



Text Part Number: 78-5040-11 Rev. A0

Catalyst 5000 Series Token Ring Software Release 3.3(3) Release Note

April 7, 2000

This document describes the Catalyst 5000 series Token Ring software release 3.3(3), including a list of problems fixed in this release and a list of known (open) problems for this release. Use this document in conjunction with the *Catalyst 5000 Series Token Ring Module Configuration Note* or the *Catalyst 5000 Series Fiber Token Ring Module Configuration Note* that ships with the copper (WS-X5030) and fiber (WS-X5031) Token Ring modules. The latest version of the configuration note ships with the Catalyst 5000 series Token Ring modules and is also available via Cisco Connection Online (CCO).

Sections in this document include the following:

- Catalyst 5000 Documentation, page 2
- Token Ring Orderable Software Images, page 2
- Problems Fixed in Token Ring Software Release 3.3(3), page 3
- Known Problems in Token Ring Software Release 3.3(3), page 3
- New Features in Token Ring Software Release 3.3(x), page 3
- Amendments to the Documentation, page 20
- Availability of Catalyst 5000 Software Upgrades on CCO, page 29
- Obtaining Service and Support, page 29
- Cisco Connection Online, page 29
- Ordering Documentation, page 30

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Catalyst 5000 Documentation

The following documents are available for the Catalyst 5000 series switch:

- *Catalyst 5000 Series Quick Software Configuration*
- *Catalyst 5000 Series Installation Guide*
- *Catalyst 5000 Series Module Installation Guide*
- *Catalyst 5000 Series Software Configuration Guide---Catalyst 5000 Series, Catalyst 4000 Series, Catalyst 2948G Series, Catalyst 2926G Series, and Catalyst 2926 Series*
- *Catalyst 5000 Series Command Reference---Catalyst 5000 Series, Catalyst 4000 Series, Catalyst 2948G Series, Catalyst 2926G Series, and Catalyst 2926 Series*
- *Catalyst 5000 Series System Message Guide---Catalyst 5000 Series, Catalyst 4000 Series, Catalyst 2948G Series, Catalyst 2926G Series, and Catalyst 2926 Series*
- *Catalyst 5000 Series Release Notes*
- *Catalyst 5000 Series Supervisor Engine Installation Guide*
- *Enterprise MIB User Quick Reference (online only)*

Cisco documentation and additional literature are available in a CD-ROM package, which ships with your product. The Documentation CD-ROM, a member of the Cisco Connection Family, is updated monthly. Therefore, it might be more current than printed documentation. To order additional copies of the Documentation CD-ROM, contact your local sales representative or call customer service. The CD-ROM package is available as a single package or as an annual subscription. You can also access Cisco documentation on the World Wide Web at <http://www.cisco.com>, <http://www-china.cisco.com>, or <http://www-europe.cisco.com>.

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Token Ring Orderable Software Images

Table 1 lists the software version and applicable ordering information for the Catalyst 5000 series Token Ring module software.

Table 1 Token Ring Software Version/Orderable Product Number Matrix

Software Version	Filename	Orderable Product Number Flash on System	Orderable Product Number Spare Upgrade (Floppy Media)
3.3(3)	c5token.3-3-3.bin	SFCFK-TR-3.3.3	SWC5K-TR-3.3.3=
3.3(2)	c5token.3-3-2.bin	SFC5K-TR-3.3.2	SWC5K-TR-3.3.2=
3.3(1)	c5token.3-3-1.bin	SFC5K-TR-3.3.1	SWC5K-TR-3.3.1=
3.2(5)	c5token.3-2-5.bin	SFC5K-TR-3.2.5	SWC5k-TR-3.2.5=
3.2(4)	c5token.3-2-4.bin	SFC5K-TR-3.2.4	SWC5k-TR-3.2.4=
3.2(3)	c5token.3-2-3.bin	SFC5K-TR-3.2.3	SWC5k-TR-3.2.3=
3.2(2)	c5token.3-2-2.bin	SFC5K-TR-3.2.2	SWC5k-TR-3.2.2=
3.2(1)	c5token.3-2-1.bin	SFC5K-TR-3.2.1	SWC5k-TR-3.2.1=

Table 1 Token Ring Software Version/Orderable Product Number Matrix (continued)

3.1(2)	c5token.3-1-2.bin	SFC5K-TR-3.1.2	SWC5k-TR-3.1.2=
3.1(1)	c5token.3-1-1.bin	SFC5K-TR-3.1.1	SWC5k-TR-3.1.1=

Problems Fixed in Token Ring Software Release 3.3(3)

The following problems have been resolved in this release of the Token Ring software.

Problem Identifier	Problem Description
CSCdp90340	The output of the show station ordertable command incorrectly displays the MAC addresses of stations monitored via Token Ring ports.
CSCdr00852	Occasionally, some Token Ring ports might be marked as faulty because the ports failed the loopback test during initialization. This is a false failure and resetting the Token Ring module will return the Token Ring ports to a normal state. This fix requires that the Token Ring module erasable programmable logic device (EPLD) images be updated. For information on updating the EPLD images, see the “Updating the Token Ring Module EPLDs” section on page 3.

Known Problems in Token Ring Software Release 3.3(3)

There are no known problems in the Catalyst 5000 series Token Ring software release 3.3(3).

New Features in Token Ring Software Release 3.3(x)

This section describes the new features that are supported in the Catalyst 5000 series Token Ring software release 3.3(x) or later.

- In Token Ring software release 3.3(2) or later, the following features are supported:
 - Updating the Token Ring Module EPLDs, page 3
 - Token Ring EPLD Update Commands, page 6
 - Configuring Explorer Throttling, page 8
- In Token Ring software release 3.3(1) or later, the following features are supported:
 - Configuring Soft Error Monitoring and Removing Adapters, page 9
 - Soft Error Monitoring Commands, page 11
 - Handlings Frames Transmitted with Invalid Source MAC Addresses, page 17

Updating the Token Ring Module EPLDs

Note The following new feature is available in the Catalyst 5000 series Token Ring software release 3.3(2) or later when used in conjunction with the Catalyst 5000 series supervisor engine module software release 4.5(3) or later and supervisor module software release 5.3(1) or later.

The Token Ring software release 3.3(2) or later is bundled with two erasable programmable logic devices (EPLDs) images (epld_par and epld_fif). When the Token Ring software release 3.3(2) or later is used in conjunction with supervisor engine module software release 4.5(3) or later or supervisor engine module software release 5.3(1) or later, you can use the bundled images to update the EPLDs on your Token Ring module and fix certain conditions that might be occurring in your network. Before updating the EPLDs on your Token Ring module, determine whether you need to do so by performing the tasks in the “Determining Whether You Need to Update Your Token Ring Module EPLDs” section on page 4.

Note The ability to update the Token Ring module EPLDs is not supported on Token Ring module hardware versions lower than 1.0.

Determining Whether You Need to Update Your Token Ring Module EPLDs

Before updating the EPLDs on your Token Ring module, you should determine whether you need to do so. To determine whether you need update the EPLD images on your Token Ring module, after downloading the Token Ring release 3.3(2) or later software, query EPLD version information by issuing the following command:

```
show tokenring [mod_num]/[port_num]
```

In addition to the current values of various Token Ring specific configuration parameters, the **show tokenring** command displays the current versions of the Token Ring module EPLDs and the versions of the EPLD images bundled with the Token Ring software image that you downloaded and stored in the module Flash.

After issuing the **show tokenring** command, you see will see a display that includes information similar to the following:

```
<partial show tokenring command output>
```

Token Ring EPLDs	FLASH	EPLD
-----	-----	-----
epld_fif	5	0
epld_par	5	0

If you are running a Token Ring module on which the EPLDs are version 3 or lower, and you are experiencing one or both of the following conditions in your network, you should consider updating the EPLD images with the images bundled in the Token Ring software release 3.3(2) or later:

- During periods of heavy traffic, reconfiguring the source SPAN port between Token Ring modules is causing traffic forwarding to fail on one or more Token Ring ports (CSCdm26185).
- A very small number of frames (approximately 1 in 10,000) are being dropped during periods of heavy traffic loads (CSCdk90382).

If you are running a Token Ring module on which the Fifocontroller EPLD (epld_fif) is version 5 or lower, and you are experiencing the following condition in your network, you should consider updating the EPLD images with the images bundled in the Token Ring software release 3.3(3) or later:

- Occasionally, some Token Ring ports might be marked as faulty because the ports failed the loopback test during initialization. This is a false failure and resetting the Token Ring module returns the Token Ring ports to a normal state (CSCdr00852).

Note A microcode upgrade using the EPLD images bundled in the Token Ring software release 3.3(3) will upgrade the `epld_fif` image to a version 6 and the `epld_par` image to a version 5. If the `epld_par` image is already a version 5 image, it will not be programmed during the image upgrade.

For information on updating your Token Ring module EPLDs, proceed to the “Updating the EPLDs” to update your EPLDs with the bundled images. If the EPLD versions in the EPLD column are version 6 or higher, you do not need to update your EPLDs.

Updating the EPLDs

If you have determined that you need to update the EPLDs on your Token Ring module, ensure that you review the information in this section before doing so.

You should update the EPLDs with caution and only when absolutely necessary. The procedure for updating your Token Ring module EPLDs requires that you reset your Catalyst 5000 series chassis, therefore, ensure that you schedule to update the EPLDs during a time that will have the least impact on your network operations.



Caution During the EPLD update, the EPLD images on the Token Ring module are erased before being reprogrammed with the EPLD images bundled with Token Ring software release 3.3(2) or later. If for some reason the Token Ring module is reset or pulled out or the switch is reset while an EPLD is in a non-programmed state, the Token Ring module could be rendered permanently unusable. Therefore, when updating the EPLD images, do not reset or remove the Token Ring module or reset the switch during the update process.

To update the EPLD images, complete the following tasks:

Step 1 Initiate the EPLD image update by issuing the following command while in privileged mode:

```
set tokenring microcode
```

Note If you have more than one Token Ring module installed in your switch, the EPLD images on all the Token Ring modules in your switch will be updated.



Caution After issuing the **set tokenring microcode** command, do not reset or pull out the Token Ring module or reset the switch until the update has completed. Resetting or pulling out the Token Ring module or resetting the switch before the update has completed could render your Token Ring module permanently unusable.

After entering the **set tokenring microcode** command, you see a display similar to the following:

```
Console>(enable) set tokenring microcode
WARNING! Do not reset token ring module(s) during this operation. Otherwise
module(s) may be damaged. If a targeted token ring module is utilized for this
console connection, the connection will disappear during the operation.
This operation may take up to 20 minutes to complete.
Do you want to continue (y/n) [n]?
```

Wait for specified module(s) to remove and insert before resetting.

```
Initiating microcode update sequence to module 4...
Initiating microcode update sequence to module 5...
```

```
Console>(enable) 1999 June 07 18:37:36 %SYS-5-MOD_REMOVE:Module 4 has been
removed
1999 June 07 18:37:36 %SYS-5-MOD_INSERT:Module 4 has been inserted
1999 June 07 18:37:43 %SYS-5-MOD_REMOVE:Module 5 has been removed
1999 June 07 18:37:43 %SYS-5-MOD_INSERT:Module 5 has been inserted
1999 June 07 18:41:03 %SYS-5-MOD_OK:Module 4 is online
1999 June 07 18:41:06 %SYS-5-MOD_OK:Module 5 is online
```

The EPLD update can take as little as 2 minutes or as long as 20 minutes to complete. When the update has completed, the Port Status LED (top left corner of each RJ-45 connector) on ports 1 and 5 turns green and the Token Ring module automatically resets.

- Step 2** Determine that the EPLD update has completed on all the Token Ring modules by verifying that messages similar to the following have displayed for each module:

```
1999 June 07 18:37:36 %SYS-5-MOD_INSERT:Module 4 has been removed
1999 June 07 18:37:36 %SYS-5-MOD_INSERT:Module 4 has been inserted
1999 June 07 18:41:03 %SYS-5-MOD_OK:Module 4 is online
```

In the above example, the EPLDs were updated on a Token Ring modules installed in slot 4 of the switch.

- Step 3** Once you are certain that the EPLD update has completed on all the Token Ring modules in your switch, reset the supervisor engine module by issuing the following command while in privileged mode:

```
reset mod_num
```

Where *mod_num* is the slot in which the supervisor engine module is installed.

Token Ring EPLD Update Commands

The following commands have been added or modified to support updating the Token Ring module EPLD images with the images bundled with the Token Ring software release 3.3(2) or later.

set tokenring microcode

Use the **set tokenring microcode** privileged command to initiate the updating of the Token Ring EPLDs.

```
set tokenring microcode
```

Syntax Description

This command has no arguments or keywords.

Default

This command has no defaults. This command is directed to all Token Ring cards in the switch.

Command Type

Switch command.

Command Mode

Privileged

Usage Guideline

The EPLD images in the main executable on each Token Ring module are updated with the appropriate EPLD images bundled with the Token Ring software release 3.3(2) or later. If an EPLD image version in Flash matches an existing EPLD version, the EPLD image on the Token Ring module is not updated. Each Token Ring module resets after the update is complete.



Caution Misuse of the **set tokenring microcode** command can render a target Token Ring module unusable. Do not pull out or reset a Token Ring module or reset the switch during the EPLD image update.

Examples

The following example shows the **set tokenring microcode** command output on a Catalyst 5000 series switch in which two Token Ring modules are installed in slots 4 and 5:

```

Console>(enable) set tokenring microcode
WARNING! Do not reset token ring module(s) during this operation. Otherwise
module(s) may be damaged. If a targeted token ring module is utilized for this
console connection, the connection will disappear during the operation.
This operation may take up to 20 minutes to complete.
Do you want to continue (y/n) [n]?

Wait for specified module(s) to remove and insert before resetting.

Initiating microcode update sequence to module 4....
Initiating microcode update sequence to module 5....

Console>(enable) 1999 June 07 18:37:36 %SYS-5-MOD_REMOVE:Module 4 has been removed
1999 June 07 18:37:36 %SYS-5-MOD_INSERT:Module 4 has been inserted
1999 June 07 18:37:43 %SYS-5-MOD_REMOVE:Module 5 has been removed
1999 June 07 18:37:43 %SYS-5-MOD_INSERT:Module 5 has been inserted
1999 June 07 18:41:03 %SYS-5-MOD_OK:Module 4 is online
1999 June 07 18:41:06 %SYS-5-MOD_OK:Module 5 is online

```

show tokenring

Use the **show tokenring** command to display the current values of various Token Ring specific configuration parameter in addition to the current versions of the Token Ring module EPLD images and the versions of the EPLD images bundled with the Token Ring software release 3.3(2) or later that has been downloaded and stored in the Token Ring module flash:

```
show tokenring [mod_num[/port_num]]
```

Syntax Description

mod_num (Optional) Number of the Token Ring module.

port_num (Optional) Number of the port on the module.

Default

The default of this command is to display the configuration information for all Token Ring modules in the switch.

Command Type

Switch command.

Command Mode

Normal.

Usage Guideline

The **show tokenring** command has been extended to display the EPLD version information on one or all Token Ring modules in the switch.

Examples

This example shows the EPLD-specific **show tokenring** output, which displays after the issuing the **show tokenring** command. The FLASH column indicates the version of the EPLD image that is bundled into the Token Ring software release 3.3(2) or later executable. The EPLD column indicates the version of the EPLD image that is burned inside of the corresponding EPLD.

<partial **show tokenring** command output>

Token Ring EPLDs	FLASH	EPLD
-----	-----	----
epld_fif	5	0
epld_par	5	0

Configuring Explorer Throttling

Note The following new feature is available in the Catalyst 5000 series Token Ring software release 3.3(2) or later when used in conjunction with the Catalyst 5000 series supervisor engine module software release 5.2(1) or later.

With this release of the Token Ring software, the number of explorer frames being forwarded by a Token Ring port can be limited. Limiting the number of explorer frames being forwarded by a Token Ring port is helpful in networks in which high levels of explorer traffic occur.

To configure the number of explorer frames that can be forwarded per second by a Token Ring port, issue the following command while in privileged mode:

```
set tokenring explorer-throttle mod_num/port_num max_explorers
```

After issuing the **set tokenring explorer-throttle** command, you see a display similar to the following:

```
Console> (enable) set token explorer-throttle 5/1 100
Explorer throttling set to 100 explorers/sec for port 5/1
```

set tokenring explorer-throttle Command

The **set tokenring explorer-throttle** command has been added to enable explorer throttling to be configured. Use the **set tokenring explorer-throttle** command to control the number of explorer frames being forwarded per second by a Token Ring module port.

set tokenring explorer-throttle *mod_num/port_num max_explorers*

Syntax Description

<i>mod_num</i>	Number of the Token Ring module.
<i>port_num</i>	Number of the port on the module.
<i>max_explorers</i>	Maximum number of explorer frames (per second) allowed to be forwarded by the Token Ring port.

Default

The default is 0; explorer frame throttling is disabled.

Command Mode

Privileged

Usage Guidelines

To disable explorer frame throttling, specify 0 for the *max_explorers* value.

If the maximum explorer threshold is reached on a port, subsequent explorer frames are dropped until the next one-second interval.

Example

This example shows how to limit the number of explorer frames being forwarded per second by a Token Ring port to 100:

```
set tokenring explorer-throttle 2/1 100
```

Configuring Soft Error Monitoring and Removing Adapters

The Catalyst 5000 series Token Ring module software release 3.3(1) or later performs error detection and isolation by monitoring the Report Soft Error MAC frames generated by stations on each port. Soft errors occur during normal ring operation and do not typically disrupt traffic on the ring. However, soft errors can occur at a rate that could potentially degrade the performance of the ring.

Using the soft error monitoring feature, you can configure soft error thresholds and sampling intervals for a port. During the interval you define, the Catalyst 5000 series Token Ring module monitors the stations on the port and, if the threshold is exceeded, can be configured to generate a trap indicating the port number and station on which the threshold was exceeded. If necessary, you can issue a Remove Ring Station MAC frame to remove the station from the ring.

In summary, the Catalyst 5000 series Token Ring module performs the following tasks:

- Monitors the Report Soft Error MAC frames generated by stations on each port, collects the data from each soft error frame, and generates a trap containing the port number and station where the user-defined soft error threshold is exceeded.
- Reports the soft error monitoring statistics via the console and SNMP.
- Provides the ability to issue a Remove Ring Station MAC frame to remove a station that is reporting a high level of errors or is not authorized to be on a ring.

Enabling or Disabling Soft Error Monitoring on a Port

Using the **set station softerror** command, you can enable or disable soft error monitoring on a Token Ring port and you can configure soft error thresholds and sampling intervals for a port. During the interval you define, the Catalyst 5000 series Token Ring module monitors the stations on the port and, if the threshold is exceeded, generates a trap indicating the port number and station on which the threshold was exceeded. If necessary, you can issue a Remove Ring Station MAC frame to remove the station from the ring.

To enable or disable soft error monitoring on a Token Ring port, issue the following command in privileged mode:

```
set station softerror mod_num | mod_num/port_num disable | enable
```

Note To enable soft error monitoring on all the ports of the Token Ring module, issue the **set station softerror** command and specify the module number of the Token Ring module.

After enabling soft error monitoring on a port using the **set station softerror** command, you see a display similar to the following:

```
Console> (enable) set station softerror 3/10 enable
Port 3/10 soft error monitoring enabled.
Console> (enable)
```

Configuring Soft Error Monitoring Error Thresholds and Sampling Intervals

To configure a soft error monitoring error threshold (the number of soft errors reported from a station connected to a port that if exceeded causes a soft error exceeded trap to be issued) and to define a sampling interval (the period, in seconds, during which the number of soft errors is monitored for each station connected to this port) issue the following command while in privileged mode:

```
set station softerror mod_num[/port_num] threshold threshold_num interval int_num
```

The possible values for the error threshold are 1 to 255. The default is 100. The possible values for the sampling interval are 0 to 65534. The default is 60. Setting the interval to zero disables the soft error exceeded traps. Without these traps, soft errors can still be monitored via the console.

Note To set the error threshold and sampling interval for all the ports of the Token Ring module, issue the **set station softerror** command and specify the module number of the Token Ring module.

After configuring the error threshold and sampling interval using the **set station softerror** command, you will see a display similar to the following:

```
Console> (enable) set station softerror 3/10 threshold 100 interval 200
Port 3/10 station soft error threshold set to 100, interval set to 200
Console> (enable)
```

Verifying the Soft Error Monitoring Configuration

To verify your soft error monitoring configuration on a port, issue the following command while in privilege mode:

```
show station softerror config mod_num[/port_num]
```

Note To view the soft error monitoring configuration for all the ports of the Token Ring module, issue the **show station softerror config** command and specify the module number of the Token Ring module.

After entering the **show station softerror config** command to verify the configuration on a port, you will see a display similar to the following:

```
Console> (enable) show station softerror config 3/10
Ports   Threshold Interval Status
-----
 3/10   100       200     enabled
Console> (enable)
```

Removing an Adapter from the Network

If a station is exceeding soft error thresholds, you can issue a Remove Ring Station MAC frame to remove the station from the ring. When issuing the **clear station** command, enter the MAC address in non-canonical format (00:11:22:33:44:55).

```
clear station mod_num/port_num mac_addr
```



Caution Issuing the **clear station** command and specifying the MAC address or ID of a station issues a Remove Station MAC frame to that station and removes the station from the ring. Use this procedure with extreme caution.

Soft Error Monitoring Commands

The following commands that support soft error monitoring configuration and management are available in the Catalyst 5000 series supervisor engine module software release 5.1(1) or later used in conjunction with the Catalyst 5000 series Token Ring software release 3.3(1) or later.

clear station

Use the **clear station** privileged command to issue a Remove Ring Station MAC frame to remove a station from the ring.

clear station *mod_num/port_num mac_addr*

Syntax Description

<i>mod_num</i>	Number of the module.
<i>port_num</i>	Number of the port on the module.
<i>mac_address</i>	MAC address of the station that you want to remove. Enter this address in non-canonical (00:11:22:33:44:55) format.

Default

The command has no default setting.

Command Type

Switch command

Command Mode

Privileged

Usage Guidelines

Issuing the **clear station** command and specifying the MAC address or ID of a station issues a Remove Station MAC frame to that station and removes the station from the ring. Use this procedure with extreme caution.

Example

The following example shows a station with the MAC address 00:40:0b:01:bc:65 on port 2 of module 3 being removed:

```
Console> (enable) clear station 3/2 00:40:0b:01:bc:65
Mac Address 00:40:0b:01:bc:65 cleared.
Console> (enable)
```

Related Commands

set station softerror
show station softerror config
show station softerror counters

clear station counters

Use the **clear station counters** privileged command to reset the soft error statistics that display when you issue the **show station softerror counters** command. You can clear statistics collected for a station on a port, the module, or for a specific port on the module.

clear station counters *mod_num*[/*port_num*]

Syntax Description

mod_num Number of the module.

port_num Number of the port on the module.

Default

The command has no default setting.

Command Type

Switch command

Command Mode

Privileged

Example

The following example shows the soft error statistics collected for stations on port 10 of module 3 being reset:

```
Console> (enable) clear station counters 3/10
Port 3/10 station counters cleared.
```

Related Commands

set station softerror

show station softerror counters

set station softerror

Use the **set station softerror** privileged command to enable or disable the collection of soft error statistics on the ports on a Token Ring module or on a specific port on the module. Also, use the **set station softerror** command to define error thresholds and sampling intervals for the ports on the Token Ring module or for a specific port on the module.

set station softerror *mod_num*[/*port_num*] **disable** | **enable**

set station softerror *mod_num*[/*port_num*] [**threshold** *thres_num* **interval** *int_num*]

Syntax Description

<i>mod_num</i>	Number of the module.
<i>port_num</i>	Number of the port on the module.
disable	Keyword used to specify for soft error statistics to not be collected for the stations on a module or on a specific port on a module.
enable	Keyword used to specify for soft error statistics to be collected for the stations on a module or on a specific port on a module.
threshold <i>thres_num</i>	Keyword used to specify the number of soft errors reported from a station connected to a port that if exceeded causes a soft error exceeded trap to be issued. Valid values are 1 to 255. The default is 100.
interval <i>int_num</i>	Keyword used to specify the sampling period (in seconds) during which the number of soft errors is monitored for each station connected to a port. Valid values are 0 to 65534. The default is 60. To disable soft error exceeded traps, set the interval to zero. Without traps, soft errors can still be monitored via the console.

Default

The default configuration has soft error monitoring disabled. The default error threshold is 100. The default interval is 60.

Command Type

Switch command

Command Mode

Privileged

Example

The following example shows how to enable the collection of soft error statistics for port 10 on module 3:

```
Console> (enable) set station softerror 3/10 enable
Port 3/10 soft error monitoring enabled.
Console> (enable)
```

The following example shows the error threshold and sampling interval for port 10 on module 3 being set:

```
Console> (enable) set station softerror 3/10 threshold 100 interval 200
Port 3/10 station soft error threshold set to 100, interval set to 200
Console> (enable)
```

Related Commands

clear station counters
show station softerror config
show station softerror counters

show station softerror config

Use the **show station softerror config** normal command to view the soft error monitoring configuration for a port, module, or for all the Token Ring modules in a switch.

show station softerror config [*mod_num*[/*port_num*]

Syntax Description

mod_num (Optional) Number of the module.

port_num (Optional) Number of the port on the module. If you do not specify a number, all ports are shown.

Default

This command has no default setting.

Command Type

Switch command

Command Mode

Normal

Example

The following example shows how to display the soft error monitoring configuration for module 3:

```

Console> show station softerror config 3
Ports   Threshold Interval Status
-----
 3/1    100         60     enabled
 3/2    100         60     enabled
 3/3    100         60     enabled
 3/4    100         60     enabled
 3/5    100         60     enabled
 3/6    100         60     enabled
 3/7    100         60     enabled
 3/8    100         60     enabled
 3/9    100         60     enabled
 3/10   100         200    enabled
 3/11   100         60     enabled
 3/12   100         60     enabled
 3/13   100         60     enabled
 3/14   100         60     enabled
 3/15   100         60     disabled
 3/16   100         60     disabled
Console>

```

Table 2 describes the fields shown in the **show station softerror config** command output.

Table 2 Show station softerror config Command Field Descriptions

Field	Description
Ports	Module and port number.
Threshold	Number of soft errors reported from a station connected to this port that if exceeded causes a soft error exceeded trap to be issued. Valid values are 1 to 255. The default is 100.
Interval	Sampling period (in seconds) during which the number of soft errors is monitored for each station connected to this port. Valid values are 0 to 65534. The default is 60.
Status	Indicates whether the collection of soft error statistics is enabled or disabled on the port.

show station softerror counters

Use the **show station softerror counters** normal command to view the soft error statistics collected for all the stations on a Token Ring port or for a specific station.

show station softerror counters *mod_num/port_num* [*mac_addr*]

Syntax Description

<i>mod_num</i>	Number of the module.
<i>port_num</i>	Number of the port on the module.
<i>mac_addr</i>	(Optional) MAC address of the station for which you want to view the soft error statistics that have been collected. Enter this address in non-canonical (00:11:22:33:44:55) format.

Default

This command has no default setting.

Command Type

Switch command

Command Mode

Normal

Example

The following example shows how to display the soft error statistics collected for:

```

Console> (enable) show station softerror counters 3/1
Port 3/1:
  Station 00:06:c1:0e:e1:40 Station-Last-NAUN 00:05:77:06:29:b0
    In-Burst-Errors          9
    Out-Burst-Errors         3
    Token-Errors             11
  Station 00:05:77:06:29:b0 Station-Last-NAUN 00:00:00:00:00:00
    Out-Burst-Errors         1
  Station 00:05:77:06:29:b2 Station-Last-NAUN 00:00:00:00:00:00
    Out-Burst-Errors         5
  Station 00:05:77:06:29:b1 Station-Last-NAUN 00:00:00:00:00:00
  Station 00:05:77:06:29:b3 Station-Last-NAUN 00:00:00:00:00:00
  Station 00:05:77:06:29:af Station-Last-NAUN 00:06:c1:0e:e1:40
Console> (enable)

```

Table 3 describes the fields shown in the **show station softerror counters** command output.

Table 3 Show station softerror counters Command Field Descriptions

Field	Description
Port	Port number.
Station	MAC address of the station.
Station-Last-NAUN	MAC address of the station's NAUN.
In-Line-Errors	Number of line errors reported by the station.
Out-Line-Errors	Number of line errors reported in error reporting packets sent by the station's nearest active downstream neighbor.
Internal-Errors	Number of adapter internal errors reported by the station.
AC-Errors	Number of address copied (AC) errors reported in error reporting packets sent by the station's nearest active downstream neighbor.
In-Burst-Errors	Number of burst errors reported by the station.
Out-Burst-Errors	Number of burst errors reported in error reporting packets sent by the station's nearest active downstream neighbor.
Abort-Errors	Number of abort delimiters reported by the station.
Lost-Frame-Errors	Number of lost frame errors reported by the station.
Congestion-Errors	Number of receive congestion errors reported by the station.
Frame-Copied Errors	Number of frame copied errors reported by the station.
Frequency-Errors	Number of frequency errors reported by the station.
Token-Errors	Number of token errors reported by this station.

Handlings Frames Transmitted with Invalid Source MAC Addresses

In some rare circumstances, certain devices (such as a faulty protocol analyzer) might transmit a frame that contains the source MAC address of another device. Because MAC addresses are used by the switch to determine where to forward a frame, an invalid frame (one that contains the source MAC address of another device) can cause the valid frames to be forwarded to the wrong port. If this situation occurs, communication to the device to which the MAC address actually belongs can be disrupted for as long as the invalid address entry is in the Token Ring port address table.

If you are experiencing network communication problems due to a device erroneously sending frames with the source MAC address of another device, you can either choose to rapidly age the entries out of the Token Ring module port address tables using the **set tokenring portaging** command or you can ensure that the Token Ring module port address tables do not contain erroneous entries by disabling address learning entirely on the Token Ring module using the **set tokenring locallearning** command.



Caution We recommend that you use the **set tokenring portaging** and **set tokenring locallearning** commands *only* in those rare circumstances in which network communications are disrupted because of invalid frames.

Configuring Token Ring Port Table Address Aging

When in a network environment in which a device is sending invalid frames, you can ensure that the Token Ring module port address tables contain correct MAC address entries by *rapidly* aging out the erroneous entries using the **set tokenring portaging** command. Rapidly aging out the Token Ring module port address table ensures that the Token Ring module port address tables do not contain invalid entries which might affect the Catalyst 5000 series switch and network communication.

The aging limit you define determines when inactive MAC addresses are removed from a port address table. The aging limit is the time (in seconds) a MAC address remains in the port's address table. Possible values are 0 and 5 through 65535 seconds. The default is 0. Zero indicates the Token Ring module port address table entries are aged out using the CAM aging time for the corresponding VLAN that has been configured using the **set cam agingtime** command. For more information about the **set cam agingtime** command, see the *Catalyst 5000 Series Command Reference*.

Note To use the fast port aging feature effectively, we recommend that you configure an aging limit of 10.

To define the address aging limits for a Token Ring port, issue the following command while in privileged mode:

```
set tokenring portaging mod_num/port_num agingtime
```

After entering the **set tokenring portaging** command, you see a display similar to the following:

```
Console> (enable) set tokenring portaging 3/2 10
Agingtime set to 10 sec for port 3/2
Console> (enable)
```

Configuring Local Address Learning

The **set tokenring locallearning** command enables you to enable or disable local MAC address learning on a Token Ring port. The default is for local address learning to be enabled.

When local address learning is enabled, the value of the address recognized (A) bit and the frame copied (C) bit in Logical Link Control (LLC) frames is set by the ports on the Token Ring module based on whether the frame was actually forwarded. However, when local address learning is disabled, the AC bits cannot be set by the ports on the Token Ring module based on whether the frame was forwarded because all frames are forwarded to the Catalyst 5000 series switching backplane.

Therefore, when local address learning is disabled on a Token Ring port, the AC bits must be set based on the type of frame that has been received. When you disable local address learning on a Token Ring port, the default is for the AC bits to always being set on LLC frames, however you can configure how the AC bits are to be set using the **set tokenring acbits** command. For more information on configuring for the setting of AC bits on frames, see the “Setting Address Recognized/Frame Copied Bits” section on page 19.

Note When local address learning is disabled on a port, the port aging limits configured using the **set tokenring portaging** command are not used.

To enable or disable local address learning, issue the following command while in privilege mode:

```
set tokenring locallearning mod_num/port_num enable | disable
```

After disabling local address learning using the **set tokenring locallearning** command, you see a display similar to the following:

```
Console> (enable) set tokenring locallearning 3/2 disable
Warning: Resetting acbit value to ALWAYS: 3/2
Local learning disabled for port 3/2
Console> (enable)
```

Setting Address Recognized/Frame Copied Bits

Using the **set tokenring acbits** command, you can specify if and how the AC bits should be set on LLC frames. When local address learning is enabled on a Token Ring port, the default is disable. When local address learning is disabled on a Token Ring port, the default is always.

To configure how the AC bits will be set for a port, issue the following command in privileged mode:

```
set tokenring acbits mod_num/port_num {enable | disable | sronly | never | always}
```

After entering the **set tokenring acbits** command, you see displays similar to the following:

```
Console> (enable) set tokenring acbits 3/2 always
Warning: Disable Local learning: 3/2
Port 3/2 acbits always
```

The syntax description for the **set tokenring acbits** command is as follows:

<i>mod_num</i>	Number of the Token Ring module.
<i>port_num</i>	(Optional) Number of the port on the Token Ring module.
enable	Keyword used to unconditionally set the AC bits on source-routed frames with a RIF length greater than 2 and on all explorer frames in addition to setting the AC bits on all frames forwarded to another port. This parameter is only valid when local address learning is enabled on a port. Therefore, specifying enable automatically enables local address learning on the port.
disable	Keyword used to specify for the AC bits to be set based exclusively on whether the frame is forwarded to another port. This parameter is only valid when local address learning is enabled on a port. Therefore, specifying disable automatically enables local address learning on the port.
sronly	Keyword used to specify for the AC bits to be set only on source-routed frames with a RIF length greater than 2 and on all explorer frames.
never	Keyword used to specify for the AC bits to never be set on LLC frames. This parameter is only valid when local address learning is disabled on the port. Therefore, specifying never automatically disables local address learning on the port.
always	Keyword used to specify for the AC bits to always be set on LLC frames. This parameter is only valid when local address learning is disabled on a port. Therefore, specifying always automatically disables local address learning on the port.

Amendments to the Documentation

This section contains information that was not included in the first release of the configuration note.

RMON Support

The descriptions of the Token Ring ring station control table and Token Ring ring station order table are incorrect. The descriptions should read as follows:

- Token Ring ring station control table

The Catalyst 5000 series Token Ring module supports the ringStationControlTable portion of the Token Ring Ring Station Group. This support allows a Catalyst 5000 series Token Ring module to gather segment information from each ring segment to which it is attached. This segment information includes Ring State, Beacon Sender, Beacon NAUN, and Active Monitor MAC Address, as well as Station Order Changes.

- Token Ring ring station order table

An ordered list of the stations on the monitored rings.

Token Ring Port Operation

The descriptions of the Token Ring port transmission modes in the Catalyst 5000 Software Configuration Guide are incorrect. The descriptions should read as follows:

Each of the 16 Token Ring ports on the Catalyst 5000 series Token Ring module can operate in one of the following modes:

- Half-duplex concentrator port---Port is connected to a single station in half duplex (HDX) mode. In this case, the port behaves like an active medium access unit (MAU) port for classic Token Ring.
- Half-duplex station emulation---Port is connected to a port on an MAU. In this case, the port behaves like a station connected to a classic Token Ring segment that contains multiple stations.
- Full-duplex concentrator port---Port is connected to a single station in full duplex (FDX) mode.
- Full-duplex station emulation---Port is connected to another Token Ring switch in FDX mode.

Configuring the Port Priority

The *Catalyst 5000 Series Token Ring Module Configuration Note* documents that the possible priority range for physical and logical ports is 0 through 255 (decimal) and that the default is 128.

While this information is correct for the physical Token Ring ports, it is incorrect for the logical ports (the connection between the Token Ring Bridge Relay Function [TrBRF] and Token Ring Concentrator Relay Function [TrCRF]). The valid priority range for the logical Token Ring ports is 0 through 7. The default is 4.

Configuring VLANs

In addition to the guidelines and restrictions listed in the configuration note, when configuring a TrBRF, note that you cannot assign more than 63 TrCRFs to a TrBRF.

Adding or Changing TrBRF Parameters

The Catalyst 5000 series Token Ring software release 3.2(1) or later supports MTUs of up to 17800 bytes. The initial release of the Catalyst 5000 series Token Ring software did not support MTUs greater than 4472. Release 3.2(1) or later supports MTUs of up to 17800.

When configuring larger MTUs for the ports or TrBRFs on a Token Ring module, remember the following:

- You cannot configure a port MTU that is greater than the MTU configured for the TrBRF to which the port belongs.
- You cannot configure an LAN Emulation Client (LEC) MTU that is greater than the MTU configured for the TrBRF to which the LEC belongs.

If you reduce the MTU for a TrBRF to a value that is less than the MTU currently configured for the individual ports or LECs in the TrBRF, the MTU for the ports or LECs is automatically reduced to a value (1500, 4472, 8144, or 17800) that is less than that specified for the TrBRF.

Adding or Changing TrBRF Parameters

The Catalyst 5000 series supervisor engine module software release 4.2 supports an additional **set vlan** command parameter, **decring**. The **decring** keyword enables you to specify a decimal logical ring number for TrCRFs. Previous releases of the supervisor engine module software allowed only hexadecimal ring numbers to be specified.

The syntax description for the **decring** keyword is as follows:

decring *decimal_ring_number* (Optional) Keyword to specify the logical ring number for Token Ring VLANs. Possible values are decimal numbers 1 to 4095. For Token Ring VLANs, this parameter is valid and required only when defining a TrCRF.

Adding or Changing TrCRF Parameters

The “Adding and Changing TrCRF Parameters” section of the *Catalyst 5000 Series Token Ring Module Configuration Note* defines two types of TrCRFs that you can configure. These types of TrCRFs are the undistributed TrCRF and the backup TrCRF.

However, the Catalyst 5000 series Token Ring software now allows you to configure a *distributed TrCRF*. A distributed TrCRF is TrCRF in which ports associated with the TrCRF are located on different Catalyst 5000 series switches.



Caution Use extreme caution when configuring a distributed TrCRF in your network. Ensure that no loops are configured in the network before doing so.

To enable or disable the capability to distribute a TrCRF, issue the following command while in privileged mode:

```
set tokenring distrib-crf {enable | disable}
```

After enabling the distribution of TrCRFs using the **set tokenring distrib-crf** command, you see a display similar to the following:

```
Console> (enable) set tokenring distrib-crf enable  
WARNING:Ports will NOT be inactivated for distributed crfs. NETWORK LOOPS MAY OCCUR.  
Console> (enable)
```

Monitoring Network Traffic

To aid in network management, the Catalyst 5000 series Token Ring module allows you to configure a Switched Port Analyzer (SPAN) port for monitoring port traffic. This SPAN support allows you to perform active monitoring on any single Token Ring source port. Active port monitoring allows you to copy the traffic being switched by a source port to a destination port. Only the logical link control (LLC) traffic that is being switched by the source port is monitored when you configure active port monitoring. The MAC frames are not monitored.

When configuring Token Ring SPAN, keep in mind the following:

- If the SPAN destination port is a Token Ring port, then the source port must be a Token Ring port.
- Any interaction between two endstations on a shared segment that is attached to a switch port configured as a SPAN source port will not be monitored at the destination SPAN port.

- For the Catalyst 5000 series Token Ring module SPAN feature to function reliably in Token Ring software releases *prior* to release 3.3(1), the SPAN port and the port being monitored must be located on the same Token Ring module and the final destination for traffic received by the source port should be a port on the same Token Ring module.
- For proper operation, the Token Ring module SPAN feature requires that the supervisor engine module is running software release 3.2(7), 4.5(2), or 5.1(1) and the Token Ring module is running the Token Ring module software release 3.3(1) or later.

Configuring SPAN

To configure a SPAN port, issue the following command in privileged mode, specifying the source port, the destination port, and the direction of traffic that you want to monitor that is being switched on the source port.

```
set span {src_mod/src_port} dest_mod/dest_port [rx | tx | both] [inpkts {enable | disable}]
[multicast {enable | disable}] [create]
```



Caution If you are running a supervisor engine module software release prior to release 4.5(1), we recommend that you configure only a single source port to be monitored. With the supervisor engine module software release 4.5(1) or later, a single source port will be the standard Token Ring SPAN configuration.

After entering the **set span** command and specifying a source port and destination port, you see a display similar to the following:

```
Console> (enable) set span 3/2 3/6 tx
Enabled monitoring of Port 3/2 transmit traffic by Port 3/6
Console> (enable)
```

Enabling and Disabling SPAN

After configuring a SPAN port, ensure that SPAN has been enabled on the switch. If SPAN is not enabled on the switch, you can enable it using the **set span** command.

To enable SPAN, issue the following command while in privileged mode:

```
set span enable
```

To disable SPAN, issue the following command while in privileged mode:

```
set span disable
```

Verifying the SPAN Configuration

To verify the SPAN configuration, issue the following command:

```
show span
```

After entering the **show span** command, you see a display similar to the following:

```

Console> (enable) show span
Destination : Port 3/6
Admin Source: Port 3/2
Oper Source : Port 3/2
Direction   : transmit
Incoming Packets: disabled
Multicast   : enabled
Console> (enable)
    
```

Table 4 describes the information returned by the **show span** command.

Table 4 show span Command Field Descriptions

Field	Description
Destination	Destination port to which the source port traffic is being copied.
Admin Source	Source port whose traffic is being monitored.
Oper Source	Source port or the ports within a TrCRF whose traffic is being monitored.
Direction	Indicates whether transmit, receive, or transmit/receive information is being monitored.
Incoming Packets	Status of whether reception of normal incoming packets on the SPAN destination port is enabled or disabled.
Multicast	Status of whether monitoring multicast traffic is enabled or disabled.

Displaying Token Ring Statistics, Status, and Station Information

You can use the following commands to view statistics and status information associated with Token Ring stations that are located on monitored rings.

show station controltable

Use the **show station controltable** normal command to display a collection of statistics and status information associated with each Token Ring station on the local ring. In addition, this command provides status information for each ring being monitored.

```
show station controltable [mod_num[/port_num]]
```

Syntax Description

- mod_num* Number of the module.
- port_num* (Optional) Number of the port on the module.

Default

This command has no default setting.

Command Type

Switch command

Command Mode

Normal

Example

The following example shows how to display a collection of statistics and status information associated with each Token Ring station on Token Ring module 3:

```

Console> (enable) show station controltable 3
Port      TableSize      ActiveStation   RingState
-----
3/1       0               0               Normal Operation
3/2       0               0               Normal Operation
3/3       0               0               Normal Operation
3/4       0               0               Normal Operation
3/5       0               0               Normal Operation
3/6       0               0               other
3/7       0               0               other
3/8       0               0               other
3/9       0               0               other
3/10      0               0               other
3/11      0               0               other
3/12      0               0               other
3/13      0               0               other
3/14      0               0               Normal Operation
3/15      0               2               Normal Operation
3/16      0               0               Normal Operation

Port      BeaconSender   BeaconNAUN      OrderChanges
-----
3/1       00:00:00:00:00:00  00:00:00:00:00:00  2
3/2       00:00:00:00:00:00  00:00:00:00:00:00  1
3/3       00:00:00:00:00:00  00:00:00:00:00:00  4
3/4       00:00:00:00:00:00  00:00:00:00:00:00  5
3/5       00:00:00:00:00:00  00:00:00:00:00:00  6
3/6       00:00:00:00:00:00  00:00:00:00:00:00  0
3/7       00:00:00:00:00:00  00:00:00:00:00:00  0
3/8       00:00:00:00:00:00  00:00:00:00:00:00  0
3/9       00:00:00:00:00:00  00:00:00:00:00:00  0
3/10      00:00:00:00:00:00  00:00:00:00:00:00  0
3/11      00:00:00:00:00:00  00:00:00:00:00:00  0
3/12      00:00:00:00:00:00  00:00:00:00:00:00  0
3/13      00:00:00:00:00:00  00:00:00:00:00:00  0
3/14      00:00:00:00:00:00  00:00:00:00:00:00  0
3/15      00:00:00:00:00:00  00:00:00:00:00:00  1
3/16      00:00:00:00:00:00  00:00:00:00:00:00  0
Console> (enable)

```

Table 5 describes the fields shown in the **show station controltable** command output.

Table 5 show station controltable Command Field Descriptions

Field	Description
Port	Module and port number.
TableSize	Number of Token Ring station entries in the table associated with this port.
ActiveStation	Number of active Token Ring station entries in the table associated with this port.
RingState	Current status of the ring.
BeaconSender	Address of the sender of the last beacon frame received on this ring. If no beacon frames have been received, this object shall be equal to six octets of zero.
BeaconNAUN	Address of the nearest upstream neighbor in the last beacon frame received on this ring. If no beacon frames have been received, this object is equal to six octets of zero.
OrderChanges	Number of add and delete events in the table associated with this port.

Related Commands

- show counters**
- show station ordertable**

show station ordertable

Use the **show station ordertable** normal command to display a listing of the order of stations on the monitored rings.

```
show station ordertable [mod_num[/port_num]]
```

Syntax Description

- mod_num* Number of the module.
- port_num* (Optional) Number of the port on the module.

Default

This command has no default setting.

Command Type

Switch command

Command Mode

Normal

Example

The following example shows how to display:

```

Console> show station ordertable 3
Port      OrderIndex      Address
-----
 3/15     1                00:05:77:05:40:63
          2                00:00:30:cf:a0:98
Console>

```

Table 6 describes the fields shown in the **show station ordertable** command output.

Table 6 show station ordertable Command Field Descriptions

Field	Description
Port	Module and port number.
OrderIndex	Location of the station with respect to other stations on the ring.
Address	Physical address of the station.

Related Commands

show counters

show station ordertable

Configuring Filters

With the Catalyst 5000 supervisor engine module software releases 3.2(4) or later or 4.3(2) or later image, used with the Catalyst 5000 Token Ring software release 3.2(3) or later, new parameters are supported by the **set port filter** command. These parameters provide the ability to configure a MAC address filter as both a source or a destination for a specified port.

The new syntax descriptions for configuring MAC address filters using the **set port filter** command are as follows:

```

set port filter mod_num/port_num mac_addr {permit | deny | permit_src | permit_dst |
deny_src | deny_dst deny_src_learn}

```

Syntax Description

<i>mod_num</i>	Number of the module.
<i>port_num</i>	(Optional) Number of the port on the module.
<i>mac_addr</i>	MAC address contained in the packets to be filtered. This address can be entered in canonical format (00-11-33-44-55) or in non-canonical (00:11:22:33:44:55) format.
permit	Keyword used to specify that the filter can permit packets with the specified MAC address or protocol type.
deny	Keyword used to specify that the filter can deny packets with the specified MAC address or protocol type.
permit_src	Keyword used to specify to allow any packet with the specified MAC address as the source address.
permit_dst	Keyword used to specify to allow any packet with the specified MAC address as the destination address.
deny_src	Keyword used to specify to block any packet with the specified MAC address as the source address.
deny_dst	Keyword used to specify to block any packet with the specified MAC address as the destination address.
deny_src_learn	Keyword used to specify that the Token Ring module is not to learn the specified MAC address as a source address.

For more information on the **set port filter** command, refer to the configuration note that shipped with your Token Ring module.

Configuring VLANs

In the *Catalyst 5000 Series Token Ring Module Configuration Note* and the *Catalyst 5000 Series Fiber Token Ring Module Configuration Note*, the description of the translation parameter of the **set vlan** command is incorrectly documented as being “the keyword that specifies a translational VLAN used to translated FDDI or Token Ring to Ethernet.”

The correct description of the translation parameter of the **set vlan** command should read as follows:

translation	(Optional) Keyword that specifies a translational VLAN used to translate FDDI to Ethernet. Possible values are 1 to 1005.
--------------------	---

Fixing a Corrupted Flash

In the event of a corrupted Flash, a Catalyst 5000 series switch can operate in boot mode. However, when the switch is operating in boot mode, a version 3.1 boot ROM is required for the supervisor module to recognize the Token Ring module.

If the Flash becomes corrupted and the supervisor engine module is running a version 3.1 boot ROM, you can download a new image through a Token Ring module while the switch is in boot mode.

If the Flash becomes corrupted and the supervisor engine module is not running a version 3.1 boot ROM, you can download a new Flash image to the switch while in boot mode via either of the following methods:

- Kermit to the console port.
- Through an installed module that is supported by the boot ROM version running on the supervisor engine module.

If you do need to upgrade your boot ROM, please contact the Cisco TAC.

Availability of Catalyst 5000 Software Upgrades on CCO

When changes are made to the Catalyst 5000 software, the new image is posted to CCO. You can then obtain a copy of the image and download it to your switch.

Obtaining Service and Support

For service and support for a product purchased from a reseller, contact the reseller. Resellers offer a wide variety of Cisco service and support programs, which are described in the section “Service and Support” in the information packet that shipped with your product.

Note If you purchased your product from a reseller, you can access Cisco Connection Online (CCO) as a guest. CCO is Cisco Systems’ primary, real-time support channel. Your reseller offers programs that include direct access to CCO’s services.

For service and support for a product purchased directly from Cisco, use CCO.

Cisco Connection Online

Cisco Connection Online (CCO) is Cisco Systems’ primary, real-time support channel. Maintenance customers and partners can self-register on CCO to obtain additional information and services.

Available 24 hours a day, 7 days a week, CCO provides a wealth of standard and value-added services to Cisco’s customers and business partners. CCO services include product information, product documentation, software updates, release notes, technical tips, the Bug Navigator, configuration notes, brochures, descriptions of service offerings, and download access to public and authorized files.

CCO serves a wide variety of users through two interfaces that are updated and enhanced simultaneously: a character-based version and a multimedia version that resides on the World Wide Web (WWW). The character-based CCO supports Zmodem, Kermit, Xmodem, FTP, and Internet e-mail, and it is excellent for quick access to information over lower bandwidths. The WWW version of CCO provides richly formatted documents with photographs, figures, graphics, and video, as well as hyperlinks to related information.

You can access CCO in the following ways:

- WWW: <http://www.cisco.com>
- WWW: <http://www-europe.cisco.com>
- WWW: <http://www-china.cisco.com>
- Telnet: cco.cisco.com
- Modem: From North America, 408 526-8070; from Europe, 33 1 64 46 40 82. Use the following terminal settings: VT100 emulation; databits: 8; parity: none; stop bits: 1; and connection rates up to 28.8 kbps.

For a copy of CCO's Frequently Asked Questions (FAQ), contact cco-help@cisco.com. For additional information, contact cco-team@cisco.com.

Note If you are a network administrator and need personal technical assistance with a Cisco product that is under warranty or covered by a maintenance contract, contact Cisco's Technical Assistance Center (TAC) at 800 553-2447, 408 526-7209, or tac@cisco.com. To obtain general information about Cisco Systems, Cisco products, or upgrades, contact 800 553-6387, 408 526-7208, or cs-rep@cisco.com.

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Documentation for Cisco products is available in three forms: in a CD-ROM package, printed books, and on the World Wide Web. You have the option of subscribing to the CD ROM package through an update service. Or you can order printed documentation at an additional cost. Refer to the information packet included with the router for detailed ordering information. You can also access Cisco documentation on the World Wide Web URL <http://www.cisco.com>.

This document is to be used in conjunction with the documents listed in the "Catalyst 5000 Documentation" section.

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