Basic System Management Configuration Guide, Cisco IOS Release 12.4T

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CONTENTS

Performing Basic System Management

This module describes the basic tasks that you can perform to manage the general system features of the Cisco IOS software--those features that are generally not specific to a particular protocol.

Finding Feature Information

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

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

Information About Performing Basic System Management

System Name

The system name, also called the hostname, is used to uniquely identify the system in your network. The system name is displayed at the CLI prompt. If no name is configured, the system default name is Router.

Command Aliases

Command aliases allow you to configure alternative syntax for commands. You may want to create aliases for commonly used or complex commands. For example, you could assign the alias **save config** to the **copy running-config startup-config** command to reduce the amount of typing you have to perform, or if your users might find the **save config** command easier to remember. Use word substitutions or abbreviations to tailor the command syntax for you and your user community.

Remember that any aliases you configure will be effective only on your system, and that the original command syntax will appear in the configuration file.

Minor Services

Minor services are small servers that run on your routing device and are useful for basic system testing and for providing basic network functions. Minor services are useful for testing connections from another host on the network.

Cisco small servers are conceptually equivalent to daemons.

Small servers provided by Cisco IOS software-based devices include TCP, UDP, HTTP, Bootstrap Protocol (BOOTP), and Finger. For information about the HTTP server, see the “Using the Cisco Web Browser User Interface” chapter in the Cisco IOS Configuration Fundamentals Configuration Guide.

The TCP small server provides the following minor services:

- Chargen--Generates a stream of ASCII data. To test this service, issue the **telnet** *a.b.c.d* **chargen**command from a remote host.
- Daytime--Returns the system date and time if you have configured Network Time Protocol (NTP) or set the date and time manually. To test this service, issue the **telnet** *a.b.c.d* **daytime**command from a remote host.
- Discard--Discards whatever you type. To test this service, issue the **telnet** *a.b.c.d* **discard**command from a remote host.
- Echo--Echoes back whatever you type. To test this service, issue the **telnet** *a.b.c.d* **echo**command from a remote host.

The UDP small server provides the following minor services:

- Chargen--Discards the datagram that you send and responds with a 72-character string of ASCII characters terminated with a CR+LF (carriage return and line feed).
- Discard--Discards the datagram you send.
- Echo--Echoes the payload of the datagram that you send.

Minor services are disabled by default.

Caution Enabling minor services creates the potential for certain types of denial-of-service (DoS) attacks, such as the UDP diagnostic port attack. Therefore, any network device that has UDP, TCP, BOOTP, or Finger services should be protected by a firewall or have the minor services disabled. For information on preventing UDP diagnostic port attacks, see the white paper titled Defining Strategies to Protect Against UDP Diagnostic Port Denial of Service Attacks a vailable on Cisco.com.

BOOTP Server

You can enable or disable an async line Bootstrap Protocol (BOOTP) service on your routing device. This small server is enabled by default. Due to security considerations, this service should be disabled if you are not using it.

Because DHCP is based on the BOOTP, both of these service share the well-known UDP server port 67 (per the Internet standards and RFCs). For more information about DHCP configuration in the Cisco IOS software, see the Cisco IOS IP Addressing Configuration Guide. For more information about BOOTP, see RFC 951. Interoperation between BOOTP and DHCP is defined in RFC 1534. DHCP is defined in RFC 2131.

Finger Protocol

The Finger protocol allows users throughout the network to get a list of the users currently using a particular routing device. The information displayed includes the processes running on the system, the line number, connection name, idle time, and terminal location. This information is provided through the Cisco IOS software **show users** EXEC command.

Hidden Telnet Addresses

You can hide addresses while attempting to establish a Telnet session. The hide feature suppresses the display of the address and continues to display all other messages that normally would be displayed during a connection attempt, such as detailed error messages if the connection fails.

EXEC Startup Delay

To delay the startup of the EXEC process on noisy lines until the line has been idle for 3 seconds, use the **service exec-wait** command in global configuration mode.

This command is useful on noisy modem lines or when a modem attached to the line is configured to ignore Microcom Networking Protocol (MNP) or V.42 negotiations, and when MNP or V.42 modems are dialing in. In these cases, noise or MNP/V.42 packets might be interpreted as usernames and passwords, causing authentication failure before the user can type a username or password. This command is not useful on nonmodem lines or lines without some kind of login configured.

Idle Telnet Connections

Normally, data sent to noncurrent Telnet connections is accepted and discarded. When the **service telnet-zero-idle** command is enabled and a session is suspended (that is, some other connection is made active),

the TCP window is set to zero. This action prevents the remote host from sending any more data until the connection is resumed. Use this command when all messages sent by the host must be seen by the users and the users are likely to use multiple sessions. Do not use this command if your host will eventually time out and log out a TCP user whose window is zero.

Interval for Load Data

You can change the period of time over which a set of data is used for computing load statistics. Decisions, such as dial backup, depend on these statistics. If you decrease the load interval, the average statistics are computed over a shorter period of time and are more responsive to bursts of traffic.

Number of TCP Transactions

When you are using a standard TCP implementation to send keystrokes between machines, TCP tends to send one packet for each keystroke typed, which can use up the bandwidth and contribute to the congestion on larger networks.

John Nagle's algorithm (RFC 896) helps alleviate the small-packet problem in TCP. The first character typed after the connection establishment is sent in a single packet, but TCP holds any additional characters that are typed until the receiver acknowledges the previous packet. Then the second, larger packet is sent, and the additional typed characters are saved until the acknowledgment comes back. The effect is to accumulate characters into larger chunks, and pace their transmission to the network at a rate matching the round-trip time of the given connection. This method is usually preferable for all TCP-based traffic.

By default, the Nagle algorithm is not enabled.

Switching and Scheduling Priorities

The normal operation of the network server allows the switching operations to use as much of the central processor as required. If the network is running unusually heavy loads that do not allow the processor the time to handle the routing protocols, you may need to give priority to the system process scheduler.

System Buffer Size

You can adjust the initial buffer pool settings and limits at which temporary buffers are created and destroyed.

During normal system operation, there are two sets of buffer pools: public and interface. They behave as follows:

- The buffers in the public pools grow and shrink based upon demand. Some public pools are temporary and are created and destroyed as needed. Other public pools are permanently allocated and cannot be destroyed. Public buffer pools are labeled as small, middle, big, very big, large, and huge.
- Interface pools are static--that is, they are all permanent. One interface pool exists for each interface. For example, a Cisco 4000 1E 4T configuration has one Ethernet buffer pool and four serial buffer pools.

The server has one pool of queueing elements and six public pools of packet buffers of different sizes. For each pool, the server keeps count of the number of outstanding buffers, the number of buffers in the free list, and the maximum number of buffers allowed in the free list.

How to Perform Basic System Management

Setting Basic System Parameters

To set basic system parameters perform the following steps. You can perform these steps based on the customization requirements of your system.

SUMMARY STEPS

1. **hostname** *name*
2. **prompt** *string*
3. **alias** *mode alias-name alias-command-line*
4. **service tcp-small-servers**
5. **service udp-small-servers**
6. **no ip bootp server**
7. **ip finger**
8. **ip finger rfc-compliant**
9. **service hide-telnet-address**
10. **line** *line-number*
11. **busy-message**
12. exit
13. **service exec-wait**
14. **service telnet-zero-idle**
15. **load-interval** *seconds*
16. **service nagle**
17. **scheduler interval** *milliseconds*
18. **scheduler allocate** [*network-microseconds process-microseconds*]
19. **scheduler process-watchdog** {**hang** | **normal** | **reload** | **terminate**}
20. **buffers** {**small** | **middle** | **big** | **verybig** | **large** | **huge** | *type number*} {**permanent** | **max-free** | **min-free** | **initial**} *number*
21. exit
22. **show aliases** [*mode*]
23. **show buffers**

DETAILED STEPS

Step 1 **hostname** *name*

Use the **hostname** *name* command to perform the basic system management task of assigning a name for your device.

Example:

```
Router(config)# hostname host1
```

Step 2 **prompt** *string*
or

no service prompt config

By default, the CLI prompt consists of the system name followed by an angle bracket (>) for user EXEC mode or a pound sign (#) for privileged EXEC mode. Use the the **prompt** *string* or the **no service prompt config** command to customize the CLI prompt for your system.

Example:

```
Router(config)# prompt Router123
```

or

Example:

```
Router(config)# no service prompt config
```

Step 3 **alias** *mode alias-name alias-command-line*
Use the **alias** *mode alias-name alias-command-line* command to create a command alias.

Example:

```
Router(config)# alias exec save config copy running-config startup-config
```

Step 4 **service tcp-small-servers**
Use the **service tcp-small-servers** command to enable minor TCP services such as chargen, daytime, discard, and echo.

Note The **no** form of the **service tcp-small-servers** command will appear in the configuration file when these basic services are disabled.

Example:

```
Router(config)# service tcp-small-servers
```

Step 5 **service udp-small-servers**
Use the **service udp-small-servers** command to enable minor UDP services such as chargen, daytime, discard, and echo.

Note The **no** form of the **service udp-small-servers** command will appear in the configuration file when these basic services are disabled.

Example:

```
Router(config)# service udp-small-servers
```

Step 6 **no ip bootp server**
Use the **no ip bootp server** command to disable the BOOTP server on your platform.

Example:

```
Router(config)# no ip bootp server
```

Step 7 **ip finger**

Use the **ip finger** command to enable a Cisco device to respond to Finger (port 79) requests. When the **ip finger** command is configured, the router will respond to a **telnet** *a.b.c.d* **finger** command from a remote host by immediately displaying the output of the **show users**command and then closing the connection.

Example:

```
Router(config)# ip finger
```

Step 8 **ip finger rfc-compliant**

Use the **ip finger rfc-compliant** command to configure the finger protocol to be compliant with RFC 1288. The **ip finger rfc-compliant** command should not be configured for devices with more than 20 simultaneous users. When the **ip finger rfc-compliant**command is configured, the router will wait for input before displaying any information. The remote user can then press the Return key to display the output of the **show users** command, or enter **/W** to display the output of the **show users wide** command. After this information is displayed, the connection is closed.

Example:

```
Router(config)# ip finger rfc-compliant
```

Step 9 **service hide-telnet-address**

Use the **service hide-telnet-address** command to configure the router to suppress Telnet addresses.

Example:

```
Router(config)# service hide-telnet-address
```

Step 10 **line** *line-number*

Use the line command to enter line configuration mode.

Example:

```
Router(config)# line 1
```

Step 11 **busy-message**

Use the **busy-message** command with the **service hide-telnet-address**command to customize the information displayed during Telnet connection attempts. If the connection attempt fails, the router suppresses the address and displays the message specified with the **busy-message** command.

Example:

```
Router(config-line)# busy-message
```

Step 12 exit

Use the **exit** command to exit line configuration mode and return to global configuration mode.

Example:

```
Router(config-line)# exit
```

Step 13 **service exec-wait**
Use the **service exec-wait**command to delay the startup of the EXEC process on noisy lines until the line has been idle for 3 seconds.

Example:

```
Router(config)# service exec-wait
```

Step 14 **service telnet-zero-idle**
Use the **service telnet-zero-idle** command to configure the Cisco IOS software to set the TCP window to zero (0) when the Telnet connection is idle.

Example:

```
Router(config)# service telnet-zero-idle
```

Step 15 **load-interval** *seconds*
Use the **load-interval** *seconds* command to change the length of time for which a set of data is used to compute load statistics.

Example:

```
Router(config)# load-interval 100
```

Step 16 **service nagle**
Use the **service nagle** command to enable the Nagle algorithm and thereby reduce the number of TCP transactions.

Example:

```
Router(config)# load-interval 100
```

Step 17 **scheduler interval** *milliseconds*
Use the **scheduler interval** *milliseconds* command to define the maximum amount of time that can elapse without running the lowest-priority system processes.

Example:

```
Router(config)# scheduler interval 100
```

Step 18 **scheduler allocate** [*network-microseconds process-microseconds*]
Use the **scheduler allocate** command to change the amount of time that the CPU spends on fast-switching and process-level operations on the Cisco 7200 series and Cisco 7500 series routers.

Caution Cisco recommends that you do not change the default values of the **scheduler allocate** command.

Example:

```
Router(config)# scheduler allocate 5000 200
```

Step 19 **scheduler process-watchdog** {**hang** | **normal** | **reload** | **terminate**}

Use the **scheduler process-watchdog** {**hang** | **normal** | **reload** | **terminate**} command to configure the characteristics for a looping process.

Example:

```
Router(config)# scheduler process-watchdog hang
```

Step 20 **buffers** {**small** | **middle** | **big** | **verybig** | **large** | **huge** | *type number*} {**permanent** | **max-free** | **min-free** | **initial**} *number*

Use the **buffers** {**small** | **middle** | **big** | **verybig** | **large** | **huge** | *type number*} {**permanent** | **max-free** | **min-free** | **initial**} *number* command to adjust the system buffer size.

Example:

```
Router(config)# buffers small permanent 10
```

Caution Cisco does not recommend that you adjust these parameters. Improper settings can adversely impact the system performance.

Step 21 exit

Use the **exit** command to exit global configuration mode and return to privileged EXEC mode.

Example:

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

Step 22 **show aliases** [*mode*]

Use the **show aliases** [*mode*] command to display a list of command aliases currently configured on your system, and the original command syntax for those aliases.

Example:

```
Router# show aliases exec
```

Step 23 **show buffers**

Use the **show buffers**command to display buffer information. For more information about this command, see the Cisco IOS Configuration Fundamentals Command Reference.

Example:

```
Router# show buffers
Buffer elements:
     1119 in free list (1119 max allowed)
     641606 hits, 0 misses, 619 created
Public buffer pools:
Small buffers, 104 bytes (total 50, permanent 50):
     48 in free list (20 min, 150 max allowed)
     2976557 hits, 0 misses, 0 trims, 0 created
     0 failures (0 no memory)
Middle buffers, 600 bytes (total 25, permanent 25, peak 37 @ 2w0d):
```

```
     25 in free list (10 min, 150 max allowed)
     445110 hits, 4 misses, 12 trims, 12 created
     0 failures (0 no memory)
Big buffers, 1536 bytes (total 50, permanent 50):
     50 in free list (5 min, 150 max allowed)
     58004 hits, 0 misses, 0 trims, 0 created
     0 failures (0 no memory)
VeryBig buffers, 4520 bytes (total 10, permanent 10):
     10 in free list (0 min, 100 max allowed)
     0 hits, 0 misses, 0 trims, 0 created
     0 failures (0 no memory)
Large buffers, 5024 bytes (total 0, permanent 0):
     0 in free list (0 min, 10 max allowed)
     0 hits, 0 misses, 0 trims, 0 created
     0 failures (0 no memory)
Huge buffers, 18024 bytes (total 0, permanent 0):
     0 in free list (0 min, 4 max allowed)
     0 hits, 0 misses, 0 trims, 0 created
     0 failures (0 no memory)
Interface buffer pools:
Syslog ED Pool buffers, 600 bytes (total 282, permanent 282):
     257 in free list (282 min, 282 max allowed)
     32 hits, 0 misses
IPC buffers, 4096 bytes (total 2, permanent 2):
     1 in free list (1 min, 8 max allowed)
     1 hits, 0 fallbacks, 0 trims, 0 created
     0 failures (0 no memory)
Header pools:
Header buffers, 0 bytes (total 511, permanent 256, peak 511 @ 2w0d):
     255 in free list (256 min, 1024 max allowed)
     171 hits, 85 misses, 0 trims, 255 created
     0 failures (0 no memory)
     256 max cache size, 256 in cache
     0 hits in cache, 0 misses in cache
Particle Clones:
     1024 clones, 0 hits, 0 misses
Public particle pools:
F/S buffers, 128 bytes (total 512, permanent 512):
     0 in free list (0 min, 512 max allowed)
     512 hits, 0 misses, 0 trims, 0 created
     0 failures (0 no memory)
     512 max cache size, 512 in cache
     0 hits in cache, 0 misses in cache
Normal buffers, 512 bytes (total 2048, permanent 2048):
     2048 in free list (1024 min, 4096 max allowed)
     0 hits, 0 misses, 0 trims, 0 created
     0 failures (0 no memory)
Private particle pools:
HQF buffers, 0 bytes (total 2000, permanent 2000):
     2000 in free list (500 min, 2000 max allowed)
     0 hits, 0 misses, 0 trims, 0 created
     0 failures (0 no memory)
Serial2/0 buffers, 512 bytes (total 256, permanent 256):
     0 in free list (0 min, 256 max allowed)
     256 hits, 0 fallbacks
     256 max cache size, 132 in cache
     124 hits in cache, 0 misses in cache
     10 buffer threshold, 0 threshold transitions
Serial2/1 buffers, 512 bytes (total 256, permanent 256):
     0 in free list (0 min, 256 max allowed)
     256 hits, 0 fallbacks
     256 max cache size, 132 in cache
     124 hits in cache, 0 misses in cache
     10 buffer threshold, 0 threshold transitions
```

Configuration Examples for Performing Basic System Management

There are no configuration examples for the Performing Basic System Management feature.

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Network Management commands	*Cisco IOS Network Management Command Reference*
Cisco IOS fundamental configuration commands	*Cisco IOS Configuration Fundamentals Command Reference*
Cisco IOS fundamental configurations	*Cisco IOS Configuration Fundamentals Configuration Guide*
Preventing UDP diagnostic port attacks	Defining Strategies to Protect Against UDP Diagnostic Port Denial of Service Attacks
DHCP configuration	*Cisco IOS IP Addressing Configuration Guide*

Standards

Standard	Title
None	--

MIBs

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

RFCs

RFC	Title
RFC 896	*Congestion Control in IP/TCP Internetworks*
RFC 951	*Algorithms for Synchronizing Network Clocks*
RFC 1288	*The Finger User Information Protocol*
RFC 1534	*Interoperation Between DHCP and BOOTP*
RFC 2131	*Dynamic Host Configuration Protocol*

Technical Assistance

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

Feature Information for Performing Basic System Management

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

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

Table 1 Feature Information for Performing Basic System Management

Feature Name	Releases	Feature Information
Performing Basic System Management	10.0	This module describes the basic tasks to manage the general system features of the Cisco IOS software.

Setting Time and Calendar Services

All Cisco routers provide an array of time-of-day services. These services allow the products to accurately keep track of the current time and date, to synchronize multiple devices to the same time, and to provide time services to other systems.

Most Cisco routers have two clocks: a battery-powered hardware clock (referenced in CLI commands as the calendar) and a software clock (referenced in CLI commands as the clock). These two clocks are managed separately.

This module describes how to update the software clock from various sources.

Finding Feature Information

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Information About Setting Time and Calendar Services

Time and Calendar Services

The primary source for time data on your system is the software clock. This clock runs from the moment the system starts up and keeps track of the current date and time. The software clock can be set from a number of sources and in turn can be used to distribute the current time through various mechanisms to other systems. When a router with a hardware clock is initialized or rebooted, the software clock is initially set based on the time in the hardware clock. The software clock can then be updated from the following sources:

- Manual configuration (using the hardware clock)
- Network Time Protocol (NTP)
- Simple Network Time Protocol (SNTP)
- VINES Time Service

Because the software clock can be dynamically updated, it has the potential to be more accurate than the hardware clock.

The software clock can provide time to the following services:

- Access lists
- Logging and debugging messages
- NTP
- The hardware clock
- User **show** commands
- VINES Time Service

Note The software clock cannot provide time to the NTP or VINES Time Service if it was set using SNTP.

The software clock keeps track of time internally based on the Coordinated Universal Time (UTC), also known as Greenwich Mean Time (GMT). You can configure information about the local time zone and summer time (daylight saving time) so that time is displayed correctly relative to the local time zone.

The software clock keeps track of whether the time is authoritative (that is, whether it has been set by a time source considered to be authoritative). If it is not authoritative, the time will be available only for display purposes and will not be redistributed.

Network Time Protocol

NTP is a protocol designed to time-synchronize a network of machines. NTP runs on UDP, which in turn runs on IP. NTP Version 3 is documented in RFC 1305.

An NTP network usually gets its time from an authoritative time source such as a radio clock or an atomic clock attached to a time server. NTP then distributes this time across the network. NTP is extremely efficient; no more than one packet per minute is necessary to synchronize two machines to the accuracy of within a millisecond of one another.

NTP uses the concept of a stratum to describe how many NTP hops away a machine is from an authoritative time source. A stratum 1 time server typically has an authoritative time source (such as a radio or atomic clock, or a Global Positioning System (GPS) time source) directly attached, a stratum 2 time server receives its time via NTP from a stratum 1 time server, and so on.

NTP has two ways to avoid synchronizing to a machine whose time may not be accurate. NTP will never synchronize to a machine that is not in turn synchronized. NTP will compare the time reported by several

machines, and will not synchronize to a machine whose time is significantly different from others, even if its stratum is lower. This strategy effectively builds a self-organizing tree of NTP servers.

The Cisco implementation of NTP does not support stratum 1 service; in other words, you cannot connect to a radio or atomic clock (for some specific platforms, however, you can connect to a GPS time-source device). Cisco recommends that the time service for your network be derived from the public NTP servers available in the IP Internet.

If the network is isolated from the Internet, the Cisco implementation of NTP allows a machine to be configured so that it acts as though it is synchronized via NTP, when in fact it has determined the time using other means. Other machines can then synchronize to that machine via NTP.

A number of manufacturers include NTP software for their host systems, and a publicly available version for systems running UNIX. This software also allows UNIX-derivative servers to acquire the time directly from an atomic clock, which would subsequently propagate time information along to Cisco routers.

The communications between machines running NTP (known as associations) are usually statically configured; each machine is given the IP address of all machines with which it should form associations. Accurate timekeeping is made possible by exchanging NTP messages between each pair of machines with an association.

However, in a LAN environment, NTP can be configured to use IP broadcast messages instead. This alternative reduces configuration complexity because each machine can be configured to send or receive broadcast messages. However, the accuracy of timekeeping is marginally reduced because the information flow is one-way only.

The time kept on a machine is a critical resource, so Cisco strongly recommends that you use the security features of NTP to avoid the accidental or malicious setting of incorrect time. Two mechanisms are available: an access list-based restriction scheme and an encrypted authentication mechanism.

When multiple sources of time (VINES, hardware clock, manual configuration) are available, NTP is always considered to be more authoritative. NTP time overrides the time set by any other method.

NTP services are disabled on all interfaces by default.

For more information about NTP, see the following sections:

- Poll-Based NTP Associations, page 17
- Broadcast-Based NTP Associations, page 18
- NTP Access Group, page 18
- NTP Services on a Specific Interface, page 19
- Source IP Address for NTP Packets, page 19
- System as an Authoritative NTP Server, page 19

Poll-Based NTP Associations

Networking devices running NTP can be configured to operate in variety of association modes when synchronizing time with reference time sources. A networking device can obtain time information on a network in two ways: by polling host servers and by listening to NTP broadcasts. This section focusses on the poll-based association modes. Broadcast-based NTP associations are discussed in the Broadcast-Based NTP Associations, page 18 section.

The following are the two most commonly used poll-based association modes:

- Client mode
- Symmetric active mode

The client and the symmetric active modes should be used when NTP is required to provide a high level of time accuracy and reliability.

When a networking device is operating in the client mode, it polls its assigned time-serving hosts for the current time. The networking device will then pick a host from among all the polled time servers to synchronize with. Because the relationship that is established in this case is a client-host relationship, the host will not capture or use any time information sent by the local client device. This mode is most suited for file-server and workstation clients that are not required to provide any form of time synchronization to other local clients. Use the **ntp server** command to individually specify the time-serving hosts that you want your networking device to consider synchronizing with and to set your networking device to operate in the client mode.

When a networking device is operating in the symmetric active mode, it polls its assigned time-serving hosts for the current time and it responds to polls by its hosts. Because this is a peer-to-peer relationship, the host will also retain time-related information of the local networking device that it is communicating with. This mode should be used when a number of mutually redundant servers are interconnected via diverse network paths. Most stratum 1 and stratum 2 servers on the Internet adopt this form of network setup. Use the **ntp peer**command to individually specify the time serving hosts that you want your networking device to consider synchronizing with and to set your networking device to operate in the symmetric active mode.

The specific mode that you should set each of your networking devices to depends primarily on the role that you want them to assume as a timekeeping device (server or client) and its proximity to a stratum 1 timekeeping server.

A networking device engages in polling when it is operating as a client or a host in the client mode or when it is acting as a peer in the symmetric active mode. Although polling does not usually exact a toll on memory and CPU resources such as bandwidth, an exceedingly large number of ongoing and simultaneous polls on a system can seriously impact the performance of a system or slow the performance of a given network. To avoid having an excessive number of ongoing polls on a network, you should limit the number of direct, peer-to-peer or client-to-server associations. Instead, you should consider using NTP broadcasts to propagate time information within a localized network.

Broadcast-Based NTP Associations

Broadcast-based NTP associations should be used when time accuracy and reliability requirements are modest and if your network is localized and has more than 20 clients. Broadcast-based NTP associations are also recommended for use on networks that have limited bandwidth, system memory, or CPU resources.

A networking device operating in the broadcast client mode does not engage in any polling. Instead, it listens for NTP broadcast packets that are transmitted by broadcast time servers. Consequently, time accuracy can be marginally reduced because time information flows only one way.

Use the **ntp broadcast client** command to set your networking device to listen for NTP broadcast packets propagated through a network. In order for broadcast client mode to work, the broadcast server and its clients must be located on the same subnet. The time server that is transmitting NTP broadcast packets will also have to be enabled on the interface of the given device using the **ntp broadcast** command.

NTP Access Group

The access list-based restriction scheme allows you to grant or deny certain access privileges to an entire network, a subnet within a network, or a host within a subnet. To define an NTP access group, use the **ntp access-group** {**peer** | **query-only** | **serve** | **serve-only**} {*access-list-number* | *access-list-number-expanded* | *access-list-name*} [**kod**] command in global configuration mode.

The access group options are scanned in the following order, from least restrictive to the most restrictive:

1. **peer** --Allows time requests and NTP control queries and allows the system to synchronize itself to a system whose address passes the access list criteria.
2. **serve** --Allows time requests and NTP control queries, but does not allow the system to synchronize itself to a system whose address passes the access list criteria.
3. **serve-only** --Allows only time requests from a system whose address passes the access list criteria.
4. **query-only** --Allows only NTP control queries from a system whose address passes the access list criteria.

If the source IP address matches the access lists for more than one access type, the first type is granted access. If no access groups are specified, all access types are granted to all systems. If any access groups are specified, only the specified access types will be granted access.

For details on NTP control queries, see RFC 1305 (NTP version 3).

The encrypted NTP authentication scheme should be used when a reliable form of access control is required. Unlike the access list-based restriction scheme that is based on IP addresses, the encrypted authentication scheme uses authentication keys and an authentication process to determine if NTP synchronization packets sent by designated peers or servers on a local network are deemed as trusted before the time information that they carry along with them is accepted.

The authentication process begins from the moment an NTP packet is created. Cryptographic checksum keys are generated using the message digest algorithm 5 (MD5) and are embedded into the NTP synchronization packet that is sent to a receiving client. Once a packet is received by a client, its cryptographic checksum key is decrypted and checked against a list of trusted keys. If the packet contains a matching authentication key, the time-stamp information that is contained within it is accepted by the receiving client. NTP synchronization packets that do not contain a matching authenticator key are ignored.

It is important to note that the encryption and decryption processes used in NTP authentication can be very CPU-intensive and can seriously degrade the accuracy of the time that is propagated within a network. If your network setup permits a more comprehensive model of access control, you should consider the use of the access list-based form of control instead.

After NTP authentication is properly configured, your networking device will synchronize with and provide synchronization only to trusted time sources.

NTP Services on a Specific Interface

NTP services are disabled on all interfaces by default. NTP is enabled globally when any NTP commands are entered. You can selectively prevent NTP packets from being received through a specific interface by using the **ntp disable** command in interface configuration mode.

Source IP Address for NTP Packets

When the system sends an NTP packet, the source IP address is normally set to the address of the interface through which the NTP packet is sent. Use the **ntp source** *interface* command in global configuration mode if you want to configure a specific interface from which the IP source address will be taken.

This interface will be used for the source address for all packets sent to all destinations. If a source address is to be used for a specific association, use the **source** keyword in the **ntp peer** or **ntp server** command.

System as an Authoritative NTP Server

Use the **ntp master** [*stratum*] command in global configuration mode if you want the system to be an authoritative NTP server, even if the system is not synchronized to an outside time source.

Note Use the **ntp master**command with caution. It is very easy to override valid time sources using this command, especially if a low stratum number is configured. Configuring multiple machines in the same network with the **ntp master** command can cause instability in timekeeping if the machines do not agree on the time.

Simple Network Time Protocol

SNTP is a simplified, client-only version of NTP for use on Cisco 1003, Cisco 1004, Cisco 1005, Cisco 1600, Cisco 1720, and Cisco 1750 routers. SNTP can receive only the time from NTP servers; it cannot be used to provide time services to other systems.

SNTP typically provides time within 100 milliseconds of the accurate time, but it does not provide the complex filtering and statistical mechanisms of NTP. In addition, SNTP does not authenticate traffic, although you can configure extended access lists to provide some protection. An SNTP client is more vulnerable to misbehaving servers than an NTP client and should be used only in situations where strong authentication is not required.

You can configure SNTP to request and accept packets from configured servers or to accept NTP broadcast packets from any source. When multiple sources are sending NTP packets, the server with the best stratum is selected. (See the “Network Time Protocol, page 16” section for a description of strata.) If multiple servers are at the same stratum, a configured server is preferred over a broadcast server. If multiple servers pass both tests, the first one to send a time packet is selected. SNTP will choose a new server only if it stops receiving packets from the currently selected server, or if a better server (according to the criteria described) is discovered.

VINES Time Service

Time service is available when Banyan VINES is configured. This protocol is a standard part of VINES. The Cisco implementation allows the VINES time service to be used in two ways. First, if the system has learned the time from some other source, it can act as a VINES time server and provide time to other machines running VINES. Second, it can use the VINES time service to set the software clock if no other form of time service is available.

Note Support for Banyan VINES and XNS is removed from Cisco IOS software in Cisco IOS Release 12.2(13)T and later releases.

Hardware Clock

Some routers contain a battery-powered hardware clock that tracks the date and time across system restarts and power outages. The hardware clock is always used to initialize the software clock when the system is restarted.

Note Within the CLI command syntax, the hardware clock is referred to as the system calendar.

If no other source is available, the hardware clock can be considered to be an authoritative source of time and be redistributed via NTP or VINES Time Service. If NTP is running, the hardware clock can be updated periodically from NTP, compensating for the inherent drift in the hardware clock.

You can configure a hardware clock (system calendar) on any device to be periodically updated from the software clock. This is advisable for any device using NTP, because the time and date on the software clock (set using NTP) will be more accurate than the hardware clock, because the time setting on the hardware clock has the potential to drift slightly over time.

Use the **ntp update-calendar** command in global configuration mode if a routing device is synchronized to an outside time source via NTP and you want the hardware clock to be synchronized to NTP time.

How to Set Time and Calendar Services

Configuring NTP

NTP services are disabled on all interfaces by default. Perform the following tasks to configure NTP service on your networking device.

Restrictions

The NTP package contains a vulnerability that could allow an unauthenticated, remote attacker to cause a DoS condition. NTP versions 4.2.4p7 and earlier are vulnerable.

The vulnerability is due to an error in handling certain malformed messages. An unauthenticated, remote attacker could send a malicious NTP packet with a spoofed source IP address to a vulnerable host. The host that processes the packet sends a response packet back to the transmitter. This action could start a loop of messages between the two hosts that could cause both the hosts to consume excessive CPU resources, use up the disk space writing messages to log files, and consume the network bandwidth. These could cause a DoS condition on the affected hosts.

For more information, see the Network Time Protocol Package Remote Message Loop Denial of Service Vulnerability web page.

Cisco IOS software releases that supports NTPv4 are not affected. All other versions of Cisco IOS and Cisco IOS XE software are affected.

To display whether a device is configured with NTP, use the **show running-config | include ntp** command. If the output returns any of the following commands, then that device is vulnerable to the attack:

- **ntp broadcast client**
- **ntp master**
- **ntp multicast client**
- **ntp peer**
- **ntp server**

For more information on understanding Cisco IOS software releases, see the White Paper: Cisco IOS Reference Guide .

There are no workarounds other than disabling NTP on the device. Only packets destined for any configured IP address on the device can exploit this vulnerability. Transit traffic will not exploit this vulnerability.

Releases later than Cisco IOS Release 12.2(33)SXH7 will not process NTP mode 7 packets, and will display the message “NTP: Receive: dropping message: Received NTP private mode packet .7” if debugs for NTP are enabled. Configure the **ntp allow mode private** command to process NTP mode 7 packets. This command is disabled by default.

Note NTP peer authentication is not a workaround and is a vulnerable configuration.

NTP services are disabled on all interfaces by default.

Networking devices running NTP can be configured to operate in variety of association modes when synchronizing time with reference time sources. A networking device can obtain time information on a network in two ways: by polling host servers and by listening to NTP broadcasts.

This section contains the following tasks:

Configuring Poll-Based NTP Associations

The following are the two most commonly used poll-based association modes:

- Client mode
- Symmetric active mode

The client and the symmetric active modes should be used when NTP is required to provide a high level of time accuracy and reliability.

You can specify the time-serving hosts that you want your networking device to consider synchronizing with and to set your networking device to operate in the client mode or in the symmetric active mode.

The specific mode that you should set each of your networking devices to depends primarily on the role that you want it to assume as a timekeeping device (server or client) and its proximity to a stratum 1 timekeeping server.

Perform the following task to configure the NTP server-peer relationship.

Note that only one end of an association needs to be configured; the other system will automatically establish the association.

Caution The **ntp clock-period** command is automatically generated to display the constantly changing correction factor when the **copy running-configuration startup-configuration**command is entered to save the configuration to NVRAM. Do not attempt to manually use the **ntp clock-period**command. Ensure that you remove this command line when copying configuration files to other devices.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ntp peer** *ip-address* [**normal-sync**] [**version** *number*] [**key** *key-id*] [**source** *interface-type interface-number*] [**prefer**]
4. **ntp server** *ip-address* [**version** *number*] [**key** *key-id*] [**source** *interface-type interface-number*] [**prefer**]
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	**ntp peer** *ip-address* [**normal-sync**] [**version** *number*] [**key** *key-id*] [**source** *interface-type interface-number*] [**prefer**] **Example:** `Router(config)# ntp peer 192.168.10.1 normal-sync version 2 prefer`	Forms a peer association with another system.
Step 4	**ntp server** *ip-address* [**version** *number*] [**key** *key-id*] [**source** *interface-type interface-number*] [**prefer**] **Example:** `Router(config)# ntp server 192.168.10.1 version 2 prefer`	Forms a server association with another system.

	Command or Action	Purpose
Step 5	**end** **Example:** `Router(config)# end`	Exits global configuration mode and returns to privileged EXEC mode.

Configuring Broadcast-Based NTP Associations

A networking device operating in the broadcast client mode does not engage in any polling. Instead, it listens for NTP broadcast packets that are transmitted by broadcast time servers. Consequently, time accuracy can be marginally reduced because time information flows only one way.

You can set your networking device to listen for NTP broadcast packets propagated through a network. The time server that is transmitting NTP broadcast packets will also have to be enabled on the interface of the given device.

Perform the following task to configure broadcast-based NTP associations.

Caution The **ntp clock-period** command is automatically generated to reflect the constantly changing correction factor when the **copy running-configuration startup-configuration**command is entered to save the configuration to NVRAM. Do not attempt to manually use the **ntp clock-period**command. Ensure that you remove this command line from the configuration when copying configuration files to other devices.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ntp broadcast version** *number*
5. **ntp broadcast client**
6. **ntp broadcastdelay** *microseconds*
7. **end**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface ethernet 0/0`	Configures an interface and enters interface configuration mode.
Step 4	**ntp broadcast version** *number* **Example:** `Router(config-if)# ntp broadcast version 2`	Configures the specified interface to send NTP broadcast packets.
Step 5	**ntp broadcast client** **Example:** `Router(config-if)# ntp broadcast client`	Configures the specified interface to receive NTP broadcast packets.
Step 6	**ntp broadcastdelay** *microseconds* **Example:** `Router(config-if)# ntp broadcastdelay 100`	Adjusts the estimated round-trip delay for NTP broadcasts.
Step 7	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Configuring NTP Authentication

After NTP authentication is properly configured, your networking device will synchronize with and provide synchronization only to trusted time sources. To configure NTP authentication, perform the following task.

Note In Cisco IOS software earlier than Release 12.0, the cryptotype value is displayed along with the NTP authentication key MD5 value when the **show running-config**command is entered. Copying and pasting the string cryptotype value that is displayed with the authentication key will result in authentication failure.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ntp authenticate**
4. **ntp authentication-key** *number* **md5** *key*
5. **ntp trusted-key** *key-id*
6. **ntp server** *ip-address* **key** *key-id*
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:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ntp authenticate** **Example:** `Router(config)# ntp authenticate`	Enables the NTP authentication feature.
Step 4	**ntp authentication-key** *number* **md5** *key* **Example:** `Router(config)# ntp authentication-key 42 md5 key1`	Defines the authentication keys. • Each key has a key number, a type, and a value. As of Cisco IOS Release 10.0 the only key type supported is **md5**.

	Command or Action	Purpose
Step 5	**ntp trusted-key** *key-id* **Example:** `Router(config)# ntp trusted-key 42`	Defines trusted authentication keys. • If a key is trusted, this system will be ready to synchronize to a system that uses this key in its NTP packets.
Step 6	**ntp server** *ip-address* **key** *key-id* **Example:** `Router(config)# ntp server 172.16.22.44 key 2`	Allows the software clock to be synchronized by an NTP time server.
Step 7	**end** **Example:** `Router(config)# end`	Exits global configuration mode and returns to privileged EXEC mode.

Configuring an External Reference Clock

Because Cisco's implementation of NTP does not support stratum 1 service, you cannot connect to a radio or atomic clock (for some specific platforms, however, you can connect to a GPS time source device). However, certain Cisco devices allow you to connect to an external GPS-based time source device for the purposes of distributing a time signal to your network using NTP.

For example, the Trimble Palisade NTP Synchronization Kit can be connected to the auxiliary port of a Cisco 7200 series router. Also, selected platforms support the use of GPS clocks from Symmetricom (formerly Telecom-Solutions). The refclock (reference clock) drivers on these platforms provide the ability to receive an Request to Send (RTS) time-stamp signal on the auxiliary port of your routing device.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **line aux** *line-number*
4. **ntp refclock** {**trimble** | **telecom-solutions**} **pps** {**cts** | **ri** | **none**} [**inverted**] [**pps-offset** *number*] [**stratum** *number*] [**timestamp-offset** *number*]
5. **end**
6. **show ntp associations**
7. **show ntp status**
8. **debug ntp refclock**

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** *line-number* **Example:** `Router(config)# line aux 0`	Enters line configuration mode for the auxiliary port 0.
Step 4	**ntp refclock** {**trimble** | **telecom-solutions**} **pps** {**cts** | **ri** | **none**} [**inverted**] [**pps-offset** *number*] [**stratum** *number*] [**timestamp-offset** *number*] **Example:** `Router(config-line)# ntp refclock trimble pps none stratum 1`	Configures an external reference clock. • To configure a Trimble Palisade GPS product connected to the auxiliary port of a Cisco 7200 series router as the NTP reference clock, use the **ntp refclock trimble pps none stratum** *number* form of the command. Use this command to enable the driver that allows the Trimble Palisade NTP Synchronization Kit to be used as the NTP reference clock source (Cisco 7200 series routers only). • To configure a Symmetricom GPS product connected to the auxiliary port of a supported router or switch as the NTP reference clock, use the **ntp refclock telecom-solutions pps cts stratum** *number* form of the command.Use this command to enable the driver that allows the Symmetricom GPS product to be used as the NTP reference clock source. • To configure a pulse per second (PPS) signal as the source for NTP synchronization, use the **ntp refclock telecom-solutions pps cts stratum** *number* form of the command. • To configure a PPS signal as the source for NTP synchronization, use the **ntp refclock**{**trimble**| **telecom-solutions**} **pps** {**cts** | **ri**} [**inverted**] [**pps-offset** *number*] [**stratum** *number*] [**timestamp-offset** *number*].
Step 5	**end** **Example:** `Router(config-line)# end`	Exits line configuration mode and returns to privileged EXEC mode.

	Command or Action	Purpose
Step 6	**show ntp associations** **Example:** `Router# show ntp associations`	Displays the status of NTP associations, including the status of the GPS reference clock.
Step 7	**show ntp status** **Example:** `Router# show ntp status`	Displays the status of NTP.
Step 8	**debug ntp refclock** **Example:** `Router# debug ntp refclock`	Allows advanced monitoring of reference clock activities for the purposes of debugging.

Configuring SNTP

SNTP generally is supported on those platforms that do not provide support for NTP, such as the Cisco 1000 series, 1600 series, and 1700 series platforms. SNTP is disabled by default. To configure SNTP, perform the following task.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **sntp server** {*address* | *hostname*}[**version***number*]
4. **sntp broadcast client**
5. **exit**
6. **show sntp**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**sntp server** {*address* | *hostname*} [**version***number*] **Example:** `Router(config)# sntp server 192.168.2.1 version 2`	Configures SNTP to request NTP packets from an NTP server. • Enter the **sntp server** command once for each NTP server. The NTP servers must be configured to respond to the SNTP messages from the router.
Step 4	**sntp broadcast client** **Example:** `Router(config)# sntp broadcast client`	Configures SNTP to accept NTP packets from any NTP broadcast server. **Note** If you enter both the **sntp server** command and the **sntp broadcast client**command, the router will accept time from a broadcast server but will prefer time from a configured server, assuming that the strata are equal.
Step 5	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode and returns to privileged EXEC mode.
Step 6	**show sntp** **Example:** `Router# show sntp`	Displays information about SNTP.

Configuring VINES Time Service

Time service is available when Banyan VINES is configured. This protocol is a standard part of VINES. Perform the following task to configure VINES Time Service.

Note Support for Banyan VINES and XNS was removed from Cisco IOS software beginning in Cisco IOS Release 12.2(13)T. The following VINES commands are not available in releases derived from 12.2(13)T, such as the 12.3 mainline release.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **vines time use-system**
4. **vines time set-system**
5. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**vines time use-system** **Example:** `Router(config)# vines time use-system`	Distributes the system software clock time to other VINES systems.
Step 4	**vines time set-system** **Example:** `Router(config)# vines time set-system`	Sets the software clock system time and date as derived from VINES time services.
Step 5	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode and returns to privileged EXEC mode.

Configuring the Time and Date Manually

If no other source of time is available, you can manually configure the current time and date after the system is restarted. The time will remain accurate until the next system restart. We recommend that you use manual configuration only as a last resort.

If you have an outside source to which the router can synchronize, you need not manually set the software clock. Perform the following task to configure the time and date manually.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **clock timezone** *zone hours-offset* [*minutes-offset*]
4. **clock summer-time** *zone* **recurring** [*week day month hh* **:** *mm week day month hh* **:** *mm* [*offset*]]
5. **clock summer-time** *zone* **date** *date month year hh:mm date month year hh* **:** *mm* [*offset*]
6. **exit**
7. **clock set** *hh* **:** *mm* **:** *ss date month year*

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	**clock timezone** *zone hours-offset* [*minutes-offset*] **Example:** `Router(config)# clock timezone PST 2 30`	Configures the time zone used by the Cisco IOS software. • The *zone* argument is the name of the time zone (typically a standard acronym). The *hours-offset* argument is the number of hours the time zone is different from UTC. The *minutes-offset* argument is the number of minutes the time zone is different from UTC. **Note** The*minutes-offset* argument of the **clock timezone** command is available for those cases where a local time zone is a percentage of an hour different from UTC/GMT. For example, the time zone for some sections of Atlantic Canada (AST) is UTC -3.5. In this case, the necessary command would be **clock timezone AST -3 30**.

	Command or Action	Purpose
Step 4	**clock summer-time** *zone* **recurring** [*week day month hh* **:** *mm week day month hh* **:** *mm* [*offset*]] **Example:** `Router(config)# clock summer-time PST recurring 1 monday january 12:12 4 Tuesday december 12:12 120`	Configures summer time (daylight saving time) in areas where it starts and ends on a particular day of the week each year . • The *offset* argument is used to indicate the number of minutes to add to the clock during summer time.
Step 5	**clock summer-time** *zone* **date** *date month year hh:mm date month year hh* **:** *mm* [*offset*] **Example:** `Router(config)# clock summer-time PST date 1 january 1999 12:12 4 december 2001 12:12 120`	Configures a specific summer time start and end date. • The *offset* argument is used to indicate the number of minutes to add to the clock during summer time.
Step 6	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode and returns to privileged EXEC mode.
Step 7	**clock set** *hh* **:** *mm* **:** *ss date month year* **Example:** `Router# clock set 12:12:12 1 january 2011`	Sets the software clock. • Use this command if no other time sources are available. The time specified in this command is relative to the configured time zone. **Note** Generally, if the system is synchronized by a valid outside timing mechanism, such as an NTP or VINES clock source, or if you have a router with a hardware clock, you need not set the software clock.

Setting the Hardware Clock

Most Cisco devices have a separate hardware-based clock in addition to the software-based clock. The hardware clock is a chip with a rechargeable backup battery that can retain the time and date information across reboots of the device.

To maintain the most accurate time update from an authoritative time source on the network, the software clock should receive time updates from an authoritative time on the network. The hardware clock should in turn be updated at regular intervals from the software clock while the system is running.

The hardware clock (system calendar) maintains time separately from the software clock. The hardware clock continues to run when the system is restarted or when the power is turned off. Typically, the hardware clock needs to be manually set only once, when the system is installed.

You should avoid setting the hardware clock manually if you have access to a reliable external time source. Time synchronization should instead be established using NTP.

Perform the following task to set the hardware clock.

SUMMARY STEPS

1. **enable**
2. **calendar set** *hh* **:** *mm* **:** *ss day month year*
3. **configure terminal**
4. **clock calendar-valid**
5. **exit**
6. **clock read-calendar**
7. **clock update-calendar**
8. **show calendar**
9. **show clock** [**detail**]
10. **show ntp associations** [**detail**]
11. **show ntp status**
12. **show sntp**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**calendar set** *hh* **:** *mm* **:** *ss day month year* **Example:** `Router# calendar set 10:12:15 monday june 1999`	Sets the hardware clock manually. **Note** Use this command when you have no access to an external time source.
Step 3	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 4	**clock calendar-valid** **Example:** `Router(config)# clock calendar-valid`	Enables the router to act as a valid time source to which network peers can synchronize. • By default, the time maintained on the software clock is not considered to be reliable and will not be synchronized with NTP or VINES time service. To set the hardware clock as a valid time source, use this command.

	Command or Action	Purpose
Step 5	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode and returns to privileged EXEC mode.
Step 6	**clock read-calendar** **Example:** `Router# clock read-calendar`	Sets the software clock to the new hardware clock setting.
Step 7	**clock update-calendar** **Example:** `Router# clock update-calendar`	Updates the hardware clock with a new software clock setting.
Step 8	**show calendar** **Example:** `Router# show calendar`	Displays the current hardware clock time.
Step 9	**show clock** [**detail**] **Example:** `Router# show clock detail`	Displays the current software clock time .
Step 10	**show ntp associations** [**detail**] **Example:** `Router# show ntp associations detail`	Displays the status of NTP associations.
Step 11	**show ntp status** **Example:** `Router# show ntp status`	Displays the status of NTP.

	Command or Action	Purpose
Step 12	**show sntp** **Example:** `Router# show sntp`	Displays information about SNTP (Cisco 1003, Cisco 1004, Cisco 1005, Cisco 1600, Cisco 1720, or Cisco 1750 routers only).

Configuring Time Ranges

Cisco IOS software allows implementation of features based on the time of day. The **time-range** global configuration command defines specific times of the day and week, which then can be referenced by a function, so that those time restrictions are imposed on the function itself.

In Cisco IOS Release 12.2, IP and IPX extended access lists are the only functions that can use time ranges. The time range allows the network administrator to define when the permit or deny statements in the access list are in effect. Prior to the introduction of this feature, access list statements were always in effect once they were applied. Both named and numbered access lists can reference a time range.

Note The time range relies on the system's software clock. For the time range feature to work the way you intend, you need a reliable clock source. Cisco recommends that you use NTP to synchronize the system's software clock.

Benefits of time ranges include the following:

- The network administrator has more control over permitting or denying a user access to resources. These resources could be an application (identified by an IP address/mask pair and a port number), policy routing, or an on-demand link (identified as interesting traffic to the dialer).
- Network administrators can set a time-based security policy, including the following:
  - Perimeter security using the Cisco IOS Firewall feature set or access lists.
  - Data confidentiality with Cisco Encryption Technology or IP security.
- Policy-based routing and queueing functions are enhanced.
- When provider access rates vary by time of day, traffic can be rerouted automatically and cost-effectively.
- Service providers can dynamically change a committed access rate (CAR) configuration to support the quality of service (QoS) service level agreements (SLAs) that are negotiated for certain times of the day.

Network administrators can control logging messages. Access list entries can log traffic at certain times of the day, but not constantly. Therefore, administrators can simply deny access without the need to analyze the many logs generated during peak hours.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **time-range** *time-range-name*
4. Do one of the following:
   - **absolute** [**start** *time date month year*] [**end** *time date month year*]
   -
   -
   - **periodic** *day-of-the-week hh* **:** *mm* **to** [*day-of-the-week*] *hh* **:** *mm*
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	**time-range** *time-range-name* **Example:** `Router(config)# time-range range1`	Assigns a name to the time range to be configured and enters time range configuration mode.

	Command or Action	Purpose

Step 4	Do one of the following:
	• **absolute** [**start** *time date month year*] [**end** *time date month year*]
	•
	•
	• **periodic** *day-of-the-week hh* **:** *mm* **to** [*day-of-the-week*] *hh* **:** *mm*
	Example:
	`Router(config-time-range)# absolute start 12:12 30 January 1999 end 12:12 30 December 2000`
	Example:
	`or`
	Example:
	`Router(config-time-range)# periodic monday 12:12 to friday 12:12`
		Specifies when the time range will be in effect.
		• Use some combination of these commands; multiple **periodic** commands are allowed; only one **absolute** command is allowed.

Step 5	**end** **Example:** `Router(config-time-range)# end`	Exits time range configuration mode and returns to privileged EXEC mode.

Verifying Time and Calendar Services

To monitor clock, calendar, and NTP EXEC services, use the following commands in privileged EXEC mode, as needed:

SUMMARY STEPS

1. **show calendar**
2. **show clock** [**detail**]
3. **show ntp associations detail**
4. **show ntp status**
5. **show sntp**

DETAILED STEPS

Step 1 **show calendar**

This command displays the current hardware clock time. The following is sample output from this command:

Example:

```
Router# show calendar
18:34:29 UTC Tue Jan 4 2011
```

Step 2 **show clock** [**detail**]

This command displays the current software clock time. The following is sample output from this command:

Example:

```
Router# show clock detail
*18:38:21.655 UTC Tue Jan 4 2011
Time source is hardware calendar
```

Step 3 **show ntp associations detail**

This command displays the status of NTP associations. The following is sample output from this command:

Example:

```
Router# show ntp associations detail
192.168.10.1 configured, insane, invalid, unsynced, stratum 16
ref ID .INIT., time 00000000.00000000 (00:00:00.000 UTC Mon Jan 1 1900)
our mode active, peer mode unspec, our poll intvl 64, peer poll intvl 1024
root delay 0.00 msec, root disp 0.00, reach 0, sync dist 15940.56
delay 0.00 msec, offset 0.0000 msec, dispersion 15937.50
precision 2**24, version 4
org time 00000000.00000000 (00:00:00.000 UTC Mon Jan 1 1900)
rec time 00000000.00000000 (00:00:00.000 UTC Mon Jan 1 1900)
xmt time D0CDE881.9A6A9005 (18:42:09.603 UTC Tue Jan 4 2011)
filtdelay =     0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
filtoffset =    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
filterror =  16000.0 16000.0 16000.0 16000.0 16000.0 16000.0 16000.0 16000.0
minpoll = 6, maxpoll = 10
192.168.45.1 configured, insane, invalid, unsynced, stratum 16
ref ID .INIT., time 00000000.00000000 (00:00:00.000 UTC Mon Jan 1 1900)
our mode client, peer mode unspec, our poll intvl 64, peer poll intvl 1024
root delay 0.00 msec, root disp 0.00, reach 0, sync dist 16003.08
delay 0.00 msec, offset 0.0000 msec, dispersion 16000.00
precision 2**24, version 4
org time 00000000.00000000 (00:00:00.000 UTC Mon Jan 1 1900)
rec time 00000000.00000000 (00:00:00.000 UTC Mon Jan 1 1900)
xmt time 00000000.00000000 (00:00:00.000 UTC Mon Jan 1 1900)
filtdelay =     0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
filtoffset =    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
filterror =  16000.0 16000.0 16000.0 16000.0 16000.0 16000.0 16000.0 16000.0
minpoll = 6, maxpoll = 10
```

Step 4 **show ntp status**

This command displays the status of NTP. The following is sample output from this command:

Example:

```
Router# show ntp status
Clock is unsynchronized, stratum 16, no reference clock
nominal freq is 250.0000 Hz, actual freq is 250.0000 Hz, precision is 2**24
reference time is 00000000.00000000 (00:00:00.000 UTC Mon Jan 1 1900)
clock offset is 0.0000 msec, root delay is 0.00 msec
root dispersion is 0.19 msec, peer dispersion is 0.00 msec
```

```
loopfilter state is 'FSET' (Drift set from file), drift is 0.000000000 s/s
system poll interval is 64, never updated.
```

Step 5 **show sntp**

This command displays information about SNTP (Cisco 1003, Cisco 1004, Cisco 1005, Cisco 1600, Cisco 1720, or Cisco 1750 routers only). The following is sample output from this command:

Example:

```
Router# show sntp
SNTP server     Stratum   Version    Last Receive
172.168.10.1      16        1        never
Broadcast client mode is enabled.
Multicast client 224.0.1.1 is enabled.
```

Configuration Examples for Setting Time and Calendar Services

Example Configuring Clock Calendar and NTP

In the following example, a router with a hardware clock that has server associations with two other systems sends broadcast NTP packets, periodically updates the hardware clock, and redistributes time into VINES:

```
clock timezone PST -8
clock summer-time PDT recurring
ntp update-calendar
ntp server 192.168.13.57
ntp server 192.168.11.58
interface Ethernet 0/0
 ntp broadcast
vines time use-system
```

In the following example, a router with a hardware clock has no outside time source, so it uses the hardware clock as an authoritative time source and distributes the time via NTP broadcast packets:

```
clock timezone MET 2
clock calendar-valid
ntp master
interface fddi 0/0
 ntp broadcast
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Network Management commands	*Cisco IOS Network Management Command Reference*
IP extended access lists	" Configuring IPv4 Addresses ” chapter of the Cisco IOS *IP Addressing Configuration Guide*
IPX extended access lists	" Configuring Novell IPX ” chapter of the *Cisco IOS Novell IPX Configuration Guide*
NTP package vulnerability	Network Time Protocol Package Remote Message Loop Denial of Service Vulnerability
Cisco IOS software releases	White Paper: Cisco IOS Reference Guide

Standards

Standard	Title
None	--

MIBs

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

RFCs

RFC	Title
RFC 1305	*Network Time Protocol (Version 3) Specification, Impl*

Technical Assistance

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

Feature Information for Setting Time and Calendar Services

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

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

Table 2 Feature Information for Setting Time and Calendar Services

Feature Name	Releases	Feature Information
Network Time Protocol	11.2(1) 12.2(28)SB 12.2(33)SRA 12.2(33)SXI 12.2(33)SXJ 12.2(50)SY 12.2(58)SE 15.0(1)M 15.1(2)S	NTP is a protocol designed to time-synchronize a network of machines. NTP runs on UDP, which in turn runs on IP. NTP is documented in RFC 1305. The following commands were introduced or modified: **ntp access-group**, **ntp allow mode passive**, **ntp authenticate**, **ntp authentication-key**, **ntp broadcast, ntp broadcast client**, **ntp broadcastdelay**, **ntp clear drift**, **ntp clock-period**, **ntp disable**, **ntp logging**, **ntp master**, **ntp max-associations**, **ntp multicast**, **ntp multicast client**, **ntp server**, **ntp source**, **ntp trusted-key**, **ntp update-calendar**.

Feature Name	Releases	Feature Information
Simple Network Time Protocol	12.0(2)T 12.2(4)T	SNTP is a simplified, client-only version of NTP for use on Cisco 1003, Cisco 1004, Cisco 1005, Cisco 1600, Cisco 1720, and Cisco 1750 routers. SNTP can receive only time from NTP servers; it cannot be used to provide time services to other systems. The following commands were introduced or modified: **sntp broadcast client**, **sntp server**.

Configuring System Logging Counts

This document describes the System Logging (error logging) count enhancement feature in Cisco IOS Release 12.2(8)T. It includes the following sections:

Feature Overview

The Cisco IOS logging facility allows you to save error messages locally or to a remote host. When these error messages exceed the capacity of the local buffer dedicated to storing them, the oldest messages are removed. To provide you with more information about messages that have occurred and may have been removed from the local buffer, an error log counter tabulates the occurrences of each error message, and time-stamps the most recent occurrence.

These messages are further sorted by message facility. Messages from each message facility are grouped together and totaled in the count. If a message is rate-limited, the count is incremented based on the actual messages that have occurred.

The **service timestamps** command configuration determines the format of the “Last Time” column in the **show logging** command output. Use the **service timestamps** command to configure the time-stamp format in the “Last Time” column.

Benefits

- Provides detailed information regarding system messages, including the most recent time the message occurred.
- Alerts you to a potential problem with the system if you see the same error message occurring repeatedly.

Related Features and Technologies

- Cisco IOS Logging

Finding Feature Information

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

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

Supported Standards MIBs and RFCs

Standards

No new or modified standards are supported by this feature.

MIBs

No new MIBs are supported by this feature

To obtain lists of supported MIBs by platform and Cisco IOS release, and to download MIB modules, go to the Cisco MIB website on Cisco.com at the following URL:

http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

RFCs

No new or modified RFCs are supported by this feature.

Configuration Tasks

See the following sections for configuration tasks for this feature. Each task in the list is identified as either required or optional.

- Enabling the Error Log Count Capability, page 46 (required)

- Enabling the Error Log Count Capability, page 46
- Verifying the Error Log Count Capability, page 47

Enabling the Error Log Count Capability

To enable the error log count capability, use the following command in global configuration mode:

Command	Purpose
`Router(config)#` **logging count**	Enables the error log count capability.

Verifying the Error Log Count Capability

Enter the **show logging count** command to view information about syslog error messages.

```
Router# show logging count
Facility       Message Name                      Sev Occur   Last Time
================================================================================
SYS            BOOTTIME                            6     1 00:00:12
SYS            RESTART                             5     1 00:00:11
SYS            CONFIG_I                            5     3 1d00h
-------------  ------------------------------  ----------------------------
SYS TOTAL                                              5
LINEPROTO      UPDOWN                              5    13 00:00:19
-------------  ------------------------------  ----------------------------
LINEPROTO TOTAL                                       13
LINK           UPDOWN                              3     1 00:00:18
LINK           CHANGED                             5    12 00:00:09
-------------  ------------------------------  ----------------------------
LINK TOTAL                                            13
SNMP           COLDSTART                           5     1 00:00:11
-------------  ------------------------------  ----------------------------
SNMP TOTAL                                             1
```

Configuration Examples

- Enabling the Error Log Count Capability Example, page 47

Enabling the Error Log Count Capability Example

In the following example, the error log count capability is enabled:

```
Router# logging count
Building configuration...
Current configuration : 2507 bytes
!
! Last configuration change at 14:53:38 UTC Tue Feb 5 2002
!
.
.
.
hostname router
!
logging count
logging buffered notifications
```

Feature Information for Event Tracer

Table 3 Feature Information for Event Tracer

Feature Name	Releases	Feature Information
Event Tracer	12.2(8)T	The Cisco IOS logging facility allows you to save error messages locally or to a remote host. The following commands were introduced or modified: **logging count**, **show logging**.

CPU Thresholding Notification

The CPU Thresholding Notification feature notifies users when a predefined threshold of CPU usage is crossed by generating a Simple Network Management Protocol (SNMP) trap message for the top users of the CPU.

Finding Feature Information

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

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

Restrictions for CPU Thresholding Notification

CPU utilization averages are computed by Cisco IOS software using a 4-millisecond Network-to-Management Interface (NMI) tick. In the unlikely event where the traffic rate is a multiple of this tick rate over a prolonged period of time, the CPU Thresholding Notification feature may not accurately measure the CPU load.

Information About CPU Thresholding Notification

The CPU Thresholding Notification feature allows you to configure CPU utilization thresholds that, when crossed, trigger a notification. Two types of CPU utilization threshold are supported:

Rising Threshold

A rising CPU utilization threshold specifies the percentage of CPU resources that, when exceeded for a configured period of time, triggers a CPU threshold notification.

Falling Threshold

A falling CPU utilization threshold specifies the percentage of CPU resources that, when CPU usage falls below this level for a configured period of time, triggers a CPU threshold notification.

How to Configure CPU Thresholding Notification

Enabling CPU Thresholding Notification

To specify the recipient of SNMP notification operations and enable CPU thresholding notification, perform these steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server enable traps cpu threshold**
4. **snmp-server host** *host-address* [**traps** | **informs**] [**version** {**1** | **2c** | **3** [**auth** | **noauth** | **priv**]}] *community-string* [**udp-port** *port*] **cpu**[*notification-type*] [**vrf** *vrf-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`	Enables global configuration mode.

	Command or Action	Purpose
Step 3	**snmp-server enable traps cpu threshold** **Example:** `Router(config)# snmp-server enable traps cpu threshold`	Enables CPU thresholding violation notification as traps and inform requests.
Step 4	**snmp-server host** *host-address* [**traps** | **informs**] [**version** {**1** | **2c** | **3** [**auth** | **noauth** | **priv**]}] *community-string* [**udp-port** *port*] **cpu**[*notification-type*] [**vrf** *vrf-name*] **Example:** `Router(config)# snmp-server host 192.168.0.0 traps public cpu`	Sends CPU traps to the specified address.

Defining CPU Thresholding Notification

To define a rising and a falling CPU threshold notification, perform these steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **process cpu threshold type** {**total** | **process** | **interrupt**} **rising** *percentage* **interval** *seconds* [**falling** *percentage* **interval** *seconds*]

DETAILED STEPS

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

	Command or Action	Purpose
Step 3	**process cpu threshold type** {**total** | **process** | **interrupt**} **rising** *percentage* **interval** *seconds* [**falling** *percentage* **interval** *seconds*] **Example:** `Router(config)# process cpu threshold type total rising 80 interval 5 falling 20 interval 5`	Sets the CPU thresholding notifications types and values. • In this example, the CPU utilization threshold is set to 80 percent for a rising threshold notification and 20 percent for a falling threshold notification, with a 5-second polling interval.

Setting the Entry Limit and Size of CPU Utilization Statistics

To set the process entry limit and the size of the history table for CPU utilization statistics, perform these steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **process cpu statistics limit entry-percentage** *number* [**size** *seconds*]

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	**process cpu statistics limit entry-percentage** *number* [**size** *seconds*] **Example:** `Router(config)# process cpu statistics limit entry-percentage 40 size 300`	Sets the process entry limit and the size of the history table for CPU utilization statistics. • In this example, to generate an entry in the history table, a process must exceed 40 percent CPU utilization. • In this example, the duration of time for which the most recent history is saved in the history table is 300 seconds.

Configuration Examples for CPU Thresholding Notification

Setting a Rising CPU Thresholding Notification Example

The following example shows how to set a rising CPU thresholding notification for total CPU utilization. When total CPU utilization exceeds 80 percent for a period of 5 seconds or longer, a rising threshold notification is sent.

```
Router(config)# process cpu threshold type total rising 80 interval 5
```

Note When the optional **falling** arguments (*percentage* and *seconds*) are not specified, they take on the same values as the **rising** arguments (*percentage* and *seconds*).

Setting a Falling CPU Thresholding Notification Example

The following example shows how to set a falling CPU thresholding notification for total CPU utilization. When total CPU utilization, which at one point had risen above 80 percent and triggered a rising threshold notification, falls below 70 percent for a period of 5 seconds or longer, a falling threshold notification is sent.

```
Router(config)# process cpu threshold type total rising 80 interval 5 falling 70 interval
5
```

Note When the optional **falling** arguments (*percentage* and *seconds*) are not specified, they take on the same values as the **rising** arguments (*percentage* and *seconds*).

Additional References

For additional information related to the CPU Thresholding Notification feature, refer to the following references:

Related Documents

Related Topic	Document Title
SNMP traps	*Configuration Fundamentals Command Reference*

Standards

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

MIBs

MIBs	MIBs Link
CISCO-PROCESS-MIB	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

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

Technical Assistance

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

Feature Information for CPU Thresholding Notification

Table 4 Feature Information for CPU Thresholding Notification

Feature Name	Releases	Feature Information
CPU Thresholding Notification	12.0(26)S 12.3(4)T 12.2(25)S	The following commands were introduced or modified: **process cpu statistics limit entry-percentage, process cpu threshold type, snmp-server enable traps cpu, snmp-server host.**

DSP Operational State Notifications

The DSP Operational State Notifications feature enables notifications to be generated when digital signaling processor (DSP) failure and recovery events occur. These notifications help facilitate troubleshooting and lessen downtime.

This feature module describes updates to the Cisco DSP Management MIB (CISCO-DSP-MGMT-MIB) for enabling and generating DSP operational state notifications. Also described is how to enable the feature either using the command-line interface (CLI) or by modifying settings at the network management device.

Finding Feature Information

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

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

Prerequisites for DSP Operational State Notifications

- Familiarity with the CISCO-DSP-MGMT-MIB and Simple Network Management Protocol (SNMP).

Information About DSP Operational State Notifications

To enable DSP operational state notifications when a DSP fails and when it recovers, you should understand the following concepts:

CISCO-DSP-MGMT-MIB

The CISCO-DSP-MGMT-MIB monitors DSP resources and status.

DSP Operational State Notification

A DSP notification consists of a DSP ID that indicates which DSP is affected and an operational state that indicates whether the DSP has failed or recovered.

When this feature is configured using the **snmp-server enable traps dsp oper-state**command, a notification is generated when a single DSP fails instead of after all DSPs have failed. For example, a DSP fails, and you lose your voice calls. In a DSP failure notification, the problem is identified. If no DSP failure notification is generated, a network management station (NMS) has to poll the router for configuration and status information to diagnose the problem.

Benefits of DSP Operational State Notifications

The DSP Operational State Notifications feature enables the generation of notifications when DSP failure and recovery events occur. These notifications help facilitate troubleshooting and lessen downtime because an NMS does not have to poll the router for configuration and status information to diagnose the problem..

How to Enable DSP Operational State Notifications

DSP operational state notifications can be configured in two ways. To configure these notifications, perform one of the following tasks:

Enabling DSP Operational State Notifications from the CLI

Perform this task to enable DSP operational state notifications from the CLI.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server enable traps** [*notification-type*][**vrrp**]
4. **end**
5. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**snmp-server enable traps** [*notification-type*][**vrrp**] **Example:** `Router(config)# snmp-server enable traps dsp oper-state`	Enables the generation of DSP notifications made up of the DSP ID that indicates which DSP is affected and the operational state that indicates whether the DSP has failed or recovered.
Step 4	**end** **Example:** `Router(config)# end`	Returns the device to privileged EXEC mode.
Step 5	**exit** **Example:** `Router# exit`	Returns the device to user EXEC mode.

Enabling DSP Operational State Notifications Using an SNMP Application

Perform this task to enable DSP operational state notifications using your SNMP application.

SUMMARY STEPS

1. **setany -v2c 1.4.198.75 test cdspEnableOperStateNotification.0 -i 1**

DETAILED STEPS

setany -v2c 1.4.198.75 test cdspEnableOperStateNotification.0 -i 1
This SNMP command sets the enable operation state notification object identifier (OID) to true.

After entering this command, the system returns the followinbg response: cdspEnableOperStateNotification.0 = true(1).

Configuration Examples for DSP Operational State Notifications

Enabling DSP Operational State Notifications Using the CLI Example

The following sample configuration code shows how to enable DSP operational state notifications using the CLI:

```
Router> enable
Router# configure terminal
Router(config)# snmp-server enable traps dsp oper-state
```

The following example shows a typical DSP failure notification:

```
*Jun 1 02:37:05.720:SNMP:V1 Trap, ent cdspMIBNotificationPrefix, addr 1.4.198.75, gentrap
6, spectrap 2
cdspOperState.37 = 2
entPhysicalEntry.7.37 = DSP (C549) 1/2/0
```

The following example shows a typical DSP recover notification:

```
*Jun 1 02:37:10.820:SNMP:V1 Trap, ent cdspMIBNotificationPrefix, addr 1.4.198.75, gentrap
6, spectrap 2
cdspOperState.37 = 1
entPhysicalEntry.7.37 = DSP (C549) 1/2/0
```

Enabling DSP Operational State Notifications Using an SNMP Application Example

The following sample configuration code shows how to enable DSP operational state notifications from your SNMP application:

In your SNMP application, you type the following command:

setany -v2c 1.4.198.75 test cdspEnableOperStateNotification.0 -i 1

The application shows the following response:

cdspEnableOperStateNotification.0 = true(1)

Additional References

The following sections provide references related to the DSP Operational State Notifications feature.

Related Documents

Related Topic	Document Title
Network management commands	*Cisco IOS Network Management Command Reference*

MIBs

MIB	MIBs Link
• CISCO-DSP-MGMT-MIB • CISCO-DSP-MGMT-CAPABILITY-MIB	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

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

Feature Information for DSP Operational State Notifications

Table 5 Feature Information for DSP Operational State Notifications

Feature Name	Releases	Feature Information
DSP Operational State Notifications	12.4(4)T	The following command was modified: **snmp-server enable traps**

Any Internet Protocol (IP) addresses and phone numbers used in this document are not intended to be actual addresses and phone numbers. Any examples, command display output, network topology diagrams, and other figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses or phone numbers in illustrative content is unintentional and coincidental.

Configuring the Event Tracer

This document describes the Event Tracer feature. It includes the following sections:

Feature Overview

The Event Tracer feature provides a binary trace facility for troubleshooting Cisco IOS software. This feature gives Cisco service representatives additional insight into the operation of the Cisco IOS software and can be useful in helping to diagnose problems in the unlikely event of an operating system malfunction or, in the case of redundant systems, route processor switchover.

Note This feature is intended for use as a software diagnostic tool and should be configured only under the direction of a Cisco Technical Assistance Center (TAC) representative.

Event tracing works by reading informational messages from specific Cisco IOS software subsystem components that have been preprogrammed to work with event tracing, and by logging messages from those components into system memory. Trace messages stored in memory can be displayed on the screen or saved to a file for later analysis.

By default, trace messages saved to a file are saved in binary format without applying additional processing or formatting. Saving messages in binary format allows event tracing to collect informational messages faster and for a longer time prior to a system malfunction or processor switchover. Optionally, event trace messages can be saved in ASCII format for additional file processing.

The Event Tracer feature can support multiple traces simultaneously. To do this, the feature assigns a unique ID number to each instance of a trace. This way, all messages associated with a single instance of a trace get the same ID number. Event tracing also applies a timestamp to each trace message, which aids in identifying the message sequence.

The number of trace messages stored in memory for each instance of a trace is configurable up to 65536 entries. As the number of trace messages stored in memory approaches the configured limit, the oldest entries are overwritten with new messages, which continues until the event trace is terminated.

Event tracing can be configured in “one-shot” mode. This is where the current contents of memory for a specified component are discarded and a new trace begins. New trace messages are collected until the message limit is reached, at which point the trace is automatically terminated.

- Benefits, page 64
- Restrictions, page 64

Benefits

Event tracing has a number of benefits to aid in system diagnosis:

Binary Data Format

Event information is saved in binary format without applying any formatting or processing of the information. This results in capturing event information more quickly and for a longer period of time in the moments leading up to a system malfunction or processor switchover. The ability to gather information quickly is also helpful in tracing events that generate a lot of data quickly.

File Storage

Information gathered by the event tracing can be written to a file where it can be saved for further analysis.

Optional ASCII Data Format

Event tracing provides an optional command to save the information in ASCII format.

Multiple Trace Capability

Event tracing can be configured to trace one or more components of the Cisco IOS software simultaneously, depending on the software version running on the networking device.

Restrictions

Event tracing provides a mechanism to help TAC representatives assist Cisco customers in diagnosing certain Cisco IOS software functions. Configuration of this feature on a networking device is recommended only under the direction of a TAC representative. This feature does not produce customer readable data; therefore, it requires the assistance of a TAC representative for proper configuration and analysis.

Finding Feature Information

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

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

Supported Standards MIBs and RFCs

Standards

None

MIBs

None

To obtain lists of supported MIBs by platform and Cisco IOS release, and to download MIB modules, go to the Cisco MIB website on Cisco.com at the following URL:

http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

RFCs

None

The list of software components that support event tracing can vary from one Cisco IOS software image to another. And in many cases, depending on the software component, the event tracing functionality is enabled or disabled by default. Knowing what software components support event tracing and knowing the existing state of the component configuration is important in deciding whether to configure event tracing.

To determine whether event tracing has been enabled or disabled by default for a specific component, follow these steps:

SUMMARY STEPS

1. Use the **monitor event-trace ?**command in global configuration mode to get a list of software components that support event tracing.
2. Use the **show monitor event-trace** *component* **all** command to determine whether event tracing is enabled or disabled by default for the component.
3. Use the **show monitor event-trace** *component* **parameters** command to find out the default size of the trace message file for the component.

DETAILED STEPS

Step 1 Use the **monitor event-trace ?**command in global configuration mode to get a list of software components that support event tracing.

Example:

```
Router(config)# monitor event-trace ?
```

Step 2 Use the **show monitor event-trace** *component* **all** command to determine whether event tracing is enabled or disabled by default for the component.

Example:

```
Router# show monitor event-trace

component
 all
```

Step 3 Use the **show monitor event-trace** *component* **parameters** command to find out the default size of the trace message file for the component.

Example:

```
Router# show monitor event-trace
```

```
component
 parameters
```

This information can help you in determining your configuration options.

Prerequisites

The list of software components that support event tracing can vary from one Cisco IOS software image to another. And in many cases, depending on the software component, the event tracing functionality is enabled or disabled by default. Knowing what software components support event tracing and knowing the existing state of the component configuration is important in deciding whether to configure event tracing.

To determine whether event tracing has been enabled or disabled by default for a specific component, follow these steps:

- **Step 1 -** Use the **monitor event-trace ?** command in global configuration mode to get a list of software components that support event tracing.

  ```
  Router(config)# monitor event-trace ?
  ```

- **Step 2 -** Use the **show monitor event-trace***component***all** command to determine whether event tracing is enabled or disabled by default for the component.

  ```
  Router# show
  monitor event-trace component all
  ```

- **Step 3 -** Use the **show monitor event-trace***component***parameters** command to find out the default size of the trace message file for the component.

  ```
  Router#
  show
  monitor event-trace
  component
  parameters
  ```

This information can help you in determining your configuration options.

Configuration Tasks

Follow the instructions in the "Configuration Tasks, page 66" section prior to configuring this feature. If the default configuration information meets your site requirements, no further configuration may be necessary, and you may proceed to the section "Verifying Event Trace Operation, page 67."

Configuring Event Tracing

In most cases where Cisco IOS software components support event tracing, the feature is configured by default. For some software components, event tracing is enabled, while for other components event tracing might be disabled. In some cases, a TAC representative may want to change the default settings.

To enable or disable event tracing, use the following commands in global configuration mode:

Command	Purpose
`Router(config)#` **monitor event-trace** *component* **enable** or `Router(config)#` **monitor event-trace** *component* **disable**	Enables or disables event tracing for the specified Cisco IOS software component on the networking device. **Note** Component names are set in the system software and are not configurable. To obtain a list of software components supporting event tracing for this release, use the **monitor event-trace**command.

Configuring the Event Trace Size

In most cases where Cisco IOS software components support event tracing, the feature is configured by default. In some cases, such as directed by a TAC representative, you might need to change the size parameter to allow for writing more or fewer trace messages to memory.

To configure the message size parameter, use the following command in global configuration mode:

Command	Purpose
`Router(config)#` **monitor event-trace** *component* **size** *number*	Configures the size of the trace for the specified component. The number of messages that can be stored in memory for each instance of a trace is configurable up to 65536 entries.

Configuring the Event Trace Message File

To configure the file location where you want to save trace messages, use the following command in global configuration mode:

Command	Purpose
`Router(config)#` **monitor event-trace** *component* **dump-file** *filename*	Configures the file where the trace messages will be saved. The maximum length of the filename (path:filename) is 100 characters. The path can point to flash memory on the networking device or to a TFTP or FTP server.

Verifying Event Trace Operation

Depending on the software component, event tracing is enabled or disabled by default. In either case, the default condition will not be reflected in the output of the **show running-config** command; however,

changing any of the settings for a command that has been enable or disabled by default will cause those changes to show up in the output of the **show running-config** command.

SUMMARY STEPS

1. If you made changes to the event tracing configuration, enter the **show running-config** command in privileged EXEC mode to verify the changes.
2. Enter the **show monitor event-trace** *component* command to verify that event tracing has been enabled or disabled for a component.
3. Verify that you have properly configured the filename for writing trace messages.

DETAILED STEPS

Step 1 If you made changes to the event tracing configuration, enter the **show running-config** command in privileged EXEC mode to verify the changes.

Example:

```
Router# show running-config
```

Step 2 Enter the **show monitor event-trace** *component* command to verify that event tracing has been enabled or disabled for a component.
In the following example, event tracing has been enabled for the IPC component. Notice that each trace message is numbered sequentially (for example, 3667) and is followed by a the timestamp (derived from the device uptime). Following the timestamp is the component specific message data.

Example:

```
Router# show monitor event-trace ipc

3667:  6840.016:Message type:3 Data=0123456789
3668:  6840.016:Message type:4 Data=0123456789
3669:  6841.016:Message type:5 Data=0123456789
3670:  6841.016:Message type:6 Data=0123456
```

To view trace information for all components enabled for event tracing, enter the **show monitor event-trace all-traces** command. In this example, separate output is provided for each event and message numbers are interleaved between the events.

Example:

```
Router# show monitor event-trace all-traces
Test1 event trace:
3667: 6840.016:Message type:3 Data=0123456789
3669: 6841.016:Message type:4 Data=0123456789
3671: 6842.016:Message type:5 Data=0123456789
3673: 6843.016:Message type:6 Data=0123456789
Test2 event trace:
3668: 6840.016:Message type:3 Data=0123456789
3670: 6841.016:Message type:4 Data=0123456789
3672: 6842.016:Message type:5 Data=0123456789
3674: 6843.016:Message type:6 Data=0123456789
```

Step 3 Verify that you have properly configured the filename for writing trace messages.

Example:

```
Router# monitor event-trace ipc dump
```

Troubleshooting Tips

Event Tracing Does Not Appear to Be Configured in the Running Configuration

Depending on the software component, event tracing is enabled or disabled by default. In either case, the default condition will not be reflected in output of the **show running-config**command; however, changing any of the settings for a command that has been enabled or disabled by default will cause those changes to show up in the output of the **show running-config** command. Changing the condition of the component back to its default state (enabled or disabled), will cause the entry not to appear in the configuration file.

Show Command Output Is Reporting "One or More Entries Lost "

The trace function is not locked while information is being displayed to the console, which means that new trace messages can accumulate in memory. If entries accumulate faster than they can be displayed, some messages can be lost; however, messages will continue to display on the console. If the number of lost messages is excessive, the **show** command will stop displaying messages.

Show Command Output Terminates Unexpectedly

The trace function is not locked while information is being displayed to the console, which means that new trace messages can accumulate in memory. If entries accumulate faster than they can be displayed, some messages can be lost. If the number of lost messages is excessive, the **show** command will stop displaying messages.

Show Command Output Is Reporting That "Tracing Currently Disabled, from EXEC Command"

The Cisco IOS software allows for the subsystem components to define whether support for event tracing is enabled or disabled at boot time. Event tracing allows users to enable or disable event tracing in two ways: using the **monitor event-trace**(EXEC) command in privileged EXEC mode or using the **monitor event-trace**(global) command in global configuration mode. To enable event tracing again in this case, you would enter the **enable** form of either of these commands.

Show Command Output Is Reporting That "Tracing Currently Disabled, from Config Mode"

The Cisco IOS software allows for the subsystem components to define whether support for event tracing is enabled or disabled at boot time. Event tracing allows users to disable event tracing in two ways: using the **monitor event-trace disable** (EXEC) command in privileged EXEC mode or using the **monitor event-trace disable** (global) command in global configuration mode. To enable event tracing again in this case, you would enter the **enable** form of either of these commands.

Event Trace Messages Are Not Being Saved in ASCII Format

By default, the **monitor event-trace** *component* **dump** and **monitor event-trace dump-traces** commands save trace messages in binary format. If you want to save trace messages in ASCII format, use either the **monitor event-trace** *component* **dump pretty**command to write the trace messages for a single event, or

the **monitor event-trace dump-traces pretty** command to write trace messages for all event traces currently enabled on the networking device.

Configuration Examples

Configuring Event Tracing for One Component Example

In the following example, the networking device has been configured to trace IPC component events:

```
monitor event-trace ipc enable
```

Configuring Event Tracing for Multiple Components Example

In the following example, the networking device has been configured to trace IPC and MBUS component events:

```
monitor event-trace ipc enable
monitor event-trace mbus enable
```

Configuring the Event Trace Size Example

In the following example, the size of the IPC trace is set to 4096 entries while the size of the MBUS trace is set to 8192 entries:

```
monitor event-trace ipc size 4096
monitor event-trace mbus size 8192
```

Configuring the Event Trace Message File Example

The following example identifies the files in which to write trace messages. In this example, event tracing has been enabled for both the IPC and MBUS components, the IPC trace messages are written to the ipcdump file in flash memory, while the MBUS trace message files are written to the mbusdump file on the TFTP server.

```
monitor event-trace ipc dump-file slot0:ipcdump
monitor event-trace mbus dump-file TFTP:mbusdump
```

Feature Information for Event Tracer

Table 6 Feature Information for Event Tracer

Feature Name	Releases	Feature Information
Event Tracer	12.0(18)S 12.2(8)T	The Event Tracer feature provides a binary trace facility for troubleshooting Cisco IOS software.. The following commands were introduced or modified: **monitor event-trace (EXEC), monitor event-trace (global), monitor event-trace dump-traces, show monitor event-trace**.

Memory Threshold Notifications

The Memory Threshold Notifications feature allows you to reserve memory for critical notifications and to configure a router to issue notifications when available memory falls below a specified threshold.

Finding Feature Information

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

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

Information About Memory Threshold Notifications

The Memory Threshold Notifications feature provides two ways to mitigate low-memory conditions on a router: notifications can be sent to indicate that free memory has fallen below a configured threshold, and memory can be reserved to ensure that sufficient memory is available to issue critical notifications. To implement the Memory Threshold Notifications feature, you should understand the following concepts:

Memory Threshold Notifications

Notifications are messages issued by the router. When you specify a memory threshold using the **memory free low-watermark** command, for example, the router issues a notification when available free memory falls below the specified threshold, and again once available free memory rises to 5 percent above the specified threshold. The following are examples of memory threshold notifications:

Available Free Memory Less Than the Specified Threshold

```
000029: *Aug 12 22:31:19.559: %SYS-4-FREEMEMLOW: Free Memory has dropped below 2000k
Pool: Processor  Free: 66814056  freemem_lwm: 204800000
```

Available Free Memory Recovered to More Than the Specified Threshold

```
000032: *Aug 12 22:33:29.411: %SYS-5-FREEMEMRECOVER: Free Memory has recovered 2000k
Pool: Processor  Free: 66813960  freemem_lwm: 0
```

Memory Reservation

Memory reservation for critical operations ensures that management processes, such as event logging, continue to function even when router memory is exhausted.

How to Define Memory Threshold Notifications

Setting a Low Free Memory Threshold

To set a low free memory threshold, perform the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. Do one of the following:
   - **memory free low-watermark processor** *threshold*
   -
   - **memory free low-watermark io** *threshold*

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	Do one of the following: • **memory free low-watermark processor** *threshold* • • **memory free low-watermark io** *threshold* **Example:** `Router(config)#` **memory free low-watermark processor 20000** **Example:** **Example:** `Router(config)#` **memory free low-watermark io 20000**	Specifies a threshold in kilobytes of free processor or input/output (I/O) memory. To view acceptable values for the memory threshold, enter the following command: • **memory free low-watermark processor ?** or • **memory free low-watermark io ?**

Reserving Memory for Critical Notifications

When a router is overloaded by processes, the amount of available memory might fall to levels insufficient for it to issue critical notifications. To reserve a region of memory to be used by the router for the issuing of critical notifications, perform the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **memory reserve critical** *kilobytes*

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	**memory reserve critical** *kilobytes* **Example:** `Router(config)# memory reserve critical 1000`	Reserves the specified amount of memory in kilobytes so that the router can issue critical notifications. • The amount of memory reserved for critical notifications cannot exceed 25 percent of total available memory.

Configuration Examples for Memory Threshold Notifications

The following examples show how to configure a router to issue notifications when available memory falls below a specified threshold and how to reserve memory for critical notifications:

- Setting a Low Free Memory Threshold Examples, page 76
- Reserving Memory for Critical Notifications Example, page 77

Setting a Low Free Memory Threshold Examples

The following example specifies a threshold of 20000 KB of free processor memory before the router issues notifications:

Threshold for Free Processor Memory

```
Router(config)# memory free low-watermark processor 20000
```

The following example specifies a threshold of 20000 KB of free I/O memory before the router issues notifications:

Threshold for Free IO Memory

```
Router(config)# memory free low-watermark io 20000
```

If available free memory falls below the specified threshold, the router sends a notification message like this one:

```
000029: *Aug 12 22:31:19.559: %SYS-4-FREEMEMLOW: Free Memory has dropped below 20000k
Pool: Processor  Free: 66814056  freemem_lwm: 204800000
```

Once available free memory rises to above 5 percent of the threshold, another notification message like this is sent:

```
000032: *Aug 12 22:33:29.411: %SYS-5-FREEMEMRECOVER: Free Memory has recovered 20000k
Pool: Processor  Free: 66813960  freemem_lwm: 0
```

Reserving Memory for Critical Notifications Example

The following example reserves 1000 KB of memory for critical notifications:

```
Router# memory reserved critical 1000
```

Note The amount of memory reserved for critical notifications cannot exceed 25 percent of total available memory.

Additional References

The following sections provide references related to the Memory Threshold Notifications feature:

Related Documents

Related Topic	Document Title
Logging system messages	Troubleshooting and Fault Management module

Standards

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

MIBs

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

RFCs

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

Technical Assistance

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

Feature Information for Memory Threshold Notifications

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

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

Table 7 Feature Information for Memory Threshold Notifications

Feature Name	Releases	Feature Information
Memory Threshold Notifications	12.2(18)S 12.0(26)S 12.3(4)T	The Memory Threshold Notifications feature allows you to reserve memory for critical notifications and to configure a router to issue notifications when available memory falls below a specified threshold.

Troubleshooting and Fault Management

This chapter describes basic tasks that you can perform to troubleshoot your system and the network. For detailed troubleshooting procedures and scenarios, refer to the *Internetwork Troubleshooting Guide* . For complete details on all **debug** commands, refer to the *Cisco IOS Debug Command Reference* .

For a complete description of the troubleshooting commands in this chapter, refer to the "Troubleshooting and Fault Management Commands" chapter in "Cisco IOS System Management Commands" part of the Release 12.2 Cisco IOS Configuration Fundamentals Command Reference. To locate documentation of other commands that appear in this chapter, use the *Cisco IOS Command Reference Master Index* or search online.

Finding Feature Information

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

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

Troubleshooting and Fault Management Task List

To manage network faults, you need to discover, isolate, and correct problems. You can discover problems with the system monitoring commands, isolate problems with the system test commands, and resolve problems with other commands, including **debug** commands.

To perform general fault management, perform the tasks described in the following sections:

In addition to the material presented in this chapter, many chapters in the Cisco IOS software configuration guides include fault management tasks specific to certain technologies and features. You can find these tasks in the "Monitoring and Maintaining" sections.

Displaying System Information Using show Commands

To provide information about system processes, the Cisco IOS software includes an extensive list of show EXEC commands. Following is a partial list of system management **show** commands. To display the information described, use the following commands in EXEC mode, as needed:

Command	Purpose
`Router#` **show c2600**	Displays information about the Cisco 2600 platform, including interrupts, IOS Priority Masks, and IDMA status, for troubleshooting.
`Router#` **show c7200**	Displays information about the CPU and midplane for the Cisco 7200 series routers.
`Router#` **show context**	Displays information stored in NVRAM when the router crashes. This command is only useful to your technical support representative. This command is supported on the Cisco 2600 and 7000 series routers.
`Router#` **show controllers**	Displays information specific to the hardware on a line card.
`Router#` **show controllers logging**	Displays logging information about a line card.
`Router#` **show controllers tech-support**	Displays general information about a line for use when reporting a problem.
`Router#` **show controllers vip** *slot-number* **tech-support**	Displays information about the Versatile Interface Processor (VIP) card for use when reporting a problem
`Router#` **show diag**	Displays hardware information (including DRAM and static RAM details) for line cards.
`Router#` **show environment** [**all** | **last** | **table**]	Displays a message indicating whether an environmental warning condition currently exists, the temperature and voltage information, the last measured value from each of the six test points stored in nonvolatile memory, or environmental specifications. Examples of systems that support this command include the Cisco 7000 and the Cisco 12000 series routers.

Command	Purpose
`Router#` **show gsr**	Displays hardware information on the Cisco 12000 series Gigabit Switch Router (GSR).
`Router#` **show gt64010**	Displays all GT64010 internal registers and interrupt status on the Cisco 7200 series routers.
`Router#` **show memory** [*memory-type*] [**free**] [**summary**]	Displays memory pool statistics including summary information about the activities of the system memory allocator and a block-by-block listing of memory use.
`Router#` **show pci** {**hardware** | **bridge** [*register*]}	Displays information about the peripheral component interconnect (PCI) hardware registers or bridge registers for the Cisco 2600 and 7000 series routers.
`Router#` **show processes** [**cpu**]	Displays information about all active processes.
`Router#` **show processes memory**	Displays information about memory usage.
`Router#` **show protocols**	Displays the configured protocols.
`Router#` **show stacks**	Displays stack usage of processes and interrupt routines, including the reason for the last system reboot. This command is only useful to your technical support representative.
`Router#` **show subsys** [**class** *class* | **name** *name*]	Displays subsystem information.
`Router#` **show tcp** [*line-number*]	Displays the status of TCP connections.
`Router#` **show tcp brief** [**all**]	Displays a concise description of TCP connection endpoints.
`Router#` **show tdm connections** [**motherboard** | **slot** *number*]	Displays a snapshot of the time-division multiplexing (TDM) bus connection or data memory in a Cisco AS5200 access server.
`Router#` **show tech-support** [**page**] [**password**]	Displays information about the system for use when reporting a problem.

Refer to specific **show** commands in the tables of configuration commands found throughout the chapters in Cisco IOS software configuration guides. Refer to the Cisco IOS software command reference publications for detailed descriptions of the commands.

Testing Network Connectivity

Configuring the TCP Keepalive Packet Service

The TCP keepalive capability allows a router to detect when the host with which it is communicating experiences a system failure, even if data stops being sent (in either direction). This capability is most useful on incoming connections. For example, if a host failure occurs while the router is communicating with a printer, the router might never notice, because the printer does not generate any traffic in the opposite direction. If keepalives are enabled, they are sent once every minute on otherwise idle connections. If 5 minutes pass and no keepalives are detected, the connection is closed. The connection is also closed if the host replies to a keepalive packet with a reset packet. This will happen if the host crashes and comes back up again.

To generate the TCP keepalive packet service, use the following command in global configuration mode:

Command	Purposes
`Router(config)#` **service** {**tcp-keepalives-in** | **tcp-keepalives-out**}	Generates TCP keepalive packets on idle network connections, either incoming connections initiated by a remote host, or outgoing connections initiated by a user.

Testing Connections with the ping Command

As an aid to diagnosing basic network connectivity, many network protocols support an echo protocol. The protocol involves sending a special datagram to the destination host, then waiting for a reply datagram from that host. Results from this echo protocol can help in evaluating the path-to-host reliability, delays over the path, and whether the host can be reached or is functioning.

To invoke the echo protocol, use the following command in either user or privileged EXEC mode:

Command	Purposes
`Router#` **ping** [*protocol*] {*host* | *address*}	Invokes a diagnostic tool for testing connectivity.

Refer to specific **ping** commands in the tables of configuration commands found throughout the chapters in Cisco IOS software configuration guides. Refer to the Cisco IOS software command reference publications for detailed descriptions of the command.

Tracing Packet Routes

To trace the routes that packets will actually take when traveling to their destinations, use the following command in either user or privileged EXEC mode:

Command	Purposes
`Router#` **trace** [*protocol*] [*destination*]	Traces packet routes through the network (privileged level).

Logging System Messages

By default, routers send logging messages (including debug command output) a logging process. The logging process controls the distribution of logging messages to various destinations, such as the logging buffer, terminal lines, or a UNIX syslog server, depending on your configuration. The process also sends messages to the console. When the logging process is on, the messages are displayed on the console after the process that generated them has finished.

When the logging process is disabled, messages are sent only to the console. The messages are sent as they are generated, so error and debug output will be interspersed with prompts or output from the command.

You can set the severity level of the messages to control the type of messages displayed for the console and each destination. You can time-stamp log messages or set the syslog source address to enhance real-time debugging and management.

System logging messages are traditionally referred to as System Error Messages. Refer to the *Cisco IOS Software System Error Messages* publication for detailed information on specific system logging messages.

Enabling System Message Logging

System message logging is enabled by default. It must be enabled in order to send messages to any destination other than the console.

To disable message logging, use the **no logging on** command. Note that disabling the logging process can slow down the router because a process cannot continue until the messages are written to the console.

To reenable message logging after it has been disabled, use the following command in global configuration mode:

Command	Purposes
`Router(config)#` **logging on**	Enables message logging.

Enabling Message Logging for a Slave Card

To enable slave VIP cards to log status messages to the console (print the messages to the screen), use the following command in global configuration mode:

Command	Purposes
`Router(config)#` **service slave-log**	Enables slave message logging.

Setting the Syslog Destination

If message logging is enabled, you can send messages to specified locations, in addition to the console.

To set the locations that receive messages, use the following commands, as needed:

Command	Purposes
`Router(config)#` **logging buffered** [*size*]	Logs messages to an internal buffer.
`Router(config)#` **logging** *host*	Logs messages to a syslog server host.
`Router#` **terminal monitor**	Logs messages to a nonconsole terminal.

The **logging buffered** command copies logging messages to an internal buffer. The buffer is circular, so newer messages overwrite older messages after the buffer is full. To display the messages that are logged in the buffer, use the **show logging** EXEC command. The first message displayed is the oldest message in the buffer. To clear the current contents of the buffer, use the **clear logging** privileged EXEC command.

The **logging**command identifies a syslog server host to receive logging messages. The *host* argument is the name or IP address of the host. By issuing this command more than once, you build a list of syslog servers that receive logging messages. The **no logging**command deletes the syslog server with the specified address from the list of syslogs.

The **terminal monitor** EXEC command locally accomplishes the task of displaying the system logging messages to a terminal.

Configuring Synchronization of Logging Messages

You can configure the system to synchronize unsolicited messages and **debug** command output with solicited device output and prompts for a specific line. You can identify the types of messages to be output asynchronously based on the level of severity. You can also determine the maximum number of buffers for storing asynchronous messages for the terminal after which messages are dropped.

When synchronous logging of unsolicited messages and **debug** command output is turned on, unsolicited device output is displayed on the console or printed after solicited device output is displayed or printed. Unsolicited messages and **debug** command output is displayed on the console after the prompt for user input is returned. Therefore, unsolicited messages and **debug** command output are not interspersed with solicited device output and prompts. After the unsolicited messages are displayed, the console displays the user prompt again.

To configure for synchronous logging of unsolicited messages and **debug** command output with solicited device output and prompts, use the following commands beginning in global configuration mode:

SUMMARY STEPS

1. Router(config)# **line** [**aux**| **console** | **vty**] *beginning-line-number* [*ending-line-number*]
2. Router(config-line)# **logging synchronous** [**level** *severity-level* | **all**] [**limit** *number-of-buffers*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config)# **line** [**aux**| **console**	**vty**] *beginning-line-number* [*ending-line-number*]	Specifies the line to be configured for synchronous logging of messages.
Step 2	Router(config-line)# **logging synchronous** [**level** *severity-level*	**all**] [**limit** *number-of-buffers*]	Enables synchronous logging of messages.

Enabling Time-Stamps on Log Messages

By default, log messages are not time-stamped. To enable time-stamping of log messages, use either of the following commands in global configuration mode:

Command	Purposes
`Router(config)#` **service timestamps log uptime** or `Router(config)#` **service timestamps log datetime** [**msec**] [**localtime**] [**show-timezone**]	Enables log time stamps.

Limiting the Error Message Severity Level and Facilities

You can limit the number of messages displayed to the selected device by specifying the severity level of the error message (see the table below for level descriptions). To do so, use the following commands in global configuration mode, as needed:

Command	Purposes
`Router(config)#` **logging console** *level*	Limits the number of messages logged to the console.
`Router(config)#` **logging monitor** *level*	Limits the number of messages logged to the terminal lines.
`Router(config)#` **logging trap** *level*	Limits the number of messages logged to the syslog servers.

If you have enabled syslog messages traps to be sent to a Simple Network Management Protocol (SNMP) network management station with the **snmp-server enable trap**command, you can change the level of messages sent and stored in a history table on the router. You can also change the number of messages that get stored in the history table.

Messages are stored in the history table because SNMP traps are not guaranteed to reach their destination. By default, one message of the level warning and above (see the table above) is stored in the history table even if syslog traps are not enabled.

To change level and table size defaults, use the following commands in global configuration mode:

SUMMARY STEPS

1. Router(config)# **logging history** *level*
2. Router(config)# **logging history size** *number*

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config)# **logging history** *level*	Changes the default level of syslog messages stored in the history file and sent to the SNMP server.
Step 2	Router(config)# **logging history size** *number*	Changes the number of syslog messages that can be stored in the history table.

Note The table below lists the level keywords and severity level. For SNMP usage, the severity level values use +1. For example, **emergency** equals 1 not 0 and **critical** equals 3 not 2.

The **logging console** command limits the logging messages displayed on the console terminal to messages with a level number at or below the specified severity level, which is specified by the *level* argument. The table below lists the error message *level* keywords and corresponding UNIX syslog definitions in order from the most severe level to the least severe level.

Table 8 System Logging Message Severity Levels

Level Keyword	Level	Description	Syslog Definition
emergencies	0	System unusable	LOG_EMERG
alerts	**1**	Immediate action needed	LOG_ALERT
critical	**2**	Critical conditions	LOG_CRIT
errors	**3**	Error conditions	LOG_ERR
warnings	4	Warning conditions	LOG_WARNING
notifications	**5**	Normal but significant condition	LOG_NOTICE
informational	**6**	Informational messages only	LOG_INFO
debugging	7	Debugging messages	LOG_DEBUG

The **no logging console** command disables logging to the console terminal.

The default is to log messages to the console at the **debugging** level and those level numbers that are lower, which means all levels. The **logging monitor** command defaults to **debugging** also. The **logging trap** command defaults to the **informational** level.

To display logging messages on a terminal, use the **terminal monitor** EXEC command.

Current software generates the following four categories of error messages:

- Error messages about software or hardware malfunctions, displayed at levels **warnings** through **emergencies**
- Output from the **debug** commands, displayed at the **debugging** level
- Interface up/down transitions and system restart messages, displayed at the **notifications** level
- Reload requests and low-process stack messages, displayed at the **informational** level

Defining the UNIX System Logging Facility

You can log messages produced by UNIX system utilities. To do this, enable this type logging and define the UNIX system facility from which you want to log messages. The table below lists the UNIX system facilities supported by the Cisco IOS software. Consult the operator manual for your UNIX operating system for more information about these UNIX system facilities. The syslog format is compatible with Berkeley Standard Distribution (BSD) UNIX version 4.3.

To define UNIX system facility message logging, use the following command in global configuration mode:

Command	Purposes
`Router(config)#` **logging facility** *facility-type*	Configures system log facilities.

Table 9 Logging Facility Type Keywords

Facility Type Keyword	Description
auth	Indicates the authorization system.
cron	Indicates the cron facility.
daemon	Indicates the system daemon.
kern	Indicates the Kernel.
local0-7	Reserved for locally defined messages.
lpr	Indicates line printer system.
mail	Indicates mail system.
news	Indicates USENET news.
sys9	Indicates system use.
sys10	Indicates system use.
sys11	Indicates system use.

Facility Type Keyword	Description
sys12	Indicates system use.
sys13	Indicates system use.
sys14	Indicates system use.
syslog	Indicates the system log.
user	Indicates user process.
uucp	Indicates UNIX-to-UNIX copy system.

Displaying Logging Information

To display logging information, use the following commands in EXEC mode, as needed:

Command	Purposes
`Router#` **show logging**	Displays the state of syslog error and event logging, including host addresses, whether console logging is enabled, and other logging statistics.
`Router#` **show controllers vip** *slot-number* **logging**	Displays the state of syslog error and event logging of a VIP card, including host addresses, whether console logging is enabled, and other logging statistics.
`Router#` **show logging history**	Displays information in the syslog history table such as the table size, the status of messages, and the text of the messages stored in the table.

Logging Errors to a UNIX Syslog Daemon

To configure the syslog daemon on a 4.3 BSD UNIX system, include a line such as the following in the /etc/syslog.conf file:

```
local7.debugging /usr/adm/logs/cisco.log
```

The **debugging** keyword specifies the syslog level; see Logging Errors to a UNIX Syslog Daemon, page 90 for a general description of other keywords. The **local7** keyword specifies the logging facility to be used; see Logging Errors to a UNIX Syslog Daemon, page 90 for a general description of other keywords.

The syslog daemon sends messages at this level or at a more severe level to the file specified in the next field. The file must already exist, and the syslog daemon must have permission to write to it.

Setting the Syslog Source Address

By default, a syslog message contains the IP address of the interface it uses to leave the router. To set all syslog messages to contain the same IP address, regardless of which interface they use, use the following command in global configuration mode.

Command	Purposes
`Router(config)#` **logging source-interface** *type number*	Sets the syslog source address.

Using Field Diagnostics on Line Cards

Each line card on the Cisco 12000 series routers can perform field diagnostic testing to isolate faulty hardware without disrupting normal operation of the system. However, performing field diagnostic testing on a line card does halt all activity on the line card for the duration of the testing. After successful completion of the field diagnostic testing, the Cisco IOS software is automatically reloaded on the line card.

Note The field diagnostic **diag** command must be executed from the Gigabit Route Processor (GRP) main console port.

To perform field diagnostic testing on a line card, use the following command in privileged EXEC mode:

Command	Purposes
`Router#` **diag** *slot-number* [**previous** | **post** | **verbose** | **wait**]	Specifies the line card on which you want to perform diagnostic testing. Optionally, specifies that previous test results are displayed, that only extended power-on self-tests (POST) be performed, that the maximum messages are displayed, or that the Cisco IOS software not be reloaded on the line card after successful completion of the tests. The following prompt is displayed: `Running Diags will halt ALL activity on the requested slot. [confirm]` At the prompt, press **Return** to confirm that you want to perform field diagnostic testing on the specified line card, or type **no** to stop the testing.

To stop field diagnostic testing on a line card, use either of the following commands in privileged EXEC mode:

Command	Purpose
`Router#` **diag** *slot-number* **halt** or `Router#` **no diag** *slot-number*	Specifies the line card on which you want to stop diagnostic testing.

Note When you stop the field diagnostic test, the line card remains down (that is, in an unbooted state). In most cases, you stopped the testing because you need to remove the line card or replace the line card. If that is not the case and you want to bring the line card back up (that is, online), you must use the **microcode reload** global configuration command or power cycle the line card.

Troubleshooting Specific Line Cards

Cisco IOS provides the **execute-on** command to allow you to issue Cisco IOS commands (such as **show** commands) to a specific line card for monitoring and maintenance. For example, you could show which Cisco IOS image is loaded on the card in slot 3 of a Cisco 12012 Gigabit Switch Router (GSR) by issuing the **execute-on slot 3 show version**command. You can also use this command for troubleshooting cards in the dial shelf of Cisco access servers.

Storing Line Card Crash Information

This section explains how to enable storing of crash information for a line card and optionally specify the type and amount of information stored. Technical support representatives need to be able to look at the crash information from the line card to troubleshoot serious problems on the line card. The crash information contains all the line card memory information, including the main memory and transmit and receive buffer information.

Caution Use the **exception linecard** global configuration command only when directed by a technical support representative, and only enable options that the technical support representative requests you to enable.

To enable and configure the crash information options for a line card, use the following command in global configuration mode.

Command	Purpose
`Router(config)#` **exception linecard** {**all** | **slot** *slot-number*} [**corefile** *filename* | **main-memory** *size* [**k** | **m**] | **queue-ram** *size* [**k** | **m**] | **rx-buffer** *size* [**k** | **m**] | **sqe-register-rx** | **sqe-register-tx** | **tx-buffer** *size* [**k** | **m**]]	Specifies the line card for which you want crash information when a line card resets. Optionally, specify the type and amount of memory to be stored.

Creating Core Dumps for System Exceptions

"System exceptions" are any unexpected system shutdowns or reboots (most frequently caused by a system failure, commonly referred to as a "system crash"). When an exception occurs, it is sometimes useful to obtain a full copy of the memory image (called a core dump) to identify the cause of the unexpected shutdown. Not all exception types will produce a core dump.

Core dumps are generally useful only to your technical support representative. The core dump file, which is a very large binary file, can be transferred to a Trivial File Transfer Protocol (TFTP), File Transfer Protocol

(FTP), or Remote Copy Protocol (RCP) server, or (on limited platforms) saved to the flash disk, and subsequently interpreted by technical personnel who have access to source code and detailed memory maps.

Caution Use the **exception** commands only under the direction of a technical support representative. Creating a core dump while the router is functioning in a network can disrupt network operation.

- Specifying the Destination for the Core Dump File, page 93
- Creating an Exception Memory Core Dump, page 96

Specifying the Destination for the Core Dump File

To configure the router to generate a core dump, you must enable exception dumps and configure a destination for the core dump file, as described in the following sections:

- Using TFTP for Core Dumps, page 93
- Using FTP for Core Dumps, page 94
- Using rcp for Core Dumps, page 95
- Using a Flash Disk for Core Dumps, page 96

Using TFTP for Core Dumps

Due to a limitation of most TFTP applications, the router will dump only the first 16 MB of the core file. Therefore, if your router's main memory is larger than 16 MB, do not use TFTP.

To configure a router for a core dump using TFTP, use the following commands in global configuration mode:

SUMMARY STEPS

1. **exception protocol tftp**
2. **exception dump** *ip-address*
3. **exception core-file** [*filepath*/]*filename*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**exception protocol tftp** **Example:**	(Optional) Explicitly specifies TFTP as the protocol to be used for router exceptions (core dumps for unexpected system shutdowns). **Note** Because TFTP is the default exception protocol, the **exception protocol tftp** command does not need to be used unless the protocol has been previously changed to ftp or rcp in your system's configuration. To determine if the exception protocol has been changed, use the **show running-config** command in EXEC mode.

	Command or Action	Purpose
Step 2	**exception dump** *ip-address* **Example:**	Configures the router to dump a core file to the specified server if the router crashes.
Step 3	**exception core-file** [*filepath*/]*filename* **Example:**	(Optional) Specifies the name to be used for the core dump file. The file usually must pre-exist on the TFTP server, and be writable.

For example, the following command configures a router to send a core file to the server at the IP address 172.17.92.2. As the exception protocol is not specified, the default protocol of TFTP will be used.

```
Router(config)# exception dump 172.17.92.2
```

The core dump is written to a file named "*hostname* -core" on the TFTP server, where hostname is the name of the route (in the example above, the file would be named Router-core). You can change the name of the core file by adding the **exception core-file** filename configuration command.

Depending on the TFTP server application used, it may be necessary to create, on the TFTP server, the empty target file to which the router can write the core. Also, make sure there is enough memory on your TFTP server to hold the complete core dump.

Using FTP for Core Dumps

To configure the router for a core dump using FTP, use the following commands in global configuration mode:

SUMMARY STEPS

1. Router(config)# **ip ftp username** *username*
2. Router(config)# **ip ftp password**[**type**] **password**
3. Router(config)# **exception protocol ftp**
4. Router(config)# **exception dump** *ip-address*
5. Router(config)# **exception core-file** *filename*

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config)# **ip ftp username** *username*	(Optional) Configures the user name for FTP connections.
Step 2	Router(config)# **ip ftp password**[**type**] **password**	(Optional) Specifies the password to be used for FTP connections.
Step 3	Router(config)# **exception protocol ftp**	Specifies that FTP should be used for core dump file transfers.

	Command or Action	Purpose
Step 4	Router(config)# **exception dump** *ip-address*	Configures the router to dump a core file to a particular server if the router crashes.
Step 5	Router(config)# **exception core-file** *filename*	(Optional) Specifies the name to be used for the core dump file.

The following example configures a router to use FTP to dump a core file named "dumpfile" to the FTP server at 172.17.92.2 when it crashes.

```
ip ftp username red
ip ftp password blue
exception protocol ftp
exception dump 172.17.92.2
exception core-file dumpfile
```

Using rcp for Core Dumps

The remote copy protocol can also be used to send a core dump file. To configure the router to send core dump files using rcp, use the following commands:

SUMMARY STEPS

1. i**p rcmd remote-username** *username*
2. **exception protocol rcp**
3. **exception dump** *ip-address*
4. **exception core-file** *filename*

DETAILED STEPS

	Command or Action	Purpose
Step 1	i**p rcmd remote-username** *username*	(Optional) Specifies the username sent by the router to the remote server with an rcp copy/write request. The remote rcp server must configured to grant write access to the specified username (in other words, an account must be defined on the network server for the username).
Step 2	**exception protocol rcp**	Configures the rcp as the protocol to use for sending core dump files.
Step 3	**exception dump** *ip-address* **Example:**	Configures the router to dump a core file to the specified server if the router crashes.
Step 4	**exception core-file** *filename* **Example:**	(Optional) Specifies the name to be used for the core dump file.

When an rcp username is not configured through the **ip rcmd remote-username** command, the rcp username defaults to the username associated with the current terminal (tty) connection. For example, if the user is connected to the router through Telnet and was authenticated through the username command, the

router software sends the Telnet username as the rcp username. If the terminal username is not available, the router hostname will be used as the rcp username.

Using a Flash Disk for Core Dumps

Some router platforms support the Flash disk as an alternative to the linear Flash memory or PCMCIA Flash card. The large storage capacity of these Flash disks makes them good candidates for another means of capturing a core dump. To configure a router for a core dump using a Flash disk, use the following command in global configuration mode:

Command	Purpose
`Router(config)# exception flash [procmem |iomem | all] device-name [: partition-number] [erase | no_erase]`	Configures the router for a core dump using a flash disk.
`Router(config)# exception core-file` *filename*	(Optional) Specifies the name to be used for the core dump file.

The **show flash all** EXEC command will list the devices you can use for the **exception flash** command.

Creating an Exception Memory Core Dump

To cause the router to create a core dump and reboot when certain memory size parameters are violated during the debugging process, use the following commands in global configuration mode:

As a debugging procedure, you can cause the router to create a core dump and reboot when certain memory size parameters are violated. The following **exception memory** commands are used to trigger a core dump:

Command	Purpose
`Router(config)# exception memory minimum` *bytes*	Triggers a core dump and system reload when the amount of free memory falls below the specified number of bytes. • Do not specify too low a memory value, as the router needs some amount of free memory to provide the core dump. • If you enter a size that is greater than the free memory (and the **exception dump** command has been configured), a core dump and router reload is generated after 60 seconds.

Command	Purpose
`Router(config)#` **memory check-interval** *seconds*	(Optional) Increases the interval at which memory will be checked. The default is 60 seconds, but much can happen in 60 seconds to mask the cause of corruption. Reducing the interval will increase CPU utilization (by around 12%) which will be acceptable in most cases, but will also increase the chance of getting a usable core. To make sure CPU utilization doesn't hit 100%, you should gradually decrease the interval on busy routers. The ideal interval is as low as possible without causing other system problems.
`Router(config)#` **exception memory fragment** *bytes*	Triggers a core dump and system reload when the amount of contiguous (non-fragmented) free memory falls below the specified number of bytes.
`Router(config)#` **exception core-file** *filename*	(Optional) Specifies the name to be used for the core dump file. The file usually must exist on the TFTP server, and be writable. Note that the file will be the same size as the amount of processor memory on the router.

Note that the **exception memory minimum** command is primarily useful if you anticipate running out of memory before a core dump can be triggered or other debugging can be performed (rapid memory leak); if the memory leak is gradual (slow drift), you have generally have time to perform debugging before the system runs out of memory and must be reloaded.

By default, the number of free memory bytes is checked every 60 seconds when these commands are configured. The frequency of this checking can be increased using the **memory check-interval** *seconds* command.

The **exception dump** *ip-address*command must be configured with these commands. If the **exception dump** command is not configured, the router reloads without triggering a core dump.

The following example configures the router to monitor the free memory. If the memory falls below 250000 bytes, the core dump is created and the router reloads.

```
exception dump 172.18.92.2
exception core-file memory.overrun
exception memory minimum 250000
```

- Setting a Spurious Interrupt Core Dump, page 97

Setting a Spurious Interrupt Core Dump

During the debugging process, you can configure the router to create a spurious interrupt core dump and reboot when a specified number of interrupts have occurred.

Caution Use the **exception spurious-interrupt** global configuration command only when directed by a technical support representative and only enable options requested by the technical support representative.

To enable and configure the crash information for spurious interrupts, use the following commands in global configuration mode:

Command	Purpose
`Router(config)#` **exception spurious-interrupt** *number*	Sets the maximum number of spurious interrupts to include in the core dump before reloading.
`Router(config)#` **exception dump** *ip-address* or `Router(config)#` **exception flash**	Specifies the destination for the core dump file.

The following example configures a router to create a core dump with a limit of two spurious interrupts:

```
exception spurious-interrupt 2
exception dump 209.165.200.225
```

Enabling Debug Operations

Your router includes hardware and software to aid in troubleshooting internal problems and problems with other hosts on the network. The **debug** privileged EXEC mode commands start the console display of several classes of network events. The following commands describe in general the system debug message feature. Refer to the *Cisco IOS Debug Command Reference* for all information regarding **debug** commands. Also refer to the *Internetwork Troubleshooting Guide* publication for additional information.

To enable debugging operations, use the following commands:

Command	Purposes
`Router#` **show debugging**	Displays the state of each debugging option.
`Router#` **debug ?**	Displays a list and brief description of all the **debug** command options.
`Router#` **debug** *command*	Begins message logging for the specified **debug** command.
`Router#` **no debug** *command*	Turns message logging off for the specified **debug** command.

Caution The system gives high priority to debugging output. For this reason, debugging commands should be turned on only for troubleshooting specific problems or during troubleshooting sessions with technical support personnel. Excessive debugging output can render the system inoperable.

You can configure time-stamping of system **debug** messages. Time-stamping enhances real-time debugging by providing the relative timing of logged events. This information is especially useful when

customers send debugging output to your technical support personnel for assistance. To enable time-stamping of system **debug** messages, use either of the following commands in global configuration mode:

Command	Purposes
`Router(config)#` **service timestamps debug uptime** or `Router(config)#` **service timestamps debug datetime** [**msec**] [**localtime**] [**show-timezone**]	Enables time-stamping of system **debug** messages.

Normally, the messages are displayed only on the console terminal. Refer to the section "Setting the Syslog Destination, page 86" earlier in this chapter to change the output device.

Enabling Conditionally Triggered Debugging

When the Conditionally Triggered Debugging feature is enabled, the router generates debugging messages for packets entering or leaving the router on a specified interface; the router will not generate debugging output for packets entering or leaving through a different interface. You can specify the interfaces explicitly. For example, you may only want to see debugging messages for one interface or subinterface. You can also turn on debugging for all interfaces that meet specified condition. This feature is useful on dial access servers, which have a large number of ports.

Normally, the router will generate debugging messages for every interface, resulting in a large number of messages. The large number of messages consumes system resources, and can affect your ability to find the specific information you need. By limiting the number of debugging messages, you can receive messages related to only the ports you wish to troubleshoot.

Conditionally Triggered Debugging controls the output from the following protocol-specific **debug** commands:

- **debug aaa** {**accounting** | **authorization** | **authentication**}
- **debug dialer** {**events** | **packets**}
- **debug isdn** {**q921** | **q931**}
- **debug modem** {**oob** | **trace**}
- **debug ppp** {**all** | **authentication** | **chap** | **error** | **negotiation** | **multilink events** | **packet**}

Although this feature limits the output of the commands listed, it does not automatically enable the generation of debugging output from these commands. Debugging messages are generated only when the protocol-specific **debug** command is enabled. The **debug** command output is controlled through two processes:

- The protocol-specific **debug** commands specify which protocols are being debugged. For example, the **debug dialer events** command generates debugging output related to dialer events.
- The **debug condition** commands limit these debugging messages to those related to a particular interface. For example, the **debug condition username bob** command generates debugging output only for interfaces with packets that specify a username of bob.

To configure Conditionally Triggered Debugging, perform the tasks described in the following sections:

- Enabling Protocol-Specific debug Commands, page 100

Enabling Protocol-Specific debug Commands

In order to generate any debugging output, the protocol-specific **debug** command for the desired output must be enabled. Use the **show debugging** command to determine which types of debugging are enabled. To display the current debug conditions, use the **show debug condition** command. To enable the desired protocol-specific **debug** commands, use the following commands in privileged EXEC mode:

Command	Purpose
`Router#` **show debugging**	Determines which types of debugging are enabled.
`Router#` **show debug condition** [*condition-id*]	Displays the current **debug** conditions.
`Router#` **debug** *protocol*	Enables the desired debugging commands.
`Router#` **no debug** *protocol*	Disables the debugging commands that are not desired.

If you do not want output, disable all the protocol-specific **debug** commands.

Enabling Conditional Debugging Commands

If no **debug condition** commands are enabled, all debugging output, regardless of the interface, will be displayed for the enabled protocol-specific **debug** commands.

The first **debug condition** command you enter enables conditional debugging. The router will display only messages for interfaces that meet one of the specified conditions. If multiple conditions are specified, the interface must meet at least one of the conditions in order for messages to be displayed.

To enable messages for interfaces specified explicitly or for interfaces that meet certain conditions, perform the tasks described in the following sections:

Displaying Messages for One Interface

To disable debugging messages for all interfaces except one, use the following command in privileged EXEC mode:

Command	Purpose
`Router#` **debug condition interface** *interface*	Enables debugging output for only the specified interface.

To reenable debugging output for all interfaces, use the **no debug interface**command.

Displaying Messages for Multiple Interfaces

To enable debugging messages for multiple interfaces, use the following commands in privileged EXEC mode:

SUMMARY STEPS

1. Router# **debug condition interface** *interface*
2. Router# **debug condition interface** *interface*

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router# **debug condition interface** *interface*	Enables debugging output for only the specified interface
Step 2	Router# **debug condition interface** *interface*	Enable debugging messages for additional interfaces. Repeat this task until debugging messages are enabled for all desired interfaces.

If you specify more than one interface by entering this command multiple times, debugging output will be displayed for all of the specified interfaces. To turn off debugging on a particular interface, use the **no debug interface** command. If you use the **no debug interface all** command or remove the last **debug interface** command, debugging output will be reenabled for all interfaces.

Limiting the Number of Messages Based on Conditions

The router can monitor interfaces to learn if any packets contain the specified value for one of the following conditions:

- username
- calling party number
- called party number

If you enter a condition, such as calling number, debug output will be stopped for all interfaces. The router will then monitor every interface to learn if a packet with the specified calling party number is sent or received on any interfaces. If the condition is met on an interface or subinterface, **debug** command output will be displayed for that interface. The debugging output for an interface is “triggered” when the condition has been met. The debugging output continues to be disabled for the other interfaces. If, at some later time, the condition is met for another interface, the debug output also will become enabled for that interface.

Once debugging output has been triggered on an interface, the output will continue until the interface goes down. However, the session for that interface might change, resulting in a new username, called party number, or calling party number. Use the **no debug interface** command to reset the debug trigger mechanism for a particular interface. The debugging output for that interface will be disabled until the interface meets one of the specified conditions.

To limit the number of debugging messages based on a specified condition, use the following command in privileged EXEC mode:

Command	Purpose
`Router#` **debug condition** {**username** *username* | **called** *dial-string* | **caller** *dial-string*}	Enables conditional debugging. The router will display only messages for interfaces that meet this condition.

To reenable the debugging output for all interfaces, enter the **no debug condition all** command.

Specifying Multiple Debugging Conditions

To limit the number of debugging messages based on more than one condition, use the following commands in privileged EXEC mode:

SUMMARY STEPS

1. Router# **debug condition**{**username** *username* | **called** *dial-string* | **caller** *dial-string*}
2. Router# **debug condition**{**username** *username* | **called** *dial-string* | **caller** *dial-string*}

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router# **debug condition**{**username** *username* | **called** *dial-string* | **caller** *dial-string*}	Enables conditional debugging, and specifies the first condition.
Step 2	Router# **debug condition**{**username** *username* | **called** *dial-string* | **caller** *dial-string*}	Specifies the second condition. Repeat this task until all conditions are specified.

If you enter multiple **debug condition** commands, debugging output will be generated if an interface meets at least one of the conditions. If you remove one of the conditions using the **no debug condition** command, interfaces that meet only that condition no longer will produce debugging output. However, interfaces that meet a condition other than the removed condition will continue to generate output. Only if no active conditions are met for an interface will the output for that interface be disabled.

Conditionally Triggered Debugging Configuration Examples

In this example, four conditions have been set by the following commands:

- **debug condition interface serial 0**
- **debug condition interface serial 1**
- **debug condition interface virtual-template 1**
- **debug condition username fred**

The first three conditions have been met by one interface. The fourth condition has not yet been met:

```
Router# show debug condition
Condition 1: interface Se0 (1 flags triggered)
        Flags: Se0
Condition 2: interface Se1 (1 flags triggered)
        Flags: Se1
Condition 3: interface Vt1 (1 flags triggered)
        Flags: Vt1
Condition 4: username fred (0 flags triggered)
```

When any **debug condition** command is entered, debugging messages for conditional debugging are enabled. The following debugging messages show conditions being met on different interfaces as the serial

0 and serial 1 interfaces come up. For example, the second line of output indicates that serial interface 0 meets the username fred condition.

```
*Mar  1 00:04:41.647: %LINK-3-UPDOWN: Interface Serial0, changed state to up
*Mar  1 00:04:41.715: Se0 Debug: Condition 4, username fred triggered, count 2
*Mar  1 00:04:42.963: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0, changed
state to up
*Mar  1 00:04:43.271: Vi1 Debug: Condition 3, interface Vt1 triggered, count 1
*Mar  1 00:04:43.271: %LINK-3-UPDOWN: Interface Virtual-Access1, changed state to up
*Mar  1 00:04:43.279: Vi1 Debug: Condition 4, username fred triggered, count 2
*Mar  1 00:04:43.283: Vi1 Debug: Condition 1, interface Se0 triggered, count 3
*Mar  1 00:04:44.039: %IP-4-DUPADDR: Duplicate address 172.27.32.114 on Ethernet 0,
sourced by 00e0.1e3e.2d41
*Mar  1 00:04:44.283: %LINEPROTO-5-UPDOWN: Line protocol on Interface Virtual-Access1,
changed state to up
*Mar  1 00:04:54.667: %LINK-3-UPDOWN: Interface Serial1, changed state to up
*Mar  1 00:04:54.731: Se1 Debug: Condition 4, username fred triggered, count 2
*Mar  1 00:04:54.735: Vi1 Debug: Condition 2, interface Se1 triggered, count 4
*Mar  1 00:04:55.735: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1, changed
state to up
```

After a period of time, the **show debug condition** command displays the revised list of conditions:

```
Router# show debug condition
Condition 1: interface Se0 (2 flags triggered)
        Flags: Se0 Vi1
Condition 2: interface Se1 (2 flags triggered)
        Flags: Se1 Vi1
Condition 3: interface Vt1 (2 flags triggered)
        Flags: Vt1 Vi1
Condition 4: username fred (3 flags triggered)
        Flags: Se0 Vi1 Se1
```

Next, the serial 1 and serial 0 interfaces go down. When an interface goes down, conditions for that interface are cleared.

```
*Mar  1 00:05:51.443: %LINK-3-UPDOWN: Interface Serial1, changed state to down
*Mar  1 00:05:51.471: Se1 Debug: Condition 4, username fred cleared, count 1
*Mar  1 00:05:51.479: Vi1 Debug: Condition 2, interface Se1 cleared, count 3
*Mar  1 00:05:52.443: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1, changed
state to down
*Mar  1 00:05:56.859: %LINK-3-UPDOWN: Interface Serial0, changed state to down
*Mar  1 00:05:56.887: Se0 Debug: Condition 4, username fred cleared, count 1
*Mar  1 00:05:56.895: Vi1 Debug: Condition 1, interface Se0 cleared, count 2
*Mar  1 00:05:56.899: Vi1 Debug: Condition 3, interface Vt1 cleared, count 1
*Mar  1 00:05:56.899: Vi1 Debug: Condition 4, username fred cleared, count 0
*Mar  1 00:05:56.903: %LINK-3-UPDOWN: Interface Virtual-Access1, changed state to down
*Mar  1 00:05:57.907: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0, changed
state to down
*Mar  1 00:05:57.907: %LINEPROTO-5-UPDOWN: Line protocol on Interface Virtual-Access1,
changed state to down
```

The final **show debug condition** output is the same as the output before the interfaces came up:

```
Router# show debug condition
Condition 1: interface Se0 (1 flags triggered)
        Flags: Se0
Condition 2: interface Se1 (1 flags triggered)
        Flags: Se1
Condition 3: interface Vt1 (1 flags triggered)
        Flags: Vt1
Condition 4: username fred (0 flags triggered)
```

Using the Environmental Monitor

Some routers and access servers have an environmental monitor that monitors the physical condition of the router. If a measurement exceeds acceptable margins, a warning message is printed to the system console.

The system software collects measurements once every 60 seconds, but warnings for a given test point are printed at most once every 4 hours. If the temperature measurements are out of specification more than the shutdown, the software shuts the router down (the fan will remain on). The router must be manually turned off and on after such a shutdown. You can query the environmental monitor using the **show environment** command at any time to determine whether a measurement is out of tolerance. Refer to the *Cisco IOS System Error Messages* publication for a description of environmental monitor warning messages.

On routers with an environmental monitor, if the software detects that any of its temperature test points have exceeded maximum margins, it performs the following steps:

1. Saves the last measured values from each of the six test points to internal nonvolatile memory.
2. Interrupts the system software and causes a shutdown message to be printed on the system console.
3. Shuts off the power supplies after a few milliseconds of delay.

The system displays the following message if temperatures exceed maximum margins, along with a message indicating the reason for the shutdown:

```
Router#
%ENVM-1-SHUTDOWN: Environmental Monitor initiated shutdown
%ENVM-2-TEMP: Inlet temperature has reached SHUTDOWN level at 64(C)
```

Refer to the hardware installation and maintenance publication for your router for more information about environmental specifications.

Configuring the XML Interface to Syslog Messages

The XML Interface to Syslog Messages features provides command-line interface (CLI) commands for enabling syslog messages to be sent in an Extensible Markup Language (XML) format. Logs in a standardized XML format can be more readily used in external customized monitoring tools.

Finding Feature Information

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

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

Information About the XML Interface to Syslog Messages Feature

Cisco IOS System Message Logging

The Cisco IOS system message logging (syslog) process allows the system to report and save important error and notifications messages, either locally or to a remote logging server. These syslog messages

include messages in a standardized format (often called system error messages) and output from **debug** commands. These messages are generated during network operation to assist users and Cisco TAC engineers with identifying the type and severity of a problem, or to aid users in monitoring router activity. Syslog messages can be sent to the console, a monitor (TTY and Telnet connections), the system buffer, or to remote hosts.

Note The system message logging process in Cisco IOS software is abbreviated as "syslog". The messages generated by this process are called "syslog messages". However, syslog messages are also referred to in Cisco IOS documenation as "system error messages" or "SEMs". Note that syslog messages are not restricted to error conditions, and can reflect purely informational messages.

XML-Formatted System Message Logging

XML, a derivative of SGML, provides a representation scheme to structuralize consistently formatted data such as that found in syslog messages.

The XML Interface to Syslog Messages features provides CLI commands for enabling syslog messages to be sent in an XML format. Logs in a standardized XML format can be more readily used in external customized monitoring tools. Within the Cisco IOS software, a closed set of meaningful XML tags are defined and, when enabled, applied to the syslog messages sent to the console, monitor, buffer, or to remote hosts.

Two system logging formats exist in Cisco IOS software: the standard logging format and the XML logging format. This means that you can specify that the standard syslog messages be sent to one remote host while the XML-formatted syslog messages are sent to another host. Similarly, if logging messages are sent to the system buffer, the XML logging buffer is separate from the standard logging buffer, and you can have the standard and XML logging buffers running at the same time.

The XML logging process is dependant on the standard logging process. In most cases, settings for the standard logging process carry over to the XML logging process. For example, the severity level for the **logging buffered xml** command is determined by the level set for the standard **logging buffered** command (or, if not set, by the default severity level for the standard buffer). Similarly, the default size of the XML logging buffer is the same as the standard logging buffer's default (the default buffer size varies by platform).

System Logging Message Formatting

System logging messages take the following format:

```
%<facility>-<severity>-<mnemonic>: <message-text>
```

For example:

```
%LINK-5-CHANGED: Interface Serial3/3, changed state to administratively down
```

Usually, these messages are proceeded by additional text, such as the timestamp and message sequence number:

```
<sequence-number>: <date or system-up-time> <time>:%<facility>-<severity>-<mnemonic>:
<message-text>
```

For example:

```
000013: Mar 18 14:52:10.039:%LINK-5-CHANGED: Interface Serial3/3, changed state to
administratively down
```

Note The timestamp format used in system logging messages is determined by the **service timestamps** global configuration mode command. The **service sequence-numbers** global configuration command enables or disables the leading sequence number. An asterix (*) before the time indicates that the time may be incorrect because the system clock has not synchronized to a reliable time source.

The table below shows the XML tags applied to syslog messages (the XML formatting):

Table 10 XML Tags used for Syslog Message Fields

	Tag Applied	Delimited Item
	<ios-log-msg></ios-log-message>	Entire syslog message.
	<facility></facility>	Facility Name. FACILITY is a code consisting of two or more uppercase letters that indicate the facility to which the message refers. A facility can be a hardware device, a protocol, or a module of the system software.
	<severity></severity>	Severity Value. SEVERITY is a single-digit code from 0 to 7 that reflects the severity of the condition. The lower the number, the more serious the situation.
	<msg-id></msg-id>	Mnemonic. The MNEMONIC is a code (usually an abbreviated description) that uniquely identifies the type of error or event.
	<seq></seq>	The error sequence number.
	<time></time>	The timestamp, including date and time, or the system uptime (time since last reboot).

	Tag Applied	Delimited Item
	<args></args>	The variables within the message text. The full "human readable" text of the message is not retained in XML. Only the variables are extracted and formatted. The variables within a system error message are identified with brackets ([chars] , [hex] , [int] , and so on) in Cisco IOS documentation. For example: %LINK-5-CHANGED: : Interface [chars], changed state to [chars] For the complete text of syslog messages, see the *Cisco IOS System Error Messages* document, available on Cisco.com. All these XML tags add significant overhead to a message. In case the message length exceeds the limit of IOS message logging, the "<args>...</args>" part will be replaced with "<args-warning>*** LOG OVERRUN ***</args-warning>"
	<arg id="x"></arg>	A specific argument. "x" is a sequential variable I.D. number, starting with zero.

The following example shows a syslog message in standard format, followed by the same message with XML formatting applied:

Standard Syslog Message Format

000013: *Oct 11 14:52:10.039: %SYS-5-CONFIG_I: Configured from console by vty0 (172.19.208.14)

XML Syslog Message Format

```
<ios-log-msg><facility>SYS</facility><severity>5</severity><msg-id>CONFIG_I</msg-
id><seq>000013</seq><time>*Oct 11 14:52:10.039</time><args><arg id="0">console</arg><arg
id="1">vty0 (172.19.208.14)</arg></args></ios-log-msg>
```

Note System logging messages include debugging messages when debugging is enabled on the router and logging is configured to record severity level 7 messages. However, debugging messages do not use the system logging message format. XML formatting will not, therefore, be applied to these messages.

How to Configure XML Formatting of Syslog Messages

Enabling logging in an XML format consists of simply using the appropriate logging command to indicate where syslog messages should be sent, followed by the **xml** keyword. Standard system message logging is enabled by default, but XML formatting of these messages is disabled by default.

As mentioned previously, the XML-formatted logging process is separate than (but dependant on) the standard logging process, so you can configure XML-formatted logging in addition to standard logging if the destination is a remote host or the system buffer.

To enable XML formatting for syslog messages, use one of the following commands in global configuration mode:

- **logging console xml**
- **logging monitor xml**
- **logging buffered xml**
- **logging host** {*ip-address* | *host-name*} **xml**

To view the status of logging and the contents of the XML logging buffer, use the **show logging xml** command in EXEC mode. To clear the contents of the XML logging buffer, use the **clear logging xml** command in EXEC mode.

SUMMARY STEPS

1. **logging console xml** [*severity-level*]
2. **logging monitor xml** [*severity-level*]
3. **logging buffered xml** [*xml-buffer-size*]
4. **logging host** {*ip-address* | *host-name*} **xml**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**logging console xml** [*severity-level*] **Example:** `Router(config)# logging console xml informational`	Enables system message logging to the console connections in XML format. Messages at or numerically below the severity level will be logged. The default severity level varies by platform, but is generally level 7 ("debugging"), meaning that messages at all severity levels (0 through 7) are logged.

	Command or Action	Purpose
Step 2	**logging monitor xml** [*severity-level*] **Example:** `Router(config)# logging monitor xml 6`	Enables system message logging to the monitor connections (all available TTY or Telnet connections) in XML format. Messages at or numerically below the severity level will be logged. The default severity level varies by platform, but is generally level 7 ("debugging"), meaning that messages at all severity levels (0 through 7) are logged. Note that the display of logging messages is often disabled by default, meaning that messages will not be displayed when you log into the terminal until you issue the **terminal monitor** EXEC mode command.
Step 3	**logging buffered xml** [*xml-buffer-size*] **Example:** `Router(config)# logging buffered xml 14336`	Enables system message logging to the system buffer in XML format. The severity level for logged messages is determined by the setting of the **logging buffered** command. If the **logging buffered** command has not been used, the default severity level for that command is used. The default severity level varies by platform, but is generally level 7 ("debugging"), meaning that messages at all severity levels (0 through 7) are logged. For more information on severity levels, see the documentation of the **logging buffered** command. The default XML logging buffer size varies by platform. (The size of the XML logging buffer is the same as the standard logging buffer's default.) The valid range for the XML buffer size is 4096 to 2147483647 bytes (4 Kilobytes to 2 Gigabytes).

Step 4	**logging host** {*ip-address* | *host-name*} **xml**
	
	Example:
	
	`Router(config)# logging host 209.165.202.132 xml`
	
	Example:
	
	`Router(config)# logging host 209.165.201.20 xml`
		Enables system message logging in XML format to the specified host.
		
		By issuing this command more than once, you build a list of syslog servers that receive logging messages.
		
		Note To send standard logging output to one host and XML-formatted logging output to another host, you must specify a different IP address (or host name) in the **logging host** (standard) command.
		
		The default severity level varies by platform, but is generally level 7 ("debugging"), meaning that messages at severity levels 0 through 7 are logged. To specify the severity level for logging to all remote hosts, use the **logging trap** command.

Configuration Examples for XML Formatting of Syslog Messages

In the following example, logging is enabled and then logging to the standard buffer and to the XML buffer is enabled. The last two **show logging** commands compare the difference between the standard syslog buffer and the XML syslog buffer.

```
Router# show logging
Syslog logging: disabled (10 messages dropped, 5 messages rate-limited, 6 flush)
    Console logging: disabled
    Monitor logging: disabled
    Buffer logging: disabled, xml disabled
    Logging Exception size (8192 bytes)
```

```
    Count and timestamp logging messages: disabled
    Trap logging: level informational, 31 message lines logged
Router# config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# logging on
Router(config)# logging buffered

Router(config)# end
Router# show logging
Syslog logging: enabled (10 messages dropped, 5 messages rate-limited, 6 flushed)
    Console logging: disabled
    Monitor logging: disabled
    Buffer logging: level debugging, 1 messages logged, xml disabled
    Logging Exception size (8192 bytes)
    Count and timestamp logging messages: disabled
    Trap logging: level informational, 32 message lines logged

Log Buffer (8192 bytes):
1w0d: %SYS-5-CONFIG_I: Configured from console by console
Router# configure terminal

Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# logging buffered xml
Router(config)# end
Router# show logging
Syslog logging: enabled (10 messages dropped, 5 messages rate-limited, 6 flushes, 0
overruns, xml enabled)
    Console logging: disabled
    Monitor logging: disabled
    Buffer logging: level debugging, 2 messages logged, xml enabled (1 messages logged)
    Logging Exception size (8192 bytes)
    Count and timestamp logging messages: disabled
    Trap logging: level informational, 33 message lines logged

Log Buffer (8192 bytes):
1w0d: %SYS-5-CONFIG_I: Configured from console by console
1w0d: %SYS-5-CONFIG_I: Configured from console by console
Router# show logging xml
<syslog-logging status="enabled" msg-dropped="10" msg-rate-limited="5" flushes="6"
overruns="0"><xml>enabled</xml></syslog-logging>
    <console-logging>disabled</console-logging>
    <monitor-logging>disabled</monitor-logging>
    <buffer-logging level="debugging" messages-logged="2"><xml messages-
logged="1">enabled</xml></buffer-logging>
    <logging-exception size="8192 bytes"></logging-exception>
    <count-and-timestamp-logging status="disabled"></count-and-timestamp-logging>
    <trap-logging level="informational" messages-lines-logged="33"></trap-logging>

<log-xml-buffer size="8192 bytes"></log-xml-buffer>
<ios-log-msg><facility>SYS</facility><severity>5</severity><msg-id>CONFIG_I</msg-
id><time>1w0d</time><args><arg id="0">console</arg><arg id="1">console</arg></args></ios-
log-msg>
```

Additional References

Related Documents

Related Topic	Document Title
System message logging	Troubleshooting and Fault Management module
Debug-level system messages	*Cisco IOS Debug Command Reference*

Standards

XML is not currently an Internet Standard. The XML 1.0 Recommendation ("Extensible Markup Language (XML) 1.0 (Second Edition)") is defined at http://www.w3.org/TR/. See also RFC 3076.

MIBs

MIB	MIBs Link
--	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs[1]	Title
RFC 3470	"Guidelines for the Use of Extensible Markup Language (XML) within IETF Protocols" (Status: BEST CURRENT PRACTICE)

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html
System Error Message Decoder tool For help with researching and resolving your Cisco IOS error messages, try the Cisco IOS Error Message Decoder tool. This tool is made available by the Cisco Technical Assistance Center (TAC) for registered Cisco.com users.	http://www.cisco.com/cgi-bin/Support/Errordecoder/home.pl

Feature Information for XML Interface to Syslog Messages

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

1 Not all supported RFCs are listed.

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

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

Table 11 Feature Information for XML Interface to Syslog Messages

Feature Name	Releases	Feature Information
XML Interface to Syslog Messages	12.2(15)T	The XML Interface to Syslog Messages feature provides command-line interface (CLI) commands for enabling syslog messages to be sent in an Extensible Markup Language (XML) format. The following commands were introduced or modified: • **clear logging xml** • **logging buffered xml** • **logging console xml** • **logging host** • **logging monitor xml** • **show logging xml**

Glossary

Note Refer to the *Internetworking Terms and Acronyms* for terms not included in this glossary.

console --In the context of this feature, specifies the connection (CTY or console line) to the console port of the router. Typically, this is a terminal attached directly to the console port, or a PC with a terminal emulation program. Corresponds to the **show terminal** command.

monitor --In the context of this feature, specifies the TTY (TeleTYpe) line connection at a line port. In other words, the "monitor" keyword corresponds to a TTY line connection or a Telnet (terminal emulation) connection. TTY lines (also called ports) communicate with peripheral devices such as terminals, modems, and serial printers. An example of a TTY connection is a PC with a terminal emulation program connected to the device using a dial-up modem.

SEMs --Abbreviation for system error messages. "System error messages" is a term sometimes used for messages generated by the system logging (syslog) process. Syslog messages use a standardized format, and come in 8 severity levels, from "emergencies" (level 0) to "debugging" (level 7). The term "system error message" is actually misleading, as these messages can include notifications of router activity beyond "errors" (such as informational notices).

syslog --Abbreviation for the system message logging process in Cisco IOS software. Also used to identify the messages generated, as in "syslog messages." Technically, the term "syslog" refers only to the process

of logging messages to a remote host or hosts, but is commonly used to refer to all Cisco IOS system logging processes.

trap --A trigger in the system software for sending error messages. In the context of this feature, "trap logging" means logging messages to a remote host. The remote host is actually a syslog host from the perspective of the device sending the trap messages, but because the receiving device typically provides collected syslog data to other devices, the receiving device is also referred to as a "syslog server."