Configuring Token Ring Switching

This chapter describes how to configure Token Ring switching on the Catalyst 5000 series switch. The Token Ring modules have 16 shielded RJ-45 (copper) or Volition (fiber) ports for Token Ring connections. These ports allow full- or half-duplex connections to other switches, hubs, or end nodes.

Note For complete information on installing Catalyst 5000 series Token Ring switching modules, refer to the *Catalyst 5000 Series Module Installation Guide*.

Note For complete syntax and usage information for the commands used in this chapter, refer to the *Command Reference* for your switch.

This chapter consists of these sections:

Understanding How Token Ring Switching Works

These sections describe how Token Ring switching works:

Supported Features

The Catalyst 5000 series Token Ring modules provide these features:

- 16 shielded RJ-45 or Volition Token Ring ports, individually programmable and capable of running in 4- or 16-Mbps, full- or half duplex, and functioning as either a concentrator or end station
- Frame forwarding between ports and modules
- Concentrator and bridge relay functions that enable switching between ports.
- Switching features
  - Source-route bridging (SRB), source-route switching, or source-route transparent (SRT) bridging
  - Store-and-forward frame-forwarding mode
  - 4-Mbps, 16-Mbps, and automatic speed adaptation
  - Dedicated Token Ring (DTR) support
  - Priority queues for multimedia traffic
  - Address and protocol filters
  - All-Routes Explorer reduction
  - Spanning-Tree Protocol support: IBM, IEEE 802.1d, Cisco
- VLAN support
- Management utilities and support
  - SNMP-based management
  - CiscoView graphical monitoring
  - TrafficDirector for Remote Monitoring (RMON)

In addition to the standard Management Information Base (MIB) objects supported by the Catalyst 5000 series switch, the Token Ring modules support these additional MIBs:

- Token Ring Extensions to the Managed Objects for Bridges (RFC 1525)
- IEEE 802.5 Token Ring MIB (RFC 1748)
- RMON MIB/Token Ring Extensions (RFC 1513) partial support

The proprietary MIBs supported are:

- Cisco Workgroup MIB (CISCO-STACK-MIB)
- VLAN Trunk Protocol (VTP) pruning (CISCO-VTP-MIB)
- Cisco VLAN Bridging (CISCO-VLAN-BRIDGING-MIB)

Most user-configurable variables are supported in either the standard MIBs or private MIBs.

Source-Route Bridging

A source-route bridge makes all forwarding decisions based on data in the Routing Information Field (RIF). It does not learn or look up Media Access Control (MAC) addresses; SRB frames without a RIF are not forwarded.

Typically, clients or servers that support source routing send an explorer frame to determine the path to a given destination. There are two types of explorer frames: All-Routes Explorer and Spanning-Tree Explorer. All SRB bridges copy All-Routes Explorer frames and add their own routing information. For frames that are received from or sent to ports that are in the spanning-tree forwarding state, bridges copy Spanning-Tree Explorer frames and add their own routing information. Because All-Routes Explorer frames will traverse all paths between two devices, they are used in path determination. Spanning-Tree Explorer frames are used to send datagrams because the spanning tree ensures that only one copy of a Spanning-Tree Explorer frame is sent to each ring.

Note The spanning tree used with source-routing is different from the IEEE spanning tree used in transparent bridges. The Catalyst 5000 series Token Ring modules support both types of spanning-tree algorithms.

Source-Route Transparent Bridging

SRT bridging is an IEEE standard that combines source-route bridging and transparent bridging. An SRT bridge forwards frames that do not contain a RIF based on the destination MAC address. Frames that contain a RIF are forwarded based upon source routing. The SRT bridge only runs the IEEE Spanning-Tree Protocol. SRT does not support the IBM Spanning-Tree Protocol.

Source-Route Switching

The Token Ring modules can forward broadcast, multicast, and unicast frames based on MAC addresses. If you have source-route bridges in your network, the Token Ring modules can forward frames based on the RIF. This dual frame-forwarding technology is called source-route switching.

In source-route switching, the switch learns and forwards frames based on source-route descriptors for stations that are one or more source-route bridge hops away. A route descriptor is a portion of a RIF that indicates a single hop. It is defined as a ring number and a bridge number. When a source-routed frame enters the switch, the switch learns the route descriptor for the hop closest to the switch. Frames received from other ports with the same next-hop route descriptor as their destination are forwarded to that port.

The key difference between SRB and source-route switching is that while a source-route switch looks at the RIF, it never updates the RIF. Therefore, all ports in a source-route switch group have the same ring number.

Source-route switching provides the following benefits:

- The switch does not need to learn the MAC addresses of the devices on the other side of a source-route bridge. Therefore, the number of MAC addresses that the switch must learn and maintain is significantly reduced.
- The switch can support parallel source-routing paths.
- An existing ring can be partitioned into several segments without requiring a change in the existing ring numbers or the source-route bridges.
- The switch can support duplicate MAC addresses if the stations reside on LAN segments with different LAN IDs (ring numbers).

To set the bridging mode of a Token Ring Concentrator Relay Function (TrCRF), perform this task in privileged mode:

Task	Command
Set the bridging mode.	**set vlan** *vlan_num* [**mode** {**srt** | **srb**}]

Dedicated Token Ring

The Token Ring modules support a new token-passing standard called Dedicated Token Ring (DTR). DTR is the IEEE 802.5R standard that:

- Enables a switch port to act as a concentrator port so that you can connect the port of the switch directly to an end station.
- Transmits in Transmit Immediate (TXI) mode (also referred to as full-duplex mode), increasing the aggregate bandwidth to 32 Mbps.

DTR provides improved access to central resources, such as network servers. The server can use the full 16 Mbps available for sending and receiving, resulting in an aggregate bandwidth of 32 Mbps.

Default Token Ring Configuration

Table 46-1 shows the Token Ring default configuration.

Table 46-1 Token Ring Default Configuration

Feature	Default Value
Port enable state	All ports are enabled
Port name	None
Port priority	Normal
Port speed	Auto-detect
Duplex mode	Autonegotiate half- or full-duplex mode
Transmission threshold	3
Minimum transmit setting	4
VLAN	All ports assigned to default TrCRF
Spanning-Tree Protocol	Enabled for all ports
All-Routes Explorer reduction	Enabled

Configuring Token Ring Ports

These sections describe how to configure Token Ring switching:

Caution Changing certain configuration parameters of a connected port will cause the port to close and reopen. You will lose all address information and statistics for that port.

Setting the Port Name

To assign a name to a port on the Token Ring module, perform this task in privileged mode:

Task		Command
Step 1	Assign a name to a port.	**set port name** *mod_num/port_num name*
Step 2	Verify that the port name is configured.	**show port** [*mod_num*[*/port_num*]]

This example shows how to set the name for a port and how to verify the name assignment:

```
Console> (enable) set port name 3/2 Print-1st Floor
Port 3/2 name set.
Console> (enable) show port 3/2
Port  Name               Status     Vlan       Level  Duplex Speed Type
----- ------------------ ---------- ---------- ------ ------ ----- ------------
 3/2  Print-1st Floor    inactive   1003       normal fdx    16    TokenRing

Last-Time-Cleared
--------------------------
Wed May 6 1998, 18:09:47
Console> (enable)
```

Setting Frame Priority Levels

To address the needs of delay-sensitive data, each port on a Token Ring module has two data queues: high-priority and low-priority queues.

The queue is determined by the value of the priority field in the frame control (FC) byte of the frame. If the FC priority is above the user-defined priority level, the frame is put in the high-priority queue and is transmitted using the frame priority. If the FC priority is at or below the user-defined priority level, the frame is sent to the low-priority queue.

You can set two types of frame priorities for a port:

- Priority threshold—Highest Token Ring frame priority in the Frame Control Field of the frame that the switch should place in the low-priority transmit queue. The default priority queue threshold is 3.
- Minimum transmit priority—Minimum reservation priority used when requesting a token on a busy ring. The default minimum frame priority is 4.

Note The defaults for the priority queue are compatible with current source-route bridges and provide a high-priority queue for Token Ring multimedia traffic (priorities 5 and 6).

To set the frame priority levels for a port, perform this task in privileged mode:

Task		Command
Step 1	Set the frame priority levels for a port.	**set tokenring priority** *mod_num/port_num* {**threshold** *0-7* | **minxmit** *0-6*}
Step 2	Verify the priority configuration.	**show tokenring** [*mod_num*[*/port_num*]]

This example shows how to set the Token Ring priority threshold to 6 on a port:

```
Console> (enable) set tokenring priority 3/2 threshold 6
Port 2 priority threshold set to 6.
Console> (enable) show tokenring 3/2
Ports   Crf/Brf      Ring#    Port-Mode        Early-Token    AC-bits
-----   ---------    -----    -------------    -----------    --------
 3/2    1003/1005    3276     fdx-cport        enabled        disabled

Ports   Prior-Thresh    Min-Xmit    MAC-Address
-----   ------------    --------    -----------------
 3/2    6               5           00:40:0b:01:bc:65

Ports   Cfg-Loss-Thresh  Cfg-Loss-Intvl  Cfg-Loss-Count  Cfg-Loss-Reason
-----   ---------------  --------------  --------------  ---------------
 3/2    50               20              0               none
Console> (enable)
```

Setting the Port Speed

The Token Ring modules support 4- and 16-Mbps Token Ring transmission speeds. You can configure ports on the Token Ring modules to operate at one of these speeds or to automatically sense the speed of the ring to which it is connected (the default setting). However, with Token Ring technology, you cannot change the transmission speed without closing and reopening the port. These rules apply:

- If the port is open and running at a transmission speed that is the same as the speed you specify when entering the **set port speed** command, no action is performed.
- If the port is open and running at a speed different from a speed you specify when entering the **set port speed** command, the port closes and reopens at the new transmission speed.
- If the port is closed, you can change the speed without any restrictions.

Note If the ports on the Token Ring modules are configured to automatically sense the speed of the ring, the first port inserted on the ring does not set the speed, because it cannot detect the speed.

Note Closing and opening the port on an existing ring at a different transmission speed from which the ring is currently operating causes the port to issue a beacon on that ring.

To set the transmission speed for a port on the Token Ring module, perform this task in privileged mode:

Task		Command
Step 1	Set the transmission speed for a Token Ring module port.	**set port speed** *mod_num/port_num* {**4** | **16** | **auto**}
Step 2	Verify the port speed.	**show port** [*mod_num*[*/port_num*]]

This example shows how to set the ring speed for a port and verify the configuration:

```
Console> (enable) set port speed 3/2 16
Port 3/2 speed set to 16Mbps.
Console> (enable) show port 3/2
Port  Name               Status     Vlan       Level  Duplex Speed Type
----- ------------------ ---------- ---------- ------ ------ ----- ------------
 3/2  Print-1st Floor    inactive   1003       normal fdx    16    TokenRing

Last-Time-Cleared
--------------------------
Wed May 6 1998, 18:09:47
Console> (enable)
```

Setting the Port Transmission Mode

Each port on the Token Ring module can operate in one of these modes:

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

The default mode, **auto**, enables the port to detect the transmission mode it needs to use. However, you can configure the mode if necessary.

To set the transmission mode for a port, perform this task in privileged mode:

Task		Command
Step 1	Set the transmission mode for a port.	**set tokenring portmode** *mod_num/port_num* {**auto** | **fdxcport** | **hdxcport** | **fdxstation** | **hdxstation** | **riro**}
Step 2	Verify the transmission mode setting.	**show tokenring** [*mod_num*[*/port_num*]]

Note The Ring in /Ring out (**riro**) parameter applies to the ports on a fiber Token Ring module only.

This example shows how to set the transmission mode for a port and verify the configuration:

```
Console> (enable) set tokenring portmode 3/2 fdxcport
Port 3/2 mode set to fdxcport
Console> (enable) show tokenring 3/2
Ports   Crf/Brf      Ring#    Port-Mode        Early-Token    AC-bits
-----   ---------    -----    -------------    -----------    --------
 3/2    1003/1005    3276     fdx-cport        enabled        disabled

Ports   Prior-Thresh    Min-Xmit    MAC-Address
-----   ------------    --------    -----------------
 3/2    6               5           00:40:0b:01:bc:65

Ports   Cfg-Loss-Thresh  Cfg-Loss-Intvl  Cfg-Loss-Count  Cfg-Loss-Reason
-----   ---------------  --------------  --------------  ---------------
 3/2    50               20              0               none
```

Setting Early Token Release

The interface ports on the Token Ring modules support early token release. Early token release allows a station to release a new token onto the ring immediately after transmitting, instead of waiting for the first frame to return. Early token release increases the total bandwidth on the ring. All ports, by default, are enabled to use early token release.

Note Early token release is valid for 16-Mbps media only. If early token release is enabled and the media speed is 4 Mbps, the switch disables this feature.

To enable the early token release feature on a Token Ring module port, perform this task in privileged mode:

Task		Command
Step 1	Enable the early token release feature on a Token Ring module port.	**set tokenring etr** *mod_num/port_num* **enable**
Step 2	Verify the early token release configuration.	**show tokenring** [*mod_num*[*/port_num*]]

This example shows how to enable early token release and verify the configuration:

```
Console> (enable) set tokenring etr 3/2 enable
Port 3/2 Early Token Release enabled.
Console> (enable) show tokenring 3/2
Ports   Crf/Brf      Ring#    Port-Mode        Early-Token    AC-bits
-----   ---------    -----    -------------    -----------    --------
 3/2    1003/1005    3276     fdx-cport        enabled        disabled

Ports   Prior-Thresh    Min-Xmit    MAC-Address
-----   ------------    --------    -----------------
 3/2    6               5           00:40:0b:01:bc:65

Ports   Cfg-Loss-Thresh  Cfg-Loss-Intvl  Cfg-Loss-Count  Cfg-Loss-Reason
-----   ---------------  --------------  --------------  ---------------
 3/2    50               20              0               none
Console> (enable)
```

To disable the early token release feature on a Token Ring module port, perform this task in privileged mode:

Task		Command
Step 1	Disable early token release on a Token Ring module port.	**set tokenring etr** *mod_num/port_num* **disable**
Step 2	Verify the early token release configuration.	**show tokenring** [*mod_num*[*/port_num*]]

Setting Address-Recognized and Frame-Copied Bits

You can specify whether the address-recognized (A) bit and the frame-copied (C) bit should be set unconditionally on repeated source-routed Logical Link Control (LLC) frames. These include source-routed frames with a RIF length greater than 2 and all Spanning-Tree Explorer and All-Routes Explorer frames. The default is disable. If this parameter is disable, the setting of these bits is based on whether the frame was actually forwarded.

To set the AC bits for a port, perform this task in privileged mode:

Task		Command
Step 1	Set the AC bits for a port.	**set tokenring acbits** *mod_num/port_num* {**enable** | **disable**}
Step 2	Verify the AC bits setting for a port.	**show tokenring** [*mod_num*[*/port_num*]]

This example shows how to set the AC bits for a port and how to verify the configuration:

```
Console> (enable) set tokenring acbits 3/2 enable
Port 3/2 acbits enabled.
Console> (enable) show tokenring 3/2
Ports   Crf/Brf      Ring#    Port-Mode        Early-Token    AC-bits
-----   ---------    -----    -------------    -----------    --------
 3/2    1003/1005    3276     fdx-cport        enabled        enabled

Ports   Prior-Thresh    Min-Xmit    MAC-Address
-----   ------------    --------    -----------------
 3/2    6               5           00:40:0b:01:bc:65

Ports   Cfg-Loss-Thresh  Cfg-Loss-Intvl  Cfg-Loss-Count  Cfg-Loss-Reason
-----   ---------------  --------------  --------------  ---------------
 3/2    50               20              0               none
Console> (enable)
```

Setting Configuration Loss Thresholds

Configuration loss occurs when a port completes a connection, allows data traffic to flow, and subsequently closes. The configuration loss threshold controls the number of configuration losses that can occur within a specified time. When the threshold is exceeded, the port is disabled and you must enable it by entering the **set port enable** command or an SNMP manager. The valid range for the configuration loss threshold is 1 through 100. The default is 8.

To set and verify the configuration loss threshold for a port, perform this task in privileged mode:

Task		Command
Step 1	Set the configuration loss threshold for a port.	**set tokenring configloss** *mod_num/port_num* {**threshold** *<1..100>* | **interval** *<1..9999>*}
Step 2	Verify the configuration loss threshold setting.	**show tokenring** [*mod_num*[*/port_num*]]

This example shows how to set the configuration loss threshold for a port and verify the configuration:

```
Console> (enable) set tokenring configloss 3/2 threshold 50
Port 3/2 configloss threshold set to 50.
Console> (enable) set tokenring configloss 3/2 interval 20
Port 3/2 configloss interval set to 20.
Console> (enable) show tokenring 3/2
Ports   Crf/Brf      Ring#    Port-Mode        Early-Token    AC-bits
-----   ---------    -----    -------------    -----------    --------
 3/2    1003/1005    3276     fdx-cport        enabled        enabled

Ports   Prior-Thresh    Min-Xmit    MAC-Address
-----   ------------    --------    -----------------
 3/2    6               5           00:40:0b:01:bc:65

Ports   Cfg-Loss-Thresh  Cfg-Loss-Intvl  Cfg-Loss-Count  Cfg-Loss-Reason
-----   ---------------  --------------  --------------  ---------------
 3/2    50               20              0               none
Console> (enable)
```

Enabling and Disabling All-Routes Explorer Reduction

For parallel SRB or SRT backbones, All-Routes Explorer reduction ensures that the number of All-Routes Explorer frames generated by the switch does not overwhelm the network.

In accordance with the IEEE 802.1d SRT standard, the Token Ring module discards any All-Routes Explorer frames that have already been on a ring attached to the switch. This ensures that only one All-Routes Explorer frame is received on each ring within each VLAN (Token Ring Bridge Relay Function [TrBRF] and Token Ring Concentrator Relay Function [TrCRF]). The number of frames is equal to the number of external parallel paths between the rings. If a port on the switch fails or is disabled, the switch no longer checks for this ring number in the RIF. This bypass allows frames to travel on alternate paths.

By default, All-Routes Explorer reduction is enabled.

To enable All-Routes Explorer reduction, perform this task in privileged mode:

Task	Command
Enable All-Routes Explorer reduction.	**set tokenring reduction enable**

To disable All-Routes Explorer reduction, perform this task in privileged mode:

Task	Command
Disable All-Routes Explorer reduction.	**set tokenring reduction disable**