functions allow you to maintain normal system operation by identifying and resolving adverse conditions prior to loss of operation.

- Environmental Monitoring Functions, on page 140

Environmental Monitoring Functions

Environmental monitoring functions use sensors to monitor the temperature of the cooling air as it moves through the chassis.

The local power supplies provide the ability to monitor:

- Input and output current
- Output voltage
- Input and output power
- Temperature
- Fan speed

The router is expected to meet the following environmental operating conditions:

- Operating Temperature Nominal—32°F to 104°F (0°C to 40°C)
- Operating Humidity Nominal—10% to 85% RH noncondensing
- Operating Humidity Short Term—10% to 85% RH noncondensing
- Operating Altitude—Sea level 0 ft to 10,000 ft (0 to 3000 m)
- AC Input Range—85 to 264 VAC

In addition, each power supply monitors its internal temperature and voltage. A power supply is either within tolerance (normal) or out of tolerance (critical). If an internal power supply's temperature or voltage reaches a critical level, the power supply shuts down without any interaction with the system processor.

The following table displays the levels of status conditions used by the environmental monitoring system.

Table 10: Levels of Status Conditions Used by the Environmental Monitoring System

Status Level	Description
Normal	All monitored parameters are within normal tolerance.
Warning	The system has exceeded a specified threshold. The system continues to operate, but operator action is recommended to bring the system back to a normal state.
Critical	An out-of-tolerance temperature or voltage condition exists. Although the system continues to operate, it is approaching shutdown. Immediate operator action is required.

The environmental monitoring system sends system messages to the console, for example, when the conditions described here are met:

Fan Failure

When the system power is on, all the fans should be operational. Although the system continues to operate if a fan fails, the system displays the following message:

```
%IOSXE_PEM-3-FANFAIL: The fan in slot 2/0 is encountering a failure condition
```

Sensors Out of Range

When sensors are out of range, the system displays the following message:

```
%ENVIRONMENTAL-1-ALERT: V: 1.0v PCH, Location: R0, State: Warning, Reading: 1102 mV
```

```
%ENVIRONMENTAL-1-ALERT: V: PEM Out, Location: P1, State: Warning, Reading: 0 mV
```

```
%ENVIRONMENTAL-1-ALERT: Temp: Temp 3, Location R0, State : Warning, Reading : 90C
```

Fan Tray (Slot P2) Removed

When the fan tray for slot P2 is removed, the system displays the following message:

```
%IOSXE_PEM-6-REMPEM_FM: PEM/FM slot P2 removed
```

Fan Tray (Slot P2) Reinserted

When the fan tray for slot P2 is reinserted, the system displays the following message:

```
%IOSXE_PEM-6-INSPEM_FM: PEM/FM slot P2 inserted
```

Fan Tray (Slot 2) is Working Properly

When the fan tray for slot 2 is functioning properly, the system displays the following message:

```
%IOSXE_PEM-6-PEMOK: The PEM in slot P2 is functioning properly
```

Fan 0 in Slot 2 (Fan Tray) is Not Working

When Fan 0 in the fan tray of slot 2 is not functioning properly, the system displays the following message:

```
%IOSXE_PEM-3-FANFAIL: The fan in slot 2/0 is encountering a failure condition
```

Fan 0 in Slot 2 (Fan Tray) is Working Properly

When Fan 0 in the fan tray of slot 2 is functioning properly, the system displays the following message:

```
%IOSXE_PEM-6-FANOK: The fan in slot 2/0 is functioning properly
```

Main Power Supply in Slot 1 is Powered Off

When the main power supply in slot 1 is powered off, the system displays the following message:

```
%IOSXE_PEM-3-PEMFAIL: The PEM in slot 1 is switched off or encountering a
failure condition.
```

Main Power Supply is Inserted in Slot 1

When the main power supply is inserted in slot 1, the system displays the following messages:

```
%IOSXE_PEM-6-INSPEM_FM: PEM/FM slot P1 inserted
%IOSXE_PEM-6-PEMOK: The PEM in slot 1 is functioning properly
```

Temperature and Voltage Exceed Max/Min Thresholds

The following example shows the warning messages indicating the maximum and minimum thresholds of the temperature or voltage:

```
Warnings :
--------
For all the temperature sensors (name starting with “Temp:”) above,
the critical warning threshold is 100C (100C and higher)
the warning threshold is 80C (range from 80C to 99C)
the low warning threshold is 1C (range from -inf to 1C).

For all voltage sensors (names starting with "V:"),
the high warning threshold starts at that voltage +10%. (voltage + 10% is warning)
the low warning threshold starts at the voltage -10%. (voltage - 10% is warning)
```

Environmental Reporting Functions

You can retrieve and display environmental status reports using the following commands:

- **debug environment**
- **debug platform software cman env monitor polling**
- **debug ilpower**
- **debug power** [**inline** | **main**]
- **show diag all eeprom**
- **show diag slot R0 eeprom detail**
- **show environment**
- **show environment all**
- **show inventory**
- **show platform all**
- **show platform diag**
- **show platform software status control-processor**
- **show version**
- **show power**
- **show power inline**

These commands show the current values of parameters such as temperature and voltage.

The environmental monitoring system updates the values of these parameters every 60 seconds. Brief examples of these commands are shown below:

debug environment: Example

```
Router# debug environment location P0
Environmental sensor Temp: Temp 1 P0 debugging is on
Environmental sensor Temp: Temp 2 P0 debugging is on
Environmental sensor Temp: Temp 3 P0 debugging is on
Environmental sensor V: PEM Out P0 debugging is on
Environmental sensor I: PEM In P0 debugging is on
Environmental sensor I: PEM Out P0 debugging is on
Environmental sensor W: In pwr P0 debugging is on
Environmental sensor W: Out pwr P0 debugging is on
Environmental sensor RPM: fan0 P0 debugging is on
```

```
*Sep 12 00:45:13.956: Sensor: Temp: Temp 1 P0, In queue 1
*Sep 12 00:45:13.956: State=Normal Reading=29
*Sep 12 00:45:13.956: Rotation count=0 Poll period=60000
*Sep 12 00:45:13.956: Sensor: Temp: Temp 1 P0 State=Normal Reading=29
*Sep 12 00:45:13.956: Inserting into queue 1 on spoke 173.
*Sep 12 00:45:13.956: Rotation count=60 Displacement=0
*Sep 12 00:45:13.956: Sensor: Temp: Temp 2 P0, In queue 1
*Sep 12 00:45:13.956: State=Normal Reading=33
*Sep 12 00:45:13.956: Rotation count=0 Poll period=60000
*Sep 12 00:45:13.956: Sensor: Temp: Temp 2 P0 State=Normal Reading=34
*Sep 12 00:45:13.956: Inserting into queue 1 on spoke 173.
*Sep 12 00:45:13.956: Rotation count=60 Displacement=0
*Sep 12 00:45:13.956: Sensor: Temp: Temp 3 P0, In queue 1
*Sep 12 00:45:13.956: State=Normal Reading=34
*Sep 12 00:45:13.956: Rotation count=0 Poll period=60000
*Sep 12 00:45:13.956: Sensor: Temp: Temp 3 P0 State=Normal Reading=35
*Sep 12 00:45:13.956: Inserting into queue 1 on spoke 173.
*Sep 12 00:45:13.956: Rotation count=60 Displacement=0
*Sep 12 00:45:13.956: Sensor: V: PEM Out P0, In queue 1
*Sep 12 00:45:13.956: State=Normal Reading=12709
*Sep 12 00:45:13.956: Rotation count=0 Poll period=60000
*Sep 12 00:45:13.956: Sensor: V: PEM Out P0 State=Normal Reading=12724
*Sep 12 00:45:13.956: Inserting into queue 1 on spoke 173.
*Sep 12 00:45:13.956: Rotation count=60 Displacement=0
*Sep 12 00:45:13.956: Sensor: I: PEM In P0, In queue 1
*Sep 12 00:45:13.956: State=Normal Reading=1
*Sep 12 00:45:13.956: Rotation count=0 Poll period=60000
*Sep 12 00:45:13.956: Sensor: I: PEM In P0 State=Normal Reading=1
*Sep 12 00:45:13.956: Inserting into queue 1 on spoke 173.
*Sep 12 00:45:13.956: Rotation count=60 Displacement=0
*Sep 12 00:45:13.956: Sensor: I: PEM Out P0, In queue 1
*Sep 12 00:45:13.956: State=Normal Reading=4
*Sep 12 00:45:13.956: Rotation count=0 Poll period=60000
*Sep 12 00:45:13.956: Sensor: I: PEM Out P0 State=Normal Reading=4
*Sep 12 00:45:13.956: Inserting into queue 1 on spoke 173.
*Sep 12 00:45:13.956: Rotation count=60 Displacement=0
*Sep 12 00:45:13.956: Sensor: W: In pwr P0, In queue 1
*Sep 12 00:45:13.956: State=Normal Reading=92
*Sep 12 00:45:13.956: Rotation count=0 Poll period=60000
*Sep 12 00:45:13.956: Sensor: W: In pwr P0 State=Normal Reading=92
*Sep 12 00:45:13.956: Inserting into queue 1 on spoke 173.
*Sep 12 00:45:13.956: Rotation count=60 Displacement=0
*Sep 12 00:45:13.956: Sensor: W: Out pwr P0, In queue 1
*Sep 12 00:45:13.956: State=Normal Reading=46
*Sep 12 00:45:13.956: Rotation count=0 Poll period=60000
*Sep 12 00:45:13.956: Sensor: W: Out pwr P0 State=Normal Reading=46
*Sep 12 00:45:13.956: Inserting into queue 1 on spoke 173.
*Sep 12 00:45:13.956: Rotation count=60 Displacement=0
*Sep 12 00:45:13.956: Sensor: RPM: fan0 P0, In queue 1
*Sep 12 00:45:13.956: State=Normal Reading=3192
*Sep 12 00:45:13.956: Rotation count=0 Poll period=60000
*Sep 12 00:45:13.956: Sensor: RPM: fan0 P0 State=Normal Reading=3180
*Sep 12 00:45:13.956: Inserting into queue 1 on spoke 173.
*Sep 12 00:45:13.956: Rotation count=60 Displacement=0
```

debug platform software cman env monitor polling: Example

```
Router# debug platform software cman env monitor polling
platform software cman env monitor polling debugging is on
Router#
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback Temp: Temp 1, P0, 29
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback Temp: Temp 2, P0, 34
```

```
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback Temp: Temp 3, P0, 35
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback V: PEM Out, P0, 12709
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback I: PEM In, P0, 1
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback I: PEM Out, P0, 4
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback W: In pwr, P0, 93
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback W: Out pwr, P0, 48
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback RPM: fan0, P0, 3192
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback Temp: Temp 1, P1, 33
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback Temp: Temp 2, P1, 32
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback Temp: Temp 3, P1, 36
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback V: PEM Out, P1, 12666
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback I: PEM In, P1, 1
*Sep 12 00:46:13.962: IOS-RP-ENVMON: sensor READ callback I: PEM Out, P1, 4
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback W: In pwr, P1, 55
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback W: Out pwr, P1, 46
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback RPM: fan0, P1, 2892
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback RPM: fan0, P2, 4894
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback RPM: fan1, P2, 4790
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback RPM: fan2, P2, 5025
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback RPM: fan3, P2, 5001
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback W: fan pwr, P2, 8
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback Temp: Inlet 1, R0, 25
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback Temp: Inlet 2, R0, 28
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback Temp: Outlet 1, R0, 30
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback Temp: Outlet 2, R0, 35
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 12v, R0, 12735
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 5v, R0, 5125
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 3.3v, R0, 3352
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 1.05v, R0, 1052
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 2.5v, R0, 0
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 1.8v, R0, 0
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 1.2v, R0, 0
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 1.15v, R0, 0
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 1.1v, R0, 0
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 1.0v, R0, 0
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 1.8v PCH, R0, 1787
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 1.5v PCH, R0, 1516
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 1.5v CPUC, R0, 1526
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 1.5v CPUI, R0, 1529
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 1.0v PCH, R0, 1009
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 1.5v QLM, R0, 0
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: VCore, R0, 0
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: VTT, R0, 0
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 0.75v CPUI, R0, 0
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback V: 0.75v CPUC, R0, 0
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback I: 12v, R0, 7
*Sep 12 00:46:13.963: IOS-RP-ENVMON: sensor READ callback W: pwr, R0, 81
```

debug ilpower: Example

```
Router# debug ilpower ?
  cdp         ILPOWER CDP messages
  controller  ILPOWER controller
  event       ILPOWER event
  ha          ILPOWER High-Availability
  port        ILPOWER port management
  powerman    ILPOWER powerman
  registries  ILPOWER registries
  scp         ILPOWER SCP messages
  upoe        ILPOWER upoe
```

debug power [inline|main]: Example

In this example, there is one 1000W power supply and one 450W power supply. Inline and main power output is shown.

```
Router# debug power ?
  inline  ILPM inline power related
  main    Main power related
  <cr>    <cr>
Router# debug power
POWER all debug debugging is on

Router# show debugging | include POWER
POWER:
POWER main debugging is on
POWER inline debugging is on
Router#
..
*Jan 21 01:29:40.786: %ENVIRONMENTAL-6-NOTICE: V: PEM Out, Location: P1, State: Warning,
Reading: 0 mV
*Jan 21 01:29:43.968: %IOSXE_PEM-6-PEMOK: The PEM in slot P1 is functioning properly
*Jan 21 01:29:43.968: %PLATFORM_POWER-6-MODEMATCH: Main power is in Boost mode
*Jan 21 01:29:43.968: Power M: Received Msg for 12V/Main, total power 1450, Run same as cfg
 Yes
*Jan 21 01:29:43.968: Power M: Received Msg for POE/ILPM, total power 500, Run same as cfg
 No
*Jan 21 01:29:43.968: Power I: Updating pool power is 500 watts
*Jan 21 01:29:43.968: Power I: Intimating modules of total power 500 watts
*Jan 21 01:29:46.488: Power M: Received Msg for 12V/Main, total power 1450, Run same as cfg
 Yes
*Jan 21 01:29:46.488: Power M: Received Msg for POE/ILPM, total power 500, Run same as cfg
 No
*Jan 21 01:29:46.488: Power I: Updating pool power is 500 watts
*Jan 21 01:29:46.488: Power I: Intimating modules of total power 500 watts
Router#
```

show diag all eeprom: Example

```
Router# show diag all eepromMIDPLANE EEPROM data:

        Product Identifier (PID) : C1100TG-1N24P32A
        Version Identifier (VID) : V01
        PCB Serial Number        : PSZ23461DXT
        Hardware Revision        : 1.0
        CLEI Code                : TBD
Slot R0 EEPROM data:

        Product Identifier (PID) : C1100TG-1N24P32A
        Version Identifier (VID) : V01
        PCB Serial Number        : PSZ23461DXT
        Hardware Revision        : 1.0
        CLEI Code                : TBD
Slot F0 EEPROM data:

        Product Identifier (PID) : C1100TG-1N24P32A
        Version Identifier (VID) : V01
        PCB Serial Number        : PSZ23461DXT
        Hardware Revision        : 1.0
        CLEI Code                : TBD
Slot 0 EEPROM data:
        Product Identifier (PID) : C1100TG-1N24P32A
        Version Identifier (VID) : V01
        PCB Serial Number        : PSZ23461DXT
        Hardware Revision        : 1.0
        CLEI Code                : TBD
SPA EEPROM data for subslot 0/0:

        Product Identifier (PID) : C1100TG-2x1GE
        Version Identifier (VID) : V01
        PCB Serial Number        :
        Top Assy. Part Number    : 68-2236-01
        Top Assy. Revision       : A0
        Hardware Revision        : 2.2
        CLEI Code                : CNUIAHSAAA
SPA EEPROM data for subslot 0/1:

        Product Identifier (PID) : C1100TG-A-48
        Version Identifier (VID) : V01
        PCB Serial Number        :
        Top Assy. Part Number    : 68-2236-01
        Top Assy. Revision       : A0
        Hardware Revision        : 2.2
        CLEI Code                : CNUIAHSAAA
SPA EEPROM data for subslot 0/2:

        Product Identifier (PID) : C1100TG-ES-24
        Version Identifier (VID) : V01
        PCB Serial Number        :
        Top Assy. Part Number    : 68-2236-01
        Top Assy. Revision       : A0
        Hardware Revision        : 2.2
        CLEI Code                : CNUIAHSAAA
SPA EEPROM data for subslot 0/3:

        Product Identifier (PID) : NIM-16A
        Version Identifier (VID) : V02
        PCB Serial Number        : DNI230206GP
        Hardware Revision        : 1.0
        CLEI Code                : IPUCBNSBAB
SPA EEPROM data for subslot 0/4 is not available

SPA EEPROM data for subslot 0/5 is not available
```

show environment: Example

In this example, note the output for the slots POE0 and POE1.

```
Router# show environment

Number of Critical alarms: 0
Number of Major alarms: 0
Number of Minor alarms: 0

Slot Sensor Current State Reading
---- ------ ------------- -------
P0 Temp: Temp 1 Normal 28 Celsius
P0 Temp: Temp 2 Normal 43 Celsius
P0 Temp: Temp 3 Normal 44 Celsius
P0 V: PEM Out Normal 12404 mV
P0 I: PEM In Normal 1 A
P0 I: PEM Out Normal 7 A
P0 P: In pwr Normal 106 Watts
```

```
P0 P: Out pwr Normal 87 Watts
P0 RPM: fan0 Normal 2952 RPM
P2 RPM: fan0 Normal 4421 RPM
P2 RPM: fan1 Normal 4394 RPM
P2 RPM: fan2 Normal 4433 RPM
P2 RPM: fan3 Normal 4410 RPM
P2 P: pwr Normal 6 Watts
POE0 Temp: Temp 1 Normal 44 Celsius
POE0 I: 12v In Normal 2 A
POE0 V: 12v In Normal 12473 mV
POE0 P: In pwr Normal 25 Watts
POE1 Temp: Temp 1 Normal 40 Celsius
POE1 I: 12v In Normal 2 mA
POE1 V: 12v In Normal 12473 mV
POE1 P: In pwr Normal 20 Watts
R0 Temp: Inlet 1 Normal 24 Celsius
R0 Temp: Inlet 2 Normal 26 Celsius
R0 Temp: Outlet 1 Normal 33 Celsius
R0 Temp: Outlet 2 Normal 32 Celsius
R0 Temp: core-B Normal 43 Celsius
R0 Temp: core-C Normal 38 Celsius
R0 V: 12v Normal 12355 mV
R0 V: 5v Normal 5090 mV
R0 V: 3.3v Normal 3331 mV
R0 V: 3.0v Normal 2998 mV
R0 V: 2.5v Normal 2436 mV
R0 V: 1.05v Normal 1049 mV
R0 V: 1.8v Normal 1798 mV
R0 V: 1.2v Normal 1234 mV
R0 V: Vcore-C Normal 1155 mV
R0 V: 1.1v Normal 1104 mV
R0 V: 1.0v Normal 1012 mV
R0 V: 1.8v-A Normal 1782 mV
R0 V: 1.5v-A Normal 1505 mV
R0 V: 1.5v-C1 Normal 1516 mV
R0 V: 1.5v-B Normal 1511 mV
R0 V: Vcore-A Normal 1099 mV
R0 V: 1.5v-C2 Normal 1492 mV
R0 V: Vcore-B1 Normal 891 mV
R0 V: Vcore-B2 Normal 904 mV
R0 V: 0.75v-B Normal 754 mV
R0 V: 0.75v-C Normal 759 mV
R0 I: 12v Normal 8 A
R0 P: pwr Normal 86 Watts
0/1 P: pwr Normal 5 Watts
P1 Temp: Temp 1 Normal 30 Celsius
P1 Temp: Temp 2 Normal 38 Celsius
P1 Temp: Temp 3 Normal 39 Celsius
P1 V: PEM Out Normal 12404 mV
P1 I: PEM In Normal 1 A
P1 I: PEM Out Normal 6 A
P1 P: In pwr Normal 86 Watts
P1 P: Out pwr Normal 68 Watts
P1 RPM: fan0 Normal 2940 RPM
```

show environment all: Example

```
Router# show environment all
Sensor List:  Environmental Monitoring
 Sensor           Location          State             Reading
 RPM: fan1        P2                Normal            6660 RPM
 RPM: fan2        P2                Normal            6600 RPM
 RPM: fan3        P2                Normal            6600 RPM
 Temp: Inlet 1    R0                Normal            26 Celsius
 Temp: Outlet 1   R0                Normal            32 Celsius
 Temp: CPU        R0                Normal            35 Celsius
 V: 12v           R0                Normal            11763 mV
 V: 5v            R0                Normal            5058 mV
 V: 3.3v_MCU      R0                Normal            3356 mV
 V: 3.3v_STBY     R0                Normal            3303 mV
 V: 2.5v          R0                Normal            2493 mV
 V: 1.8v_STBY     R0                Normal            1808 mV
 V: 1.8v_FPGA     R0                Normal            1795 mV
 V: 1.24v         R0                Normal            1246 mV
 V: 1.2v_VDDQ     R0                Normal            1211 mV
 V: 1.2v_MGT      R0                Normal            1196 mV
 V: 1.2v_DB       R0                Normal            1208 mV
 V: 1.05v         R0                Normal            1046 mV
 V: 1.02v_ETH     R0                Normal            1026 mV
 V: 1.0v_PVNN     R0                Normal            831 mV
 V: 1.0v_PVCC     R0                Normal            994 mV
 V: 1.0v_PVCCP    R0                Normal            998 mV
 V: 1.0v_FPGA     R0                Normal            997 mV
 V: 1.0v_MGT      R0                Normal            1010 mV
 V: 1.0v_DB       R0                Normal            1007 mV
 V: 0.6v          R0                Normal            605 mV
```

show inventory: Example

```
Router# show inventory

+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
INFO: Please use "show license UDI" to get serial number for licensing.
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

NAME: "Chassis", DESCR: "Cisco C1100TG-1N24P32A terminal server"
PID: C1100TG-1N24P32A  , VID: V01  , SN: PSZ23461E0E

NAME: "Fan Tray", DESCR: "Cisco C1100TG-1N24P32A, C1100TGX-1N24P32A Fan Assembly"
PID: C1100TG-FANASSY2  , VID:      , SN:

NAME: "module 0", DESCR: "Cisco C1100TG-1N24P32A Built-In NIM controller"
PID: C1100TG-1N24P32A  , VID:      , SN:

NAME: "NIM subslot 0/1", DESCR: "48 ports Async Lite Serial"
PID: C1100TG-A-48      , VID: V01  , SN:

NAME: "NIM subslot 0/2", DESCR: "C1100TG-ES-24"
PID: C1100TG-ES-24     , VID: V01  , SN:

NAME: "NIM subslot 0/3", DESCR: "16 ports Async Serial NIM"
PID: NIM-16A           , VID: V02  , SN: DNI230206GP

NAME: "NIM subslot 0/0", DESCR: "Front Panel 2 ports Gigabitethernet Module"
PID: C1100TG-2x1GE     , VID: V01  , SN:

NAME: "module R0", DESCR: "Cisco C1100TG-1N24P32A Route Processor"
PID: C1100TG-1N24P32A  , VID: V01  , SN: PSZ23461DXT

NAME: "module F0", DESCR: "Cisco C1100TG-1N24P32A Forwarding Processor"
PID: C1100TG-1N24P32A  , VID:      , SN:
```

show platform: Example

```
Router# show platform
Chassis type: C1100TG-1N24P32A

Slot      Type                State                 Insert time (ago)
--------- ------------------- --------------------- -----------------
0         C1100TG-1N24P32A    ok                    1w0d
 0/0      C1100TG-2x1GE       ok                    1w0d
 0/1      C1100TG-A-48        ok                    1w0d
 0/2      C1100TG-ES-24       ok                    1w0d
 0/3      NIM-16A             ok                    1w0d
R0        C1100TG-1N24P32A    ok, active            1w0d
F0        C1100TG-1N24P32A    ok, active            1w0d
P0        PWR-12V             empty                 never
P2        C1100TG-FANASSY     ok                    1w0d

Slot      CPLD Version        Firmware Version
--------- ------------------- ---------------------------------------
0         2004172A            17.2.1, 1913f73a
R0        2004172A            17.2.1, 1913f73a
F0        2004172A            17.2.1, 1913f73a
```

show platform diag: Example

```
Router# show platform diag
Chassis type: C1100TG-1N24P32A

Slot: 0, C1100TG-1N24P32A
  Running state               : ok
  Internal state              : online
  Internal operational state  : ok
  Physical insert detect time : 00:00:45 (1w0d ago)
  Software declared up time   : 00:01:28 (1w0d ago)
  CPLD version                : 2004172A
  Firmware version            : 17.2.1, 1913f73a

Sub-slot: 0/0, C1100TG-2x1GE
  Operational status          : ok
  Internal state              : inserted
  Physical insert detect time : 00:02:09 (1w0d ago)
  Logical insert detect time  : 00:02:09 (1w0d ago)

Sub-slot: 0/1, C1100TG-A-48
  Operational status          : ok
  Internal state              : inserted
  Physical insert detect time : 00:02:09 (1w0d ago)
  Logical insert detect time  : 00:02:09 (1w0d ago)

Sub-slot: 0/2, C1100TG-ES-24
  Operational status          : ok
  Internal state              : inserted
  Physical insert detect time : 00:02:09 (1w0d ago)
  Logical insert detect time  : 00:02:09 (1w0d ago)

Sub-slot: 0/3, NIM-16A
  Operational status          : ok
  Internal state              : inserted
  Physical insert detect time : 00:04:12 (1w0d ago)
  Logical insert detect time  : 00:04:12 (1w0d ago)

Slot: R0, C1100TG-1N24P32A
  Running state               : ok, active
  Internal state              : online
  Internal operational state  : ok
  Physical insert detect time : 00:00:45 (1w0d ago)
  Software declared up time   : 00:00:45 (1w0d ago)
  CPLD version                : 2004172A
  Firmware version            : 17.2.1, 1913f73a

Slot: F0, C1100TG-1N24P32A
  Running state               : ok, active
  Internal state              : online
  Internal operational state  : ok
  Physical insert detect time : 00:00:45 (1w0d ago)
  Software declared up time   : 00:01:24 (1w0d ago)
  Hardware ready signal time  : 00:01:17 (1w0d ago)
  Packet ready signal time    : 00:01:32 (1w0d ago)
  CPLD version                : 2004172A
  Firmware version            : 17.2.1, 1913f73a

Slot: P0, PWR-12V
  State                       : empty
  Physical insert detect time : 00:00:00 (never ago)

Slot: P2, C1100TG-FANASSY
  State                       : ok
  Physical insert detect time : 00:01:15 (1w0d ago)
```

show platform software status control-processor: Example

```
Router# show platform software status control-processor
RP0: online, statistics updated 10 seconds ago
Load Average: healthy
  1-Min: 0.53, status: healthy, under 5.00
  5-Min: 0.90, status: healthy, under 5.00
  15-Min: 0.87, status: healthy, under 5.00
Memory (kb): healthy
  Total: 3884836
  Used: 1976928 (51%), status: healthy
  Free: 1907908 (49%)
  Committed: 3165956 (81%), under 90%
Per-core Statistics
CPU0: CPU Utilization (percentage of time spent)
  User:  2.10, System:  2.20, Nice:  0.00, Idle: 95.69
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU1: CPU Utilization (percentage of time spent)
  User:  2.80, System:  2.60, Nice:  0.00, Idle: 94.50
  IRQ:  0.00, SIRQ:  0.10, IOwait:  0.00
CPU2: CPU Utilization (percentage of time spent)
  User:  1.90, System:  2.10, Nice:  0.00, Idle: 96.00
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
CPU3: CPU Utilization (percentage of time spent)
  User: 10.12, System:  0.60, Nice:  0.00, Idle: 89.27
  IRQ:  0.00, SIRQ:  0.00, IOwait:  0.00
```

show diag slot R0 eeprom detail: Example

```
Router# show diag slot R0 eeprom detail
Slot R0 EEPROM data:
        EEPROM version           : 4
        Compatible Type          : 0xFF
        PCB Serial Number        : PSZ23461DXT
        Controller Type          : 3500
        Hardware Revision        : 1.0
        Top Assy. Part Number    : 74-122798-03
        Board Revision           : 02
        Deviation Number         : 0
        Fab Version              : 03
        Product Identifier (PID) : C1100TG-1N24P32A
        Version Identifier (VID) : V01
        CLEI Code                : TBD
        Processor type           : D0
        Chassis Serial Number    : PSZ23461E0E
        Chassis MAC Address      : 70c9.c686.2f00
        MAC Address block size   : 64
        Manufacturing Test Data  : 00 00 00 00 00 00 00 00
        Asset ID                 :
```

show version: Example

```
Router# show version

Cisco IOS XE Software, Version BLD_POLARIS_DEV_LATEST_20200506_055739
Cisco IOS Software [Amsterdam], ISR Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Experimental
 Version 17.4.20200506:061234
[S2C-build-polaris_dev-112576-/nobackup/mcpre/BLD-BLD_POLARIS_DEV_LATEST_20200506_055739
121]
Copyright (c) 1986-2020 by Cisco Systems, Inc.
Compiled Wed 06-May-20 06:31 by mcpre


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GPL code under the terms of GPL Version 2.0.  For more details, see the
documentation or "License Notice" file accompanying the IOS-XE software,
or the applicable URL provided on the flyer accompanying the IOS-XE
software.


ROM: (c)

RSBL uptime is 1 week, 23 hours, 48 minutes
Uptime for this control processor is 1 week, 23 hours, 50 minutes
System returned to ROM by Reload Command
System image file is
"bootflash:c1100tg-universalk9.BLD_POLARIS_DEV_LATEST_20200506_055739.SSA.bin"
Last reload reason: Reload Command



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.



Suite License Information for Module:'esg'

--------------------------------------------------------------------------------
Suite                 Suite Current         Type           Suite Next reboot
--------------------------------------------------------------------------------

Technology Package License Information:

-----------------------------------------------------------------
Technology    Technology-package           Technology-package
              Current       Type           Next reboot
------------------------------------------------------------------
appxk9           None             Smart License    None
securityk9       None             Smart License    None
ipbase           ipbasek9         Smart License    ipbasek9

The current throughput level is 500000 kbps


Smart Licensing Status: UNREGISTERED/No Licenses in Use

cisco C1100TG-1N24P32A (1RU) processor with 1383987K/6147K bytes of memory.
Processor board ID PSZ23461E0E
Router operating mode: Autonomous
1 Virtual Ethernet interface
26 Gigabit Ethernet interfaces
64 terminal lines
8192K bytes of non-volatile configuration memory.
4194304K bytes of physical memory.
6565887K bytes of flash memory at bootflash:.

Configuration register is 0x2102
```

CHAPTER 14

Factory Reset

This chapter describes Factory Reset feature and how it can be used to protect or restore a router to an earlier, fully functional state.

Feature Information for Factory Reset

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 https://cfnng.cisco.com/. An account on Cisco.com is not required.

Table 11: Feature Information for VxLAN Static Routing

Feature Name	Releases	Feature Information
Factory Reset	Cisco IOS XE Everest 16.6.1	This feature was introduced.
factory-reset all secure	Cisco IOS XE Amsterdam 17.2.1	Added the **factory-reset all secure** command.

Information About Factory Reset

The factory reset is a process of clearing the current running and startup configuration information on a router, and resetting the router to an earlier, fully functional state. From Cisco IOS XE Amsterdam XE 17.2 and later, you can use the **factory-reset all secure** command to reset the router and securely clear the files stored in the bootflash memory.

Table 12: Table 1 covers details of data erased or retained during the factory reset process:

Data Erased	Data Retained
Non-volatile random-access memory (NVRAM) data	Data from remote field-replaceable units (FRUs).
OBFL (Onboard Failure Logging) logs	Value of configuration register
Licenses	Contents of USB
User data, startup, and running configuration	Credentials (Secure Unique Device Identifier [SUDI] certificates, public key infrastructure (PKI) keys, and FIPS-related keys)
ROMMON variables	
All writable file systems and personal data. **Note** If the current boot image is a remote image or stored on a USB, NIM-SSD, or such, ensure that you take a backup of the image before starting the factory reset process.	

After the factory reset process is complete, the router reboots to ROMMON mode. If you have the zero-touch provisioning (ZTP) capability setup, after the router completes the factory reset procedure, the router reboots with ZTP configuration.

Prerequisites for Performing Factory Reset

- Ensure that all the software images, configurations and personal data is backed up before performing the factory reset operation.
- Ensure that there’s uninterrupted power supply when the feature reset process is in progress.
- When you execute the factory reset operation with the secure option, it does not save the boot image, even if the image is stored locally. The **factory-reset all secure** command erases all the files. If the current boot image is a remote image or stored on a USB, NIM-SSD, or such, ensure that you take a backup of the image before starting the factory reset process.
- Ensure that ISSU/ISSD (In- Service Software Upgrade or Downgrade) is not in progress before starting the factory reset process.

Restrictions for Performing a Factory Reset

- Any software patches that are installed on the router are not restored after the factory reset operation.
- If the factory reset command is issued through a Virtual Teletype (VTY) session, the session is not restored after the completion of the factory reset process.

When to Perform Factory Reset

- Return Material Authorization (RMA): If a router is returned back to Cisco for RMA, it is important that all sensitive information is removed.
- Router is Compromised: If the router data is compromised due to a malicious attack, the router must be reset to factory configuration and then reconfigured once again for further use.
- Repurposing: The router needs to be moved to a new topology or market from the existing site to a different site.

How to Perform a Factory Reset

Step 1 Log in to a Cisco 1100 Terminal Server Gateway.

Important If the current boot image is a remote image or is stored in a USB or a NIM-SSD, ensure that you take a backup of the image before starting the factory reset process.

Step 2 Execute either the **factory-reset all secure 3-pass** or **factory-reset all secure 7-pass** command.

The system displays the following message when you use the **factory-reset all secure 3-pass** command:

```
Router# factory-reset all secure 3-pass

The factory reset operation is irreversible for securely reset all. Are you sure? [confirm]
This operation may take hours. Please do not power cycle.

*Jun 19 00:53:33.385: %SYS-5-RELOAD: Reload requested by Exec. Reload Reason: Factory Reset.Jun 19
00:53:42.856: %PMAN-5-EXITACTION:

Enabling factory reset for this reload cycle
  Jun 19 00:54:06.914: Factory reset secure operation. Write 0s. Please do not power cycle.
  Jun 19 01:18:36.040: Factory reset secure operation. Write 1s. Please do not power cycle.
  Jun 19 01:43:49.263: Factory reset secure operation. Write random. Please do not power cycle.
  Jun 19 02:40:29.770: Factory reset secure operation completed.
Initializing Hardware ....
```

The system displays the following message when you use the **factory-reset all secure 7-pass** command:

```
Router# factory-reset all secure 7-pass

The factory reset operation is irreversible for securely reset all. Are you sure? [confirm]
This operation may take hours. Please do not power cycle.

*Apr 25 12:36:29.281: %SYS-5-RELOAD: Reload requested by Exec. Reload Reason: Factory Reset.Apr 25
12:36:59.275: Factory reset secure operation. Write 0s.   Apr 25 12:40:48.143: Factory reset secure
 operation. Write 1s.
  Apr 25 12:44:54.977: Factory reset secure operation. Write random. Please do not power cycle.
  Apr 25 13:02:00.424: Factory reset secure operation. Write random. Please do not power cycle.
  Apr 25 13:19:02.930: Factory reset secure operation. Write 0s. Please do not power cycle.
  Apr 25 13:22:56.965: Factory reset secure operation. Write 1s. Please do not power cycle.
  Apr 25 13:27:05.775: Factory reset secure operation. Write random. Please do not power cycle.
  Apr 25 13:44:11.174: Factory reset secure operation completed.
Both copies of Nvram are corrupted.
```

Step 3 Enter **confirm** to proceed with the factory reset.

Note The duration of the factory reset process depends on the storage size of the router. It can extend between 30 minutes and up to 3 hours on a high availability setup. If you want to quit the factory reset process, press the **Escape** key.

What Happens after a Factory Reset

After the factory reset is successfully completed, the router boots up. However, before the factory reset process started, if the configuration register was set to manually boot from ROMMON, the router stops at ROMMON.

After you configure Smart Licensing, execute the **#show license status** command, to check whether Smart Licensing is enabled for your instance.

Note If you had Specific License Reservation enabled before you performed the factory reset, use the same license and enter the same license key that you received from the smart agent.

CHAPTER 15

Configuring Cisco C1100TG-A-48 or C1100TG-A-32 Serial Port Module on Cisco 1100 Terminal Gateway

This document provides information on how to configure the Cisco C1100TG-A-48 or C1100TG-A-32 Serial port module on Cisco 1100 Terminal Gateway. This chapter contains the following sections:

Configuring Cisco C1100TG-A-48 or C1100TG-A-32 as a Terminal Server

It provides console level access to multiple Cisco devices for remote configuration and management.

The Cisco C1100TG-A-48 or C1100TG-A-32 modules are used to provide out of band connectivity to the console ports of other devices. On the Cisco C1100TG-A-48 or C1100TG-A-32 async modules, the interfaces are addressed as `interface async <slot/subslot/port>`.

Prerequisites for Configuring Cisco C1100TG-A-48 or C1100TG-A-32 as a Terminal Server

You must have privileged EXEC access to the router's command line interface (CLI). For more information on using the command line and for understanding command modes, see Using Cisco IOS Software.

For instructions on connecting a console to your router, refer to the documentation that accompanied your router, or refer to the online documentation for your equipment.

How to Configure Cisco C1100TG-A-48 or C1100TG-A-32 as a Terminal Server

Perform the following steps to configure. In the below mentioned configuration steps a basic terminal server function is configured using default parameters.

1. From privileged EXEC mode, enter the configure command.

   router#**configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

2. router(config)#**ip vrf Mgmt-intf**

   !--- If not done already, create management vrf globally (in this example vrf Mgmt-intf)

3. router(config-vrf)#**interface GigabitEthernet0**

4. router(config-if)#**vrf forwarding Mgmt-intf**

   !--- Assign interface GigabitEthernet0 to vrf Mgmt-intf

5. router(config-if)#**ip address 10.75.163.95 255.255.255.0**

   !--- Use a public IP address to ensure connectivity

6. router(config-if)#**ip route vrf Mgmt-intf 0.0.0.0 0.0.0.0 10.75.163.1**

   !--- configure correct route to gateway in vrf Mgmt-intf

7. router(config)#**line 0/1/0**

   !--- switch to Line configuration mode for asynchronous port configuration

8. router(config-line)#**transport input all**

   !--- Defines the protocols to use when connecting to a specific line of the device. In this case all protocols (default)

9. router(config-line)#**no exec**

   !--- Allow an outgoing connection only

Optional Parameters

transport input all [databits] [parity] [speed]

[databits]	Sets the number of data bits per character that are interpreted and generated by the router hardware.
[parity]	Sets terminal parity. Need to sync with device console.
[speed]	Sets the transmit and receive speeds. Need to sync with device console.

Verification and Troubleshooting

Use the following show commands for the verification:

```
router#show running-config
Building configuration...
...

!--- Lines omitted for brevity

ip vrf Mgmt-intf
!
!
interface GigabitEthernet0
 ip vrf forwarding Mgmt-intf
 ip address 10.75.163.95 255.255.255.0
!
ip route vrf Mgmt-intf 0.0.0.0 0.0.0.0 10.75.163.1
!
line 0/1/0
 transport input all
no exec
!
end
```

Command Summary

The following commands are explained:

- transport input
- databits
- parity
- speed

transport input

Defines the protocols that needs to be used when connecting to the terminal server.

transport input {all | lat | mop | nasi | none | pad | rlogin | ssh | telnet | udptn}

Syntax Description

all	All protocols
lat	DEC LAT protocol
mop	DEC MOP Remote Console Protocol
nasi	NASI protocol
none	No protocols
pad	X.3 PAD
rlogin	Unix rlogin protocol
ssh	TCP/IP SSH protocol
telnet	TCP/IP Telnet protocol
udptn	UDPTN async via UDP protocol

databits

Sets the number of data bits per character that are interpreted and generated by the router hardware. To restore the default value, use the **no** form of the command.

databits {5 | 6 | 7 | 8}

no databits

Syntax Description

5	Five data bits per character.
6	Six data bits per character.
7	Seven data bits per character.
8	Eight data bits per character (default).

Usage Guideline: You need to sync between Device Console line and Terminal Server TTY line.

Note Only 7 and 8 data bits work.

parity

Defines generation of a parity bit. To specify no parity, use the no form of this command.

parity {none | even | odd | space | mark}

no parity

Syntax Description

none	No parity (Default)
even	Even parity
odd	Odd parity
space	Space parity
mark	Mark parity

Usage Guideline: Need to sync between Device Console line and Terminal Server TTY line.

speed

Sets the transmit and receive speed.

Syntax Description

<0-4294967295>	Baud rate in bits per second (bps).

Default speed is 9600.

Usage Guideline: Need to sync between Device Console line and Terminal Server TTY line.

show line

Use **show line** command to check all the TTY line summary information. The output contains information about mapping between async interface and line number, the line speed, uses, noise and so on. The line that begins with the asterisk "*" indicates that the line is in use.

```
Router#show  line
   Tty Line Typ     Tx/Rx    A Modem  Roty AccO AccI  Uses  Noise Overruns  Int
*     0    0 CTY              -    -      -    -    -     0      0    0/0      -
      1    1 AUX   9600/9600  -    -      -    -    -     0      0    0/0      -
* 0/1/0    2 TTY   9600/9600  -    -      -    -    -     1      7    0/0      -
  0/1/1    3 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
  0/1/2    4 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
  0/1/3    5 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
  0/1/4    6 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
  0/1/5    7 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
  0/1/6    8 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
  0/1/7    9 TTY   9600/9600  -    -      -    -    -     0      6    0/0      -
  0/1/8   10 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
  0/1/9   11 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/10   12 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/11   13 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/12   14 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/13   15 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/14   16 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/15   17 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/16   18 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/17   19 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/18   20 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/19   21 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/20   22 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/21   23 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/22   24 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
 0/1/23   25 TTY   9600/9600  -    -      -    -    -     0      7    0/0      -
*   866  866 VTY              -    -      -    -    -    19      0    0/0      -
*   867  867 VTY              -    -      -    -    -    32      0    0/0      -
    868  868 VTY              -    -      -    -    -    13      0    0/0      -
    869  869 VTY              -    -      -    -    -     0      0    0/0      -
    870  870 VTY              -    -      -    -    -     0      0    0/0      -
Line(s) not in async mode -or- with no hardware support:
26-865
```

You can also use **show line** <line number> command to get the TTY line detail information. It gives you the information about the configured or by default parameters on that TTY line.

```
Router#show line 2
   Tty Line Typ     Tx/Rx    A Modem  Roty AccO AccI  Uses  Noise Overruns  Int
* 0/1/0    2 TTY   9600/9600  -    -      -    -    -     1      7    0/0      -

Line 0/1/0, Location: "", Type: "XTERM"
Length: 24 lines, Width: 117 columns
Baud rate (TX/RX) is 9600/9600, no parity, 2 stopbits, 8 databits
Status: Ready, Connected, Active
Capabilities: EXEC Suppressed
Modem state: Ready
Group codes:    0
Special Chars: Escape  Hold  Stop  Start  Disconnect  Activation
                ^^x    none   -     -       none
Timeouts:      Idle EXEC    Idle Session   Modem Answer  Session   Dispatch
                never         never                         none     not set
                            Idle Session Disconnect Warning
                              never
                            Login-sequence User Response
                             00:00:30
                            Autoselect Initial Wait
                              not set
Modem type is unknown.
Session limit is not set.
Time since activation: 00:24:46
Editing is enabled.
```

```
History is enabled, history size is 10.
DNS resolution in show commands is enabled
Full user help is disabled
Allowed input transports are lat pad telnet rlogin mop udptn nasi ssh acercon.
Allowed output transports are lat pad telnet rlogin mop nasi ssh.
Preferred transport is lat.
Shell: enabled
Shell trace: off
No output characters are padded
No special data dispatching characters
```

show interface

Use **show interface async** <slot/subslot/interface> command to get the async interface details including counters of input/output queue, rate, packets, bytes, and so on.

```
Router#show interfaces async 0/1/0
Async0/1/0 is up, line protocol is down
  Hardware is NIM-24A
  MTU 1500 bytes, BW 17 Kbit/sec, DLY 0 usec,
     reliability 25/255, txload 1/255, rxload 1/255
  Encapsulation ASYNC, loopback not set
  Keepalive not set
  Last input never, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/0 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     114 packets input, 12608 bytes, 0 no buffer
     Received 0 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     17 packets output, 17 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 unknown protocol drops
     0 output buffer failures, 0 output buffers swapped out
```

show tcp

Use **show tcp** <line number> command to get the tcp session detailed information including foreign host, connection state, Event Timers, datagrams counters, and so on.

```
Router#show tcp 2

tty0/1/0, virtual tty from host 10.75.157.51
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 255
Local host: 10.75.163.116, Local port: 2002
Foreign host: 10.75.157.51, Foreign port: 17719
Connection tableid (VRF): 1
Maximum output segment queue size: 20

Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)

Event Timers (current time is 0x11F2BAC0):
Timer          Starts    Wakeups            Next
Retrans           112          0             0x0
TimeWait            0          0             0x0
AckHold            15          2             0x0
SendWnd             0          0             0x0
```

```
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger            0          0             0x0
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0

iss: 2183166457  snduna: 2183179079  sndnxt: 2183179079
irs:  334962581  rcvnxt:  334962632

sndwnd:  24656  scale:      0  maxrcvwnd:   4128
rcvwnd:   4078  scale:      0  delrcvwnd:     50

SRTT: 1000 ms, RTTO: 1003 ms, RTV: 3 ms, KRTT: 0 ms
minRTT: 1 ms, maxRTT: 1000 ms, ACK hold: 200 ms
uptime: 1919014 ms, Sent idletime: 1811238 ms, Receive idletime: 1811237 ms
Status Flags: passive open, active open
Option Flags: Retrans timeout
IP Precedence value : 0

Datagrams (max data segment is 536 bytes):
Rcvd: 125 (out of order: 0), with data: 14, total data bytes: 50
Sent: 114 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0), with
data: 111, total data bytes: 12621

 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0
TCP Semaphore      0x7FC594004670  FREE
```

CHAPTER 16

Configuring Cisco C1100TG-ES-24 EtherSwitch Network Interface Module

This document provides on how to configure Cisco C1100TG-ES-24 EtherSwitch Network Interface Module on the Cisco 1100 Terminal Gateway. This chapter contains the following sections:

Overview

The Cisco C1100TG-ES-24 EtherSwitch Network Interface Module (NIM) integrates the Layer 2 features and provides a 1-Gbps connection to the multigigabit fabric (MGF) for intermodule communication.

Finding Support Information for Platforms and Cisco IOS Software Images

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

Software Features

The following are the switching software features supported on the Cisco Cisco C1100TG-ES-24 EtherSwitch Network Interface Module:

Assigning IP Addresses to Switch Virtual Interfaces

To configure IP routing, you need to assign IP addresses to Layer 3 network interfaces. This enables communication with the hosts on those interfaces that use IP. IP routing is disabled by default, and no IP addresses are assigned to Switch Virtual Interfaces (SVIs).

An IP address identifies a destination for IP packets. Some IP addresses are reserved for special uses and cannot be used for host, subnet, or network addresses. RFC 1166, “Internet Numbers,” contains the official description of these IP addresses.

An interface can have one primary IP address. A a subnet mask identifies the bits that denote the network number in an IP address.

Beginning in privileged EXEC mode, follow these steps to assign an IP address and a network mask to an SVI

SUMMARY STEPS

1. **configure terminal**
2. **interface vlan** *vlan_id*
3. **ip address** *ip-address subnet-mask*
4. **end**
5. **show interfaces** [*interface-id*]**show ip interface** [*interface-id*]**show running-config interface** [*interface-id*]
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface vlan** *vlan_id*	Enter interface configuration mode, and specify the Layer 3 VLAN to configure.
Step 3	**ip address** *ip-address subnet-mask*	Configure the IP address and IP subnet mask.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**show interfaces** [*interface-id*]**show ip interface** [*interface-id*]**show running-config interface** [*interface-id*]	Verify your entries.
Step 6	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

What to do next

IEEE 802.1x Protocol

The IEEE 802.1x standard defines a client/server-based access control and authentication protocol that prevents clients from connecting to a LAN through publicly accessible ports unless they are authenticated. The authentication server authenticates each client connected to a port before making available any services offered by the router or the LAN.

Until the client is authenticated, IEEE 802.1x access control allows only Extensible Authentication Protocol over LAN (EAPOL), Cisco Discovery Protocol (CDP), and Spanning Tree Protocol (STP) traffic through the port to which the client is connected. After authentication, normal traffic can pass through the port. For more information on IEEE 802.1x port-based authentication, see the Configuring IEEE 802.1x Port-Based Authentication chapter of the *Security Configuration Guide, Cisco IOS XE Gibraltar 16.10.x*.

IGMP Snooping for IPv4

IGMP snooping allows switches to examine IGMP packets and make forwarding decisions based on their content. You can configure the switch to use IGMP snooping in subnets that receive IGMP queries from either IGMP or the IGMP snooping querier. IGMP snooping constrains IPv4 multicast traffic at Layer 2 by configuring Layer 2 LAN ports dynamically to forward IPv4 multicast traffic only to those ports that want to receive it.

Layer 2 switches can use IGMP snooping to constrain the flooding of multicast traffic by dynamically configuring Layer 2 interfaces so that multicast traffic is forwarded to only those interfaces associated with IP multicast devices. As the name implies, IGMP snooping requires the LAN switch to snoop on the IGMP transmissions between the host and the router and to keep track of multicast groups and member ports. When the switch receives an IGMP report from a host for a particular multicast group, the switch adds the host port number to the forwarding table entry; when it receives an IGMP Leave Group message from a host, it removes the host port from the table entry. It also periodically deletes entries if it does not receive IGMP membership reports from the multicast clients. For more information on this feature, see http://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst3750x_3560x/software/release/15-2_1_e/configuration/guide/scg3750x/swigmp.html .

MAC Table Manipulation

This section includes the following:

Creating a Static Entry in the MAC Address Table

Perform the following task to create a static entry in the MAC address table.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mac address-table static mac-address vlan** *vlan-id* **interface** *Interface-id*
4. end
5. show mac address-table

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	**mac address-table static mac-address vlan** *vlan-id* **interface** *Interface-id* **Example:** `Router(config)# mac address-table static`	Creates a static entry in the MAC address table.

	Command or Action	Purpose
	`00ff.ff0d.2dc0 vlan 1 interface gigabitethernet 0/1/0`	

Step 4	end
	Example:
	`Router(config)# end`
		Returns to privileged EXEC mode.

Step 5	show mac address-table **Example:** `Router# show mac address-table`	Verifies the MAC address table.

MAC Address-Based Traffic Blocking

Perform the following task to block all traffic to or from a MAC address in a specified VLAN.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mac address-table static mac-address vlan** *vlan-id* **drop**
4. end
5. show mac address-table

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	**mac address-table static mac-address vlan** *vlan-id* **drop** **Example:** `Router(config)# mac address-table static 00ff.ff0d.2dc0 vlan 1 drop`	Creates a static entry with drop action in the MAC address table.
Step 4	end **Example:**	Returns to privileged EXEC mode.

	Command or Action	Purpose
	`Router(config)# end`	
Step 5	show mac address-table **Example:** `Router# show mac address-table`	Verifies the MAC address table.

Configuring and Verifying the Aging Timer

Perform this task to configure the aging timer.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. mac address-table aging-time time
4. end
5. show mac address-table aging-time

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	mac address-table aging-time time
	Example:
	`Router(config)# mac address-table aging-time 600`
	or
	Example:
	`Router(config)# mac address-table aging-time 0`
		Configures the MAC address aging timer age in seconds.
		• The accept value is either 0 or 10-1000000 seconds. Default value is 300 seconds.
		• The maximum aging timer supported by switch chipset is 634 seconds. If configure greater than 634 seconds, MAC address will age out after 634 seconds.
		• The value 0 means dynamic MAC entries will never age out.

Step 4	end
	Example:
	`Router(config)# end`
		Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 5	show mac address-table aging-time **Example:** `Router# show mac address-table aging-time`	Verifies the MAC address table.

Spanning Tree Protocol

Spanning Tree Protocol (STP) is a Layer 2 link management protocol that provides path redundancy while preventing undesirable loops in the network. For a Layer 2 Ethernet network to function properly, only one active path can exist between any two stations. Spanning tree operation is transparent to end stations, which cannot detect whether they are connected to a single LAN segment or to a switched LAN of multiple segments. For more information on this feature, see
http://www.cisco.com/c/en/us/td/docs/routers/access/interfaces/software/feature/guide/geshwic_cfg.html .

Configuring the Switched Port Analyzer

This section describes how to configure a Switched Port Analyzer (SPAN) session on Cisco C1100TG-ES-24. The following restrictions apply to the Cisco C1100TG-ES-24:

- Only intra-module local SPAN is supported and cross module SPAN is not supported.
- Each Cisco C1100TG-ES-24 supports only one local SPAN session.
- Each SPAN session supports only one source port and one destination port.

Note Tx, Rx, or both Tx and Rx monitoring is supported.

Configuring the SPAN Sources

To configure the source for a SPAN session, use the **monitor session** *session* **source** {**interface** *type 0/slot/port* | **vlan** *vlan_ID* [**,** | **-** | **rx** | **tx** | **both**]} command in global configuration mode. This command specifies the SPAN session, the source interfaces or VLANs, and the traffic direction to be monitored.

```
Router(config)# monitor session

1
 source interface

gigabitethernet 0/1/1
```

Configuring SPAN Destinations

To configure the destination for a SPAN session, use the **monitor session** *session* **destination** {**interface** *type slot/subslot/port* | **-** | **rx** | **tx** | **both**]} command in global configuration mode.

```
Router(config)# monitor session

1
 destination interface

gigabitethernet 0/1/1
```

Verifying the SPAN Session

Use the **show monitor session** command to verify the sources and destinations configured for the SPAN session.

```
Router#show monitor session 1

Session 1
---------
Session 1
---------
Type : Local Session
Source Ports :
Both : Gi0/1/0
Destination Ports : Gi0/1/1
```

Removing a SPAN Session

To remove sources or destinations from the SPAN session, use the **no monitor session** *session* command in global configuration mode as shown in the following example:

Router(config)#**no monitor session** *1*

Configuring Layer 2 Quality of Service

Cisco C1100TG-ES-24 supports four egress queues on each port for L2 data traffic. The four queues are strict priority queues by default, which is, queue one is lowest priority queue and queue four is highest priority queue. Shaped Deficit Weight Round Robin (SDWRR) is also supported and the weight of each queue can be configured.

The Cisco C1100TG-ES-24 L2 QoS configuration is a global configuration and it is not per module nor per port.

Configuring 802.1p COS-based Queue Mapping

Beginning in privileged EXEC mode, follow these steps to configure the CoS based queue mapping:

SUMMARY STEPS

1. configure terminal
2. wrr-queue cos-map qid cos1..cosn
3. end
4. show wrr-queue cos-map

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	wrr-queue cos-map qid cos1..cosn	Specify the CoS values that are mapped to the queue id. Default values are as follows: CoS Value - Queue ID 0, 1 - Q1

	Command or Action	Purpose
		2, 3 - Q2 4, 5 - Q3 6, 7 - Q4
Step 3	end	Return to privileged EXEC mode.
Step 4	show wrr-queue cos-map	Display the mapping of the queues.

What to do next

To disable the new CoS settings and return to default settings, use the no wrr-queue cos-map global configuration command.

Configuring SDWRR Priority

Beginning in privileged EXEC mode, follow these steps to configure the SDWRR priority:

SUMMARY STEPS

1. configure terminal
2. wrr-queue bandwidth weight1...weight4
3. end
4. show wrr-queue bandwidth

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	wrr-queue bandwidth weight1...weight4	Assign SDWRR weights to the four CoS queues. The range for the WRR values weight1 through weight4 is 1 to 255.
Step 3	end	Return to privileged EXEC mode.
Step 4	show wrr-queue bandwidth	Display the SDWRR bandwidth allocation for the queues.

What to do next

Note Once SDWRR priority is configured the SDWRR scheduling will be activated and strict priority will be disabled. To disable the SDWRR scheduling and enable the strict priority scheduling, use the no wrr-queue bandwidth global configuration command.

Configuring the CoS Value for an Interface

Beginning in privileged EXEC mode, follow these steps to define the default CoS value of a port or to assign the default CoS to all incoming packets on the port:

SUMMARY STEPS

1. configure terminal
2. Interface interface-id
3. switchport priority {default default-cos | override}
4. end
5. show interface interface-id switchport
6. copy running-config startup-config

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	Interface interface-id	Specify the EtherSwitch interface and enter interface configuration mode.
Step 3	switchport priority {default default-cos | override}	Configure the default CoS value for the port. • For default-cos, specify a default CoS value to be assigned to a port. For incoming untagged packets, the default CoS value becomes the CoS value for the packet. The CoS range is 0 to 7. The default is 0. • •Use the override keyword to override the CoS value of the incoming tagged packets and to apply the default port CoS value to the packets. By default, CoS override is disabled.
Step 4	end	Return to privileged EXEC mode.
Step 5	show interface interface-id switchport	Verify your entries
Step 6	copy running-config startup-config	(Optional) Save your entries in the configuration file.

What to do next

To return to the default setting, use the no switchport priority {default | override} interface configuration command.

VLANs

Virtual local-area networks (VLANs) are a group of end stations with a common set of requirements, independent of physical location. VLANs have the same attributes as a physical LAN but allow you to group end stations even if they are not located physically on the same LAN segment. For more information on this feature, see http://www.cisco.com/c/en/us/td/docs/routers/access/interfaces/software/feature/guide/geshwic_cfg.html .

Configuring LAN Ports for Layer 2 Switching

This chapter describes how to use the command-line interface (CLI) to configure Gigabit Ethernet, and 10/100/1000-Gigabit Ethernet LAN ports for Layer 2 switching on the device. The configuration tasks in this section apply to LAN ports on LAN switching modules.

Layer 2 LAN Port Modes

The following table lists the Layer 2 LAN port modes and describes how they function on LAN ports.

Table 13: Layer 2 LAN Port Modes

Mode	Function
switchport mode access	Puts the LAN port into permanent nontrunking mode and negotiates to convert the link into a nontrunk link. The LAN port becomes a nontrunk port even if the neighboring LAN port does not agree to the change.
switchport mode dynamic desirable	Makes the LAN port actively attempt to convert the link to a trunk link. The LAN port becomes a trunk port if the neighboring LAN port is set to **trunk**, **desirable**, or **auto** mode. This is the default mode for all LAN ports.
switchport mode dynamic auto	Makes the LAN port willing to convert the link to a trunk link. The LAN port becomes a trunk port if the neighboring LAN port is set to **trunk** or **desirable** mode.
switchport mode trunk	Puts the LAN port into permanent trunking mode and negotiates to convert the link into a trunk link. The LAN port becomes a trunk port even if the neighboring port does not agree to the change.
switchport nonegotiate	Puts the LAN port into permanent trunking mode but prevents the port from generating DTP frames. You must configure the neighboring port manually as a trunk port to establish a trunk link.

Note DTP is a point-to-point protocol. However, some internetworking devices might forward DTP frames improperly. To avoid this problem, ensure that LAN ports connected to devices that do not support DTP are configured with the **access** keyword if you do not intend to trunk across those links. To enable trunking to a device that does not support DTP, use the **nonegotiate** keyword to cause the LAN port to become a trunk but not generate DTP frames.

Default Layer 2 LAN Interface Configuration

The following table shows the Layer 2 LAN port default configuration.

Table 14: Layer 2 LAN Interface Default Configuration

Feature	Default
Interface mode:	
• Before entering the **switchport** command	
• After entering the **switchport** command	**switchport mode dynamic desirable**
Default access VLAN	VLAN 1

Feature	Default
Native VLAN (for 802.1Q trunks)	VLAN 1

Configuring LAN Interfaces for Layer 2 Switching

These sections describe how to configure Layer 2 switching on the device:

Note Use the **default interface** {**ethernet** | **fastethernet** | **gigabitethernet** | **tengigabitethernet**} *slot/subslot/port* command to revert an interface to its default configuration.

Configuring a LAN Port for Layer 2 Switching

To configure a LAN port for Layer 2 switching, perform this task:

SUMMARY STEPS

1. Router(config)# **interface** *type* [1] *slot/subslot/port*
2. Router(config-if)# **shutdown**
3. Router# **show running-config interface** [*type* [2] *slot/port*]
4. Router# **show interfaces** [*type* [3] *slot/subslot/port*] **switchport**
5. Router# **show interfaces** [*type* [4] *slot/subslot/port*] **trunk**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config)# **interface** *type* [1] *slot/subslot/port*	Selects the LAN port to configure.
Step 2	Router(config-if)# **shutdown**	(Optional) Shuts down the interface to prevent traffic flow until configuration is complete.
Step 3	Router# **show running-config interface** [*type* [2] *slot/port*]	Displays the running configuration of the interface.
Step 4	Router# **show interfaces** [*type* [3] *slot/subslot/port*] **switchport**	Displays the switch port configuration of the interface.
Step 5	Router# **show interfaces** [*type* [4] *slot/subslot/port*] **trunk**	Displays the trunk configuration of the interface.

What to do next

After you enter the **switchport** command, the default mode is **switchport mode dynamic desirable**. If the neighboring port supports trunking and is configured to allow trunking, the link becomes a Layer 2 trunk when you enter the **switchport** command. By default, LAN trunk ports negotiate encapsulation. If the

[1] type = ethernet , fastethernet , gigabitethernet , or tengigabitethernet
[2] type = ethernet , fastethernet , gigabitethernet , or tengigabitethernet
[3] type = ethernet , fastethernet , gigabitethernet , or tengigabitethernet
[4] type = ethernet , fastethernet , gigabitethernet , or tengigabitethernet

neighboring port supports ISL and 802.1Q encapsulation and both ports are set to negotiate the encapsulation type, the trunk uses ISL encapsulation (10-Gigabit Ethernet ports do not support ISL encapsulation).

Configuring a Layer 2 Switching Port as a Trunk

These section describe configuring a Layer 2 switching port as a trunk:

Configuring the Layer 2 Switching Port as 802.1Q Trunk

Note Complete the steps in the Configuring a LAN Port for Layer 2 Switching, on page 175 before performing the tasks in this section.

- When you enter the **switchport** command with no other keywords, the default mode is **switchport mode dynamic desirable** and **switchport trunk encapsulation negotiate**.

To configure the Layer 2 switching port as an ISL or 802.1Q trunk, perform this task:

Command	Purpose
`Router(config-if)# switchport mode trunk`	(Optional) Configures the Layer 2 switching port mode as 802.1Q trunk.

When configuring the Layer 2 switching port as 802.1Q trunk, note the following information:

- The **switchport mode trunk** command (see the Configuring the Layer 2 Trunk Not to Use DTP , on page 177) is not compatible with the **switchport trunk encapsulation negotiate** command.
- To support the **switchport mode trunk** command, you must configure the encapsulation as 802.1Q.

Configuring the Layer 2 Trunk to Use DTP

Note Complete the steps in the “Configuring a LAN Port for Layer 2 Switching” section before performing the tasks in this section.

To configure the Layer 2 trunk to use DTP, perform this task:

Command	Purpose
`Router(config-if)# switchport mode dynamic {auto | desirable}`	(Optional) Configures the trunk to use DTP.
`Router(config-if)# no switchport mode`	Reverts to the default trunk trunking mode (**switchport mode dynamic desirable**).

When configuring the Layer 2 trunk to use DTP, note the following information:

- Required only if the interface is a Layer 2 access port or to specify the trunking mode.
- See the Layer 2 LAN Port Modes table for information about trunking modes.

Configuring the Layer 2 Trunk Not to Use DTP

Note Complete the steps in the “Configuring a LAN Port for Layer 2 Switching” section before performing the tasks in this section.

To configure the Layer 2 trunk not to use DTP, perform this task:

SUMMARY STEPS

1. Router(config-if)# **switchport mode trunk**
2. Router(config-if)# **no switchport mode**
3. Router(config-if)# **switchport nonegotiate**
4. Router(config-if)# **no switchport nonegotiate**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config-if)# **switchport mode trunk**	(Optional) Configures the port to trunk unconditionally.
Step 2	Router(config-if)# **no switchport mode**	Reverts to the default trunk trunking mode (**switchport mode dynamic desirable**).
Step 3	Router(config-if)# **switchport nonegotiate**	(Optional) Configures the trunk not to use DTP.
Step 4	Router(config-if)# **no switchport nonegotiate**	Enables DTP on the port.

What to do next

When configuring the Layer 2 trunk not to use DTP, note the following information:

- Before entering the **switchport mode trunk** command, you must configure the encapsulation (see the “Configuring the Layer 2 Switching Port as 802.1Q Trunk” section).
- To support the **switchport nonegotiate** command, you must enter the **switchport mode trunk** command.
- Enter the **switchport mode dynamic trunk** command. See Layer 2 LAN Port Modes table for information about trunking modes.
- Before entering the **switchport nonegotiate** command, you must configure the encapsulation (see the “Configuring the Layer 2 Switching Port as 802.1Q Trunk” section) and configure the port to trunk unconditionally with the **switchport mode trunk** command (see the “Configuring the Layer 2 Trunk to Use DTP” section).

Configuring the Access VLAN

Note Complete the steps in the Configuring a LAN Port for Layer 2 Switching, on page 175 before performing the tasks in this section.

To configure the access VLAN, perform this task:

Configuring the 802.1Q Native VLAN

Command	Purpose
`Router(config-if)# switchport access vlan vlan_ID`	(Optional) Configures the access VLAN, which is used if the interface stops trunking. The *vlan_ID* value can be 1 through 4094, except reserved VLANs.
`Router(config-if)# no switchport access vlan`	Reverts to the default value (VLAN 1).

Note Complete the steps in the Configuring a LAN Port for Layer 2 Switching, on page 175 before performing the tasks in this section.

To configure the 802.1Q native VLAN, perform this task:

Command	Purpose
`Router(config-if)# switchport trunk native vlan vlan_ID`	(Optional) Configures the 802.1Q native VLAN.
`Router(config-if)# no switchport trunk native vlan`	Reverts to the default value (VLAN 1).

When configuring the native VLAN, note the following information:

- The *vlan_ID* value can be 1 through 4094, except reserved VLANs.
- The access VLAN is not automatically used as the native VLAN.

Configuring the List of VLANs Allowed on a Trunk

Note Complete the steps in the Configuring a LAN Port for Layer 2 Switching, on page 175 before performing the tasks in this section.

To configure the list of VLANs allowed on a trunk, perform this task:

Command	Purpose
`Router(config-if)# switchport trunk allowed vlan {add | except | none | remove} vlan [,vlan[,vlan[,...]]`	(Optional) Configures the list of VLANs allowed on the trunk.
`Router(config-if)# no switchport trunk allowed vlan`	Reverts to the default value (all VLANs allowed).

When configuring the list of VLANs allowed on a trunk, note the following information:

- The vlan parameter is either a single VLAN number from 1 through 4094, or a range of VLANs described by two VLAN numbers, the lesser one first, separated by a dash. Do not enter any spaces between comma-separated vlan parameters or in dash-specified ranges.
- All VLANs are allowed by default.
- You can remove VLAN 1. If you remove VLAN 1 from a trunk, the trunk interface continues to send and receive management traffic, for example, Cisco Discovery Protocol (CDP), VLAN Trunking Protocol (VTP), Port Aggregation Protocol (PAgP), and DTP in VLAN 1.

STP Overview

STP is a Layer 2 link-management protocol that provides path redundancy while preventing undesirable loops in the network. For a Layer 2 Ethernet network to function properly, only one active path can exist between any two stations. STP operation is transparent to end stations, which cannot detect whether they are connected to a single LAN segment or a switched LAN of multiple segments.

Cisco 4-Ports and 8-Ports Layer 2 Gigabit EtherSwitch Network Interface Modules use STP (the IEEE 802.1D bridge protocol) on all VLANs. By default, a single instance of STP runs on each configured VLAN (provided you do not manually disable STP). You can enable and disable STP on a per-VLAN basis.

Cisco 4-Ports and 8-Ports Layer 2 Gigabit EtherSwitch Network Interface Modules support the following three STP:

Multiple Spanning Tree protocol

MST maps multiple VLANs into a spanning tree instance, with each instance having a spanning tree topology independent of other spanning tree instances. This architecture provides multiple forwarding paths for data traffic, enables load balancing, and reduces the number of spanning tree instances required to support a large number of VLANs. MST improves the fault tolerance of the network because a failure in one instance (forwarding path) does not affect other instances (forwarding paths).

Per-VLAN Spanning Tree+

Per-VLAN Spanning Tree+ (PVST+) is an extension of the PVST standard. Per-VLAN Spanning Tree+ (PVST+) allows interoperability between CST and PVST in Cisco switches and supports the IEEE 802.1Q standard.

Rapid Per-VLAN Spanning Tree+

Rapid-PVST uses the existing configuration for PVST+; however, Rapid-PVST uses RSTP to provide faster convergence. Independent VLANs run their own RSTP instance. Dynamic entries are flushed immediately on a per-port basis upon receiving a topology change. UplinkFast and BackboneFast configurations are ignored in Rapid-PVST mode; both features are included in RSTP.

Default STP Configuration

The following table shows the default STP configuration.

Table 15: STP Default Configuration

Feature	Default Value
Disable state	STP disabled for all VLANs

Feature	Default Value
Bridge priority	32768
STP port priority (configurable on a per-port basis—used on LAN ports configured as Layer 2 access ports)	128
STP port cost (configurable on a per-port basis—used on LAN ports configured as Layer 2 access ports)	Gigabit Ethernet: 4
STP VLAN port priority (configurable on a per-VLAN basis—used on LAN ports configured as Layer 2 trunk ports)	128
STP VLAN port cost (configurable on a per-VLAN basis—used on LAN ports configured as Layer 2 trunk ports)	Gigabit Ethernet:1000000000
Hello time	2 seconds
Forward delay time	15 seconds
Maximum aging time	20 seconds
Mode	PVST

Enabling STP

Note STP is disabled by default on all VLANs.

You can enable STP on a per-VLAN basis. The Cisco 4-Ports and 8-Ports Layer 2 Gigabit EtherSwitch Network Interface Modules maintain a separate instance of STP for each VLAN (except on VLANs on which you disable STP).

To enable STP on a per-VLAN basis, perform this task:

SUMMARY STEPS

1. Device(config)# **spanning-tree** *mode* [**pvst** | **rapid-pvst** | **mst**]
2. Device(config)# **spanning-tree vlan** *vlan_ID*
3. Device(config)# **default spanning-tree vlan** *vlan_ID*
4. Device(config)# **no spanning-tree vlan** *vlan_ID*
5. Device(config)# **end**
6. Device# **show spanning-tree vlan** *vlan_ID*

DETAILED STEPS

	Command or Action	Purpose
Step 1	Device(config)# **spanning-tree** *mode* [**pvst** | **rapid-pvst** | **mst**]	Enables STP on a required mode.

	Command or Action	Purpose
Step 2	Device(config)# **spanning-tree vlan** *vlan_ID*	Enables STP on a per-VLAN basis. The *vlan_ID* value can be 1 through 4094, except reserved VLANs (see STP Default Configuration table).
Step 3	Device(config)# **default spanning-tree vlan** *vlan_ID*	Reverts all STP parameters to default values for the specified VLAN.
Step 4	Device(config)# **no spanning-tree vlan** *vlan_ID*	Disables STP on the specified VLAN; see the following Cautions for information regarding this command.
Step 5	Device(config)# **end**	Exits configuration mode.
Step 6	Device# **show spanning-tree vlan** *vlan_ID*	Verifies that STP is enabled.

What to do next

Caution Do not disable spanning tree on a VLAN unless all switches and bridges in the VLAN have spanning tree disabled. You cannot disable spanning tree on some switches and bridges in a VLAN and leave it enabled on other switches and bridges in the VLAN. This action can have unexpected results because switches and bridges with spanning tree enabled will have incomplete information regarding the physical topology of the network.

Caution We do not recommend disabling spanning tree, even in a topology that is free of physical loops. Spanning tree serves as a safeguard against misconfigurations and cabling errors. Do not disable spanning tree in a VLAN without ensuring that there are no physical loops present in the VLAN.

This example shows how to enable STP on VLAN 200:

```
Device# configure terminal

Device(config)# spanning-tree mst
Device(config)# spanning-tree vlan 200

Device(config)# end

Device#
```

Note STP is disabled by default.

This example shows how to verify the configuration:

```
Device(config)# spanning-tree pvst
Device# show spanning-tree vlan 200

G0:VLAN0200
  Spanning tree enabled protocol ieee
  Root ID    Priority    32768
             Address     00d0.00b8.14c8
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    32768
             Address     00d0.00b8.14c8
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300
Interface        Role Sts Cost      Prio.Nbr Status
---------------- ---- --- --------- -------- --------------------------------
Gi1/4            Desg FWD 200000    128.196  P2p
Gi1/5            Back BLK 200000    128.197  P2p
Device#
```

Note You must have at least one interface that is active in VLAN 200 to create a VLAN 200 spanning tree. In this example, two interfaces are active in VLAN 200.

Configuring Optional STP Features

This section describes how to configure the following optional STP features:

Enabling PortFast

Caution Use PortFast *only* when connecting a single end station to a Layer 2 access port. Otherwise, you might create a network loop.

To enable PortFast on a Layer 2 access port, perform this task:

SUMMARY STEPS

1. Router(config)# **interface** {*type* [1] *slot/port* }
2. Router(config-if)# **spanning-tree portfast**
3. Router(config-if)# **spanning-tree portfast default**
4. Router(config-if)# **end**
5. Router# **show running interface** {*type* [2]*slot/port* }

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config)# **interface** {*type* [5] *slot/port* }	Selects a port to configure.
Step 2	Router(config-if)# **spanning-tree portfast**	Enables PortFast on a Layer 2 access port connected to a single workstation or server.
Step 3	Router(config-if)# **spanning-tree portfast default**	Enables PortFast.

[1] type = ethernet , fastethernet , gigabitethernet , or tengigabitethernet
[2] type = ethernet , fastethernet , gigabitethernet , or tengigabitethernet

	Command or Action	Purpose
Step 4	Router(config-if)# **end**	Exits configuration mode.
Step 5	Router# **show running interface** {*type* [6]*slot/port* }	Verifies the configuration.

Enabling PortFast

This example shows how to enable PortFast on Gigabit Ethernet interface 1:

```
Router# configure terminal

Router(config)# interface GigabitEthernet 1
Router(config-if)# spanning-tree portfast

Router(config-if)# end

Router#
```

This example shows how to verify the configuration:

```
Router# show running-config interface fastethernet 5/8

Building configuration...
Current configuration:
!
interface GigabitEthernet1
 no ip address
 switchport
 switchport access vlan 200
 switchport mode access
 spanning-tree portfast
end
Router#
```

To enable the default PortFast configuration, perform this task:

SUMMARY STEPS

1. Router(config)# **spanning-tree portfast default**
2. Router(config)# **show spanning-tree summary totals**
3. Router(config)# **show spanning-tree interface** *x* **detail**
4. Router(config-if)# **spanning-tree portfast trunk**
5. Router# **show spanning-tree interface fastEthernet** *x* **detail**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config)# **spanning-tree portfast default**	Configures the PortFast default.
Step 2	Router(config)# **show spanning-tree summary totals**	Verifies the global configuration.
Step 3	Router(config)# **show spanning-tree interface** *x* **detail**	Verifies the effect on a specific port.
Step 4	Router(config-if)# **spanning-tree portfast trunk**	Enables the PortFast trunk on a port

	Command or Action	Purpose
Step 5	Router# **show spanning-tree interface fastEthernet** *x* **detail**	Verifies the configuration.

What to do next

This example shows how to enable the default PortFast configuration:

```
Router# configure terminal

Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# spanning-tree portfast default

Router(config)# ^Z
Root bridge for:VLAN0010
EtherChannel misconfiguration guard is enabled
Extended system ID   is disabled
Portfast             is enabled by default
PortFast BPDU Guard  is disabled by default
Portfast BPDU Filter is disabled by default
Loopguard            is disabled by default
UplinkFast           is disabled
BackboneFast         is disabled
Pathcost method used is long
Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
VLAN0001                  0        0         0        1          1
VLAN0010                  0        0         0        2          2
---------------------- -------- --------- -------- ---------- ----------
2 vlans                   0        0         0        3          3
Router#
Router# show spanning-tree interface GigabitEthernet 0/1/0 detail

Port 17 (GigabitEthernet0/1/0) of G0:VLAN0020 is forwarding
   Port path cost 4, Port priority 128, Port Identifier 128.17.
   Designated root has priority 32788, address f44e.05da.bb11
   Designated bridge has priority 32788, address f44e.05da.bb11
   Designated port id is 128.17, designated path cost 0
   Timers: message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   Link type is point-to-point by default
   BPDU: sent 61, received 0
Router(config-if)# spanning-tree portfast trunk

%Warning:portfast should only be enabled on ports connected to a single
 host. Connecting hubs, concentrators, switches, bridges, etc... to this
 interface  when portfast is enabled, can cause temporary bridging loops.
 Use with CAUTION
```

Configuring PortFast BPDU Filtering

These sections describe how to configure PortFast BPDU filtering.

To enable PortFast BPDU filtering globally, perform this task:

SUMMARY STEPS

1. Router(config)# **spanning-tree portfast bpdufilter default**

2. Router# **show spanning-tree summary totals**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config)# **spanning-tree portfast bpdufilter default**	Enables BPDU filtering globally on the router.
Step 2	Router# **show spanning-tree summary totals**	Verifies the configuration.

Enabling PortFast BPDU Filtering

BPDU filtering is set to default on each port. This example shows how to enable PortFast BPDU filtering on the port and verify the configuration in PVST+ mode:

```
Router(config)# spanning-tree portfast bpdufilter default

Router(config)# ^Z
Router# show spanning-tree summary totals

Switch is in pvst mode
Root bridge for: G0:VLAN0013, G0:VLAN0020, G1:VLAN0020
EtherChannel misconfig guard is enabled
Extended system ID           is enabled
Portfast Default             is disabled
PortFast BPDU Guard Default  is disabled
Portfast BPDU Filter Default is disabled
Loopguard Default            is disabled
UplinkFast                   is disabled
BackboneFast                 is disabled
Pathcost method used         is short
Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
3 vlans                      0         0        0          3          3
```

To enable PortFast BPDU filtering on a nontrunking port, perform this task:

SUMMARY STEPS

1. Router(config)# **interface fastEthernet 4/4**
2. Router(config-if)# **spanning-tree bpdufilter enable**
3. Router# **show spanning-tree interface fastEthernet 4/4**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config)# **interface fastEthernet 4/4**	Selects the interface to configure.
Step 2	Router(config-if)# **spanning-tree bpdufilter enable**	Enables BPDU filtering.
Step 3	Router# **show spanning-tree interface fastEthernet 4/4**	Verifies the configuration.

What to do next

This example shows how to enable PortFast BPDU filtering on a nontrunking port:

```
Router(config)# interface fastEthernet 4/4
Router(config-if)# spanning-tree bpdufilter enable

Router(config-if)# ^Z
Router# show spanning-tree interface fastEthernet 4/4
Vlan             Role Sts Cost      Prio.Nbr Status
---------------- ---- --- --------- -------- --------------------------------
VLAN0010         Desg FWD 1000      160.196  Edge P2p
Router# show spanning-tree interface fastEthernet 4/4 detail

 Port 196 (FastEthernet4/4) of VLAN0010 is forwarding
   Port path cost 1000, Port priority 160, Port Identifier 160.196.
   Designated root has priority 32768, address 00d0.00b8.140a
   Designated bridge has priority 32768, address 00d0.00b8.140a
   Designated port id is 160.196, designated path cost 0
   Timers:message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state:1
   The port is in the portfast mode by portfast trunk configuration
   Link type is point-to-point by default
   Bpdu filter is enabled
   BPDU:sent 0, received 0
Router#
```

Enabling BPDU Guard

To enable BPDU Guard globally, perform this task:

SUMMARY STEPS

1. Router(config)# **spanning-tree portfast bpduguard default**
2. Router(config)# **end**
3. Router# **show spanning-tree summary totals**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config)# **spanning-tree portfast bpduguard default** **Example:** `Router(config)# no spanning-tree portfast bpduguard default`	Enables BPDU Guard globally. Disables BPDU Guard globally.
Step 2	Router(config)# **end**	Exits configuration mode.
Step 3	Router# **show spanning-tree summary totals**	Verifies the configuration.

What to do next

This example shows how to enable BPDU Guard:

```
Router# configure terminal
Router(config)# spanning-tree portfast bpduguard
Router(config)# end
Router#
```

This example shows how to verify the configuration:

```
Router# show spanning-tree summary totals
 default
Root bridge for:VLAN0010
EtherChannel misconfiguration guard is enabled
Extended system ID   is disabled
Portfast             is enabled by default
PortFast BPDU Guard  is disabled by default
Portfast BPDU Filter is enabled by default
Loopguard            is disabled by default
UplinkFast           is disabled
BackboneFast         is disabled
Pathcost method used is long
Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
2 vlans                   0        0         0        3          3
Router#
```

Enabling UplinkFast

UplinkFast increases the bridge priority to 49152 and adds 3000 to the STP port cost of all Layer 2 LAN interfaces on the device, decreasing the probability that the router will become the root bridge. The *max_update_rate* value represents the number of multicast packets transmitted per second (the default is 150 packets per second). UplinkFast cannot be enabled on VLANs that have been configured for bridge priority. To enable UplinkFast on a VLAN with bridge priority configured, restore the bridge priority on the VLAN to the default value by entering a **no spanning-tree vlan** *vlan_ID* **priority** command in global configuration mode.

Note When you enable UplinkFast, it affects all VLANs on the device. You cannot configure UplinkFast on an individual VLAN.

To enable UplinkFast, perform this task:

SUMMARY STEPS

1. Router(config)# **spanning-tree uplinkfast** [**max-update-rate** *max_update_rate*]
2. Router(config)# **no spanning-tree uplinkfast max-update-rate**
3. Router(config)# **no spanning-tree uplinkfast**
4. Router(config)# **end**
5. Router# **show spanning-tree vlan** *vlan_ID*

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config)# **spanning-tree uplinkfast** [**max-update-rate** *max_update_rate*]	Enables UplinkFast.
Step 2	Router(config)# **no spanning-tree uplinkfast max-update-rate**	Reverts to the default rate.
Step 3	Router(config)# **no spanning-tree uplinkfast**	Disables UplinkFast.
Step 4	Router(config)# **end**	Exits configuration mode.
Step 5	Router# **show spanning-tree vlan** *vlan_ID*	Verifies that UplinkFast is enabled.

What to do next

This example shows how to enable UplinkFast with an update rate of 400 packets per second:

```
Router# configure terminal

Router(config)# spanning-tree uplinkfast max-update-rate 400

Router(config)# exit

Router#
```

This example shows how to verify that UplinkFast is enabled:

```
Router# show spanning-tree uplinkfast

UplinkFast is enabled
Router#
```

Enabling BackboneFast

Note BackboneFast operates correctly only when enabled on all network devices in the network. BackboneFast is not supported on Token Ring VLANs. This feature is supported for use with third-party network devices.

To enable BackboneFast, perform this task:

SUMMARY STEPS

1. Router(config)# **spanning-tree backbonefast**
2. Router(config)# **no spanning-tree backbonefast**
3. Router(config)# **end**
4. Router# **show spanning-tree vlan** *vlan_ID*

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config)# **spanning-tree backbonefast**	Enables BackboneFast.
Step 2	Router(config)# **no spanning-tree backbonefast**	Disables BackboneFast.
Step 3	Router(config)# **end**	Exits configuration mode.
Step 4	Router# **show spanning-tree vlan** *vlan_ID*	Verifies that UplinkFast is enabled.

What to do next

This example shows how to enable BackboneFast:

```
Router# configure terminal

Router(config)# spanning-tree backbonefast

Router(config)# end

Router#
```

This example shows how to verify that BackboneFast is enabled:

```
Router# show spanning-tree backbonefast

BackboneFast is enabled
BackboneFast statistics
-----------------------
Number of transition via backboneFast (all VLANs) : 0
Number of inferior BPDUs received (all VLANs)     : 0
Number of RLQ request PDUs received (all VLANs)   : 0
Number of RLQ response PDUs received (all VLANs)  : 0
Number of RLQ request PDUs sent (all VLANs)       : 0
Number of RLQ response PDUs sent (all VLANs)      : 0
```

Router#

CHAPTER 17

Support for Security-Enhanced Linux

This chapter describes the SELinux feature, and includes the following sections:

Overview

Security-Enhanced Linux (SELinux) is a solution composed of Linux kernel security module and system utilities to incorporate a strong, flexible Mandatory Access Control (MAC) architecture into Cisco IOS-XE platforms.

SELinux provides an enhanced mechanism to enforce the separation of information, based on confidentiality and integrity requirements, which addresses threats of tampering and bypassing of application security mechanisms and enables the confinement of damage that malicious or flawed applications can cause.

Prerequisites for SELinux

There are no specific prerequisites for this feature.

Restrictions for SELinux

There are no specific restrictions for this feature.

Information About SELinux

SELinux enforces mandatory access control policies that confine user programs and system services to the minimum privilege required to perform their assigned functionality. This reduces or eliminates the ability of these programs and daemons to cause harm when compromised (for example, through buffer overflows or misconfigurations). This is a practical implementation of principle of least privilege by enforcing MAC on Cisco IOS-XE platforms. This confinement mechanism works independently of the traditional Linux access control mechanisms. SELinux provides the capability to define policies to control the access from an application process to any resource object, thereby allowing for the clear definition and confinement of process behavior.

SELinux can operate either in **Permissive mode** or **Enforcing mode** when enabled on a system.

- In Permissive mode, SELinux does not enforce the policy, and only generates system logs for any denials caused by violation of the resource access policy. The operation is not denied, but only logged for resource access policy violation.
- In Enforcing mode, the SELinux policy is enabled and enforced. It denies resource access based on the access policy rules, and generates system logs.

From Cisco IOS XE 17.13.1a, SELinux is enabled in Enforcing mode by default on supported Cisco IOS XE platforms. In the Enforcing mode, any system resource access that does not have the necessary allow policy is treated as a violation, and the operation is denied. The violating operation fails when a denial occurs, and system logs are generated. In Enforcing mode, the solution works in access-violation prevention mode.

Supported Platforms

From Cisco IOS XE 17.13.1a, SELinux is enabled on the following platforms:

- Cisco 1000 Series Aggregation Services Routers
- Cisco 1000 Series Integrated Services Routers
- Cisco 4000 Series Integrated Services Routers
- Cisco Catalyst 8000v Edge Software
- Cisco Catalyst 8200 Series Edge Platforms
- Cisco Catalyst 8300 Series Edge Platforms
- Cisco Catalyst 8500 and 8500L Series Edge Platforms
- Cisco VG Series Gateways: VG400, VG410, VG420, and VG450
- Cisco 1100 Terminal Services Gateway

Configuring SELinux

The are no additional requirements or configuration steps needed to enable or use the SELinux feature in Enforcing mode.

The following commands are introduced as part of the SELinux feature:

```
set platform software selinux {default | enforcing | permissive}
```

```
platform security selinux {enforcing | permissive}
```

```
show platform software selinux
```

Note These new commands are implemented as **service internal** commands.

Configuring SELinux (EXEC Mode)

Use the **set platform software selinux** command to configure SELinux in EXEC mode.

The following example shows SELinux configuration in EXEC mode:

```
Device# set platform software selinux ?

default  Set SELinux mode to default
enforcing  Set SELinux mode to enforcing
permissive  Set SELinux mode to permissive
```

Configuring SELinux (CONFIG Mode)

Use the **platform security selinux** command to configure SELinux in configuration mode.

The following example shows SELinux configuration in CONFIG mode:

```
Device(config)# platform security selinux

enforcing  Set SELinux policy to Enforcing mode
permissive  Set SELinux policy to Permissive mode

Device(config)# platform security selinux permissive

Device(config)#
*Oct 20 21:52:45.155: %IOSXE-1-PLATFORM: R0/0:
SELINUX_MODE_PROG: Platform Selinux confinement mode downgraded to permissive!

Device(config)#
```

Examples for SELinux

The following example shows the output for changing the mode from Enforcing to Permissive:

```
“*Oct 20 21:44:03.609: %IOSXE-1-PLATFORM: R0/0:
SELINUX_MODE_PROG: Platform Selinux confinement mode downgraded to permissive!”
```

The following example shows the output for changing the mode from Permissive to Enforcing:

```
“*Oct 20 21:44:34.160: %IOSXE-1-PLATFORM: R0/0:
SELINUX_MODE_PROG: Platform Selinux confinement mode upgraded to enforcing!”
```

Note If the SELinux mode is changed, this change is considered a system security event, and a system log message is generated.

SysLog Message Reference

Facility-Severity-Mnemonic	**%SELINUX-1-VIOLATION**
Severity-Meaning	Alert Level Log
Message	N/A
Message Explanation	Resource access was made by the process for which a resource access policy does not exist. The operation was flagged, and resource access was denied. A system log was generated with information that process resource access has been denied.
Component	SELINUX
Recommended Action	Contact Cisco TAC with the following relevant information as attachments: • The exact message as it appears on the console or in the system • Output of the **show tech-support** command (text file) • Archive of Btrace files from the box using the following command: **request platform software trace archive target <URL>** • Output of the **show platform software selinux** command

The following examples demonstrate sample syslog messages:

Example 1:

```
*Nov 14 00:09:04.943: %SELINUX-1-VIOLATION: R0/0: audispd: type=AVC
msg=audit(1699927057.934:129): avc: denied { getattr } for pid=5899 comm="ls"
path="/root/test" dev="rootfs" ino=25839
scontext=system_u:system_r:polaris_iosd_t:s0
tcontext=system_u:object_r:admin_home_t:s0 tclass=file permissive=0
```

Example 2:

```
*Nov 14 00:09:04.947: %SELINUX-1-VIOLATION: R0/0: audispd: t type=AVC
msg=audit(1699927198.486:130): avc: denied { write } for pid=6012 comm="echo"
path="/root/test" dev="rootfs" ino=25839
scontext=system_u:system_r:polaris_iosd_t:s0
tcontext=system_u:object_r:admin_home_t:s0 tclass=file permissive= 0
```

Verifying SELinux Enablement

Use the **show platform software selinux** command to view the SELinux configuration mode:

```
Device# show platform software selinux
=========================================
IOS-XE SELINUX STATUS
=========================================
SElinux Status :    Enabled
Current Mode :      Enforcing
Config file Mode :  Enforcing
```

Troubleshooting SELinux

If there is an instance of an SELinux violation on your device or network, please reach out to Cisco TAC with the following details:

- The message exactly as it appears on the console or in the system log. For example:

  ```
  device#request platform software trace archive target
      flash:selinux_btrace_logs
  ```

- Output of the **show tech-support** command (text file)
- Archive of Btrace files from the box using the following command:

  request platform software trace archive target <URL>

- Output of the **show platform software selinux** command