Frame Relay Queueing and Fragmentation at the Interface

Feature History

Release	Modification
12.2(14)S	This feature was introduced.

This document describes the Frame Relay Queueing and Fragmentation at the Interface feature in Cisco IOS Release 12.2(14)S and includes the following sections:

Feature Overview

The Frame Relay Queueing and Fragmentation at the Interface feature introduces support for low-latency queueing (LLQ) and FRF.12 end-to-end fragmentation on a Frame Relay interface. This new feature simplifies the configuration of low-latency, low-jitter quality of service (QoS) by enabling the queueing policy and fragmentation configured on the main interface to apply to all permanent virtual circuits (PVCs) and subinterfaces under that interface. Before the introduction of this feature, queueing and fragmentation had to be configured on each individual PVC. Subrate shaping can also be configured on the interface.

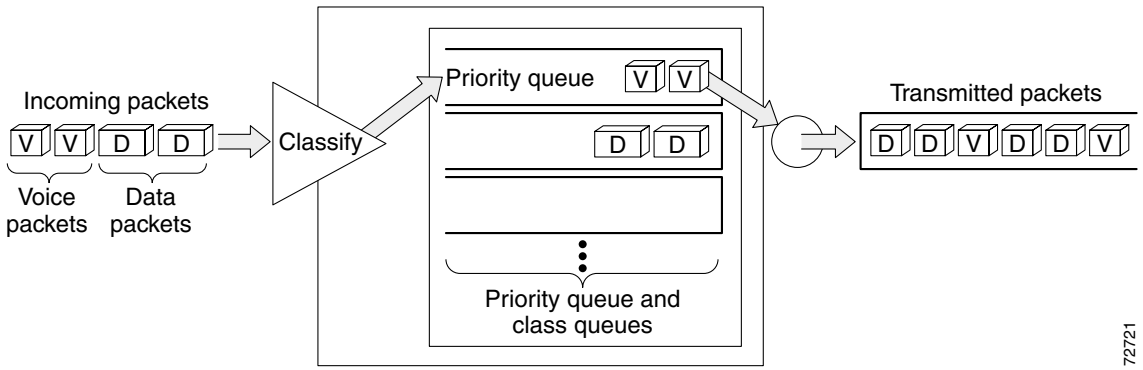
How Frame Relay Queueing and Fragmentation at the Interface Works

When FRF.12 end-to-end fragmentation is enabled on an interface, all PVCs on the main interface and its subinterfaces will have fragmentation enabled with the same configured fragment size. To maintain low latency and low jitter for higher priority traffic, the configured fragment size must be greater than

the largest high-priority frames. This configuration will prevent priority traffic from being fragmented and queued behind non-priority fragmented frames. If the size of a priority frame is larger than the configured fragment size, the priority frame will be fragmented. Local Management Interface (LMI) traffic will not be fragmented and is guaranteed its required bandwidth.

When a low-latency queueing policy map is applied to the interface, traffic through the interface is identified using class maps and is directed to the appropriate queue. Time-sensitive traffic such as voice should be classified as high priority and will be queued on the priority queue. Traffic that does not fall into one of the defined classes will be queued on the class-default queue. Frames from the priority queue and class queues are subject to fragmentation and interleaving. As long as the configured fragment size is larger than the high-priority frames, the priority queue traffic will not be fragmented and will be interleaved with fragmented frames from other class queues. This approach provides the highest QoS transmission for priority queue traffic. Figure 1 illustrates the interface queueing and fragmentation process.

Figure 1 Frame Relay Queueing and Fragmentation at the Interface



Subrate shaping can also be applied to the interface, but interleaving of priority frames will not work when shaping is configured. If shaping is not configured, each PVC will be allowed to send bursts of traffic up to the physical line rate.

When shaping is configured and traffic exceeds the rate at which the shaper can send frames, the traffic is queued at the shaping layer using fair queueing. After a frame passes through the shaper, the frame is queued at the interface using whatever queueing method is configured. If shaping is not configured, then queueing occurs only at the interface.

Note For interleaving to work, both fragmentation and the low-latency queueing policy must be configured with shaping disabled.

The Frame Relay Queueing and Fragmentation at the Interface feature supports the following functionality:

- Voice over Frame Relay
- Weighted Random Early Detection
- Frame Relay payload compression
- IP header compression

Benefits

Simple Configuration

The Frame Relay Queueing and Fragmentation at the Interface feature allows fragmentation, low latency queueing, and subrate shaping to be configured on a Frame Relay interface queue. The fragmentation and queueing and shaping policy will apply to all PVCs and subinterfaces under the main interface, eliminating the need to configure QoS on each PVC individually.

Flexible Bandwidth

This feature allows PVCs to preserve the logical separation of traffic from different services while reducing bandwidth partitioning between PVCs. Each PVC can send bursts of traffic up to the interface shaping rate or, if shaping is not configured, the physical interface line rate.

Restrictions

- Interface fragmentation and Frame Relay traffic shaping cannot be configured at the same time.
- Interface fragmentation and class-based fragmentation cannot be configured at the same time.
- Frame Relay switched virtual circuits (SVCs) are not supported.
- Hierarchical shaping and multiple shapers are not supported.

Related Documents

For more information about shaping and low-latency queueing for Frame Relay, refer to the following documents:

- *Cisco IOS Quality of Service Solutions Configuration Guide*, Release 12.2
- *Cisco IOS Quality of Service Solutions Command Reference*, Release 12.2
- *Low Latency Queueing for Frame Relay*, Cisco IOS Release 12.1(2)T feature module

For more information about Frame Relay fragmentation, refer to the following documents:

- *Cisco IOS Wide-Area Networking Configuration Guide*, Release 12.2
- *Cisco IOS Wide-Area Networking Command Reference*, Release 12.2

Supported Platforms

- Cisco 7200 series
- Cisco 7400 series
- Cisco 7500 series

Determining Platform Support Through Cisco Feature Navigator

Cisco IOS software is packaged in feature sets that support specific platforms. To get updated information regarding platform support for this feature, access Cisco Feature Navigator. Cisco Feature Navigator dynamically updates the list of supported platforms as new platform support is added for the feature.

Cisco Feature Navigator is a web-based tool that enables you to determine which Cisco IOS software images support a specific set of features and which features are supported in a specific Cisco IOS image. You can search by feature or release. Under the release section, you can compare releases side by side to display both the features unique to each software release and the features in common.

To access Cisco Feature Navigator, you must have an account on Cisco.com. If you have forgotten or lost your account information, send a blank e-mail to cco-locksmith@cisco.com. An automatic check will verify that your e-mail address is registered with Cisco.com. If the check is successful, account details with a new random password will be e-mailed to you. Qualified users can establish an account on Cisco.com by following the directions at http://www.cisco.com/register.

Cisco Feature Navigator is updated regularly when major Cisco IOS software releases and technology releases occur. For the most current information, go to the Cisco Feature Navigator home page at the following URL:

http://www.cisco.com/go/fn

Availability of Cisco IOS Software Images

Platform support for particular Cisco IOS software releases is dependent on the availability of the software images for those platforms. Software images for some platforms may be deferred, delayed, or changed without prior notice. For updated information about platform support and availability of software images for each Cisco IOS software release, refer to the online release notes or, if supported, Cisco Feature Navigator.

Supported Standards, MIBs, and RFCs

Standards

FRF.12, *Frame Relay Fragmentation Implementation Agreement*, December 1997

MIBs

No new or modified 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.

Prerequisites

The tasks in this document assume that you know how to configure low-latency queueing and shaping service policies.

The following prerequisites are specific to the Cisco 7500 series:

- The Frame Relay Queueing and Fragmentation at the Interface feature is supported on VIP-based interfaces with VIP2-50 or higher.
- Distributed Cisco Express Forwarding (dCEF) must be enabled both globally and on the Frame Relay interface.

Configuration Tasks

See the following sections for configuration tasks for the Frame Relay Queueing and Fragmentation at the Interface feature. Each task in the list is identified as either required or optional.

- Configuring Class Policy for the Priority Queue (required)
- Configuring Class Policy for the Bandwidth Queues (optional)
- Configuring the Shaping Policy Using the Class-Default Class (optional)
- Configuring Queueing and Fragmentation on the Frame Relay Interface (required)
- Verifying Frame Relay Queueing and Fragmentation at the Interface (optional)

Configuring Class Policy for the Priority Queue

To configure a policy map for the priority class, use the following commands beginning in global configuration mode.

	Command	Purpose
Step 1	`Router(config)# policy-map policy-map`	Specifies the name of the policy map to be created or modified. • Use this command to define the queueing policy for the priority queue.
Step 2	`Router(config-pmap)# class class-name`	Specifies the name of a class to be created and included in the service policy. • The class name that you specify in the policy map defines the characteristics for that class and its match criteria as configured using the **class-map** command.
Step 3	`Router(config-pmap-c)# priority bandwidth-kbps`	Creates a strict priority class and specifies the amount of bandwidth, in kbps, to be assigned to the class.

Configuring Class Policy for the Bandwidth Queues

To configure a policy map and create class policies that make up the service policy, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# policy-map policy-map`	Specifies the name of the policy map to be created or modified. • The bandwidth queues and the priority queue use the same policy map.
Step 2	`Router(config-pmap)# class class-name`	Specifies the name of a class to be created and included in the service policy. • The class name that you specify in the policy map defines the characteristics for that class and its match criteria as configured using the **class-map** command.
Step 3	`Router(config-pmap-c)# bandwidth bandwidth-kbps`	Specifies the amount of bandwidth to be assigned to the class, in kbps, or as a percentage of the available bandwidth. Bandwidth must be specified in kbps or as a percentage consistently across classes. (Bandwidth of the priority queue must be specified in kbps.) • The sum of all bandwidth allocation on an interface cannot exceed 75 percent of the total available interface bandwidth. However, under aggressive circumstances in which you want to configure more than 75 percent of the interface bandwidth to classes, you can override the 75 percent maximum by using the **max-reserved-bandwidth** command.

Configuring the Shaping Policy Using the Class-Default Class

In general, the class-default class is used to classify traffic that does not fall into one of the defined classes. Even though the class-default class is predefined when you create the policy map, you still have to configure it. If a default class is not configured, traffic that does not match any of the configured classes is given best-effort treatment, which means that the network will deliver the traffic if it can, without any assurance of reliability, delay prevention, or throughput.

If you configure shaping in addition to queueing on the interface, use the class-default class to configure the shaping policy. The shaping policy will serve as the parent in a hierarchical traffic policy. The queueing policy will serve as the child policy. The class-default class is used for the shaping policy so that all traffic for the entire interface is shaped and a bandwidth-limited stream can be created.

To configure the shaping policy in the class-default class, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# policy-map policy-map`	Specifies the name of the policy map to be created or modified. • Use this command to define the shaping policy.
Step 2	`Router(config-pmap)# class class-default`	Specifies the default class so that you can configure or modify its policy.
Step 3	`Router(config-pmap-c)# shape [average | peak] mean-rate [[burst-size] [excess-burst-size]]`	(Optional) Shapes traffic to the indicated bit rate according to the algorithm specified.
Step 4	`Router(config-pmap-c)# service-policy policy-map-name`	Specifies the name of a policy map to be used as a matching criterion (for nesting traffic policies [hierarchical traffic policies] within one another). • Use this command to attach the policy map for the priority queue (the child policy) to the shaping policy (the parent policy).

Configuring Queueing and Fragmentation on the Frame Relay Interface

To configure low-latency queueing and FRF.12 end-to-end fragmentation on a Frame Relay interface, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# interface type number`	Configures an interface type and enters interface configuration mode.
Step 2	`Router(config-if)# encapsulation frame-relay`	Enables Frame Relay encapsulation.
Step 3	`Router(config-if)# service-policy output policy-map-name`	Attaches a policy map to an output interface, to be used as the service policy for that interface. • If shaping is being used, use this command to attach the shaping policy (which includes the nested queueing policy) to the interface. • Interleaving of high-priority frames will not work if shaping is configured on the interface. • If shaping is not being used, use this command to attach the queueing policy to the interface.
Step 4	`Router(config-if)# frame-relay fragment fragment-size end-to-end`	Enables fragmentation of Frame Relay frames. • To maintain low latency and low jitter for priority queue traffic, configure the fragment size to be greater than the largest high-priority frame that would be expected.

Verifying Frame Relay Queueing and Fragmentation at the Interface

To verify the configuration and performance of Frame Relay queueing and fragmentation at the interface, perform the following steps:

Step 1 Enter the **show running-config** command to verify the configuration.

```
Router# show running-config
Building configuration...

.
.
.

class-map match-all voice
  match ip precedence 5
!
!policy-map llq
  class voice
    priority 64
policy-map shaper
  class class-default
   shape peak 96000
   service-policy llq
!
!interface Serial1/1
 ip address 16.0.0.1 255.255.255.0
 encapsulation frame-relay
 service-policy output shaper
 frame-relay fragment 80 end-to-end
!
```

Step 2 Enter the **show policy-map interface** command to display low- latency queueing information, packet counters, and statistics for the policy map applied to the interface. Compare the values in the "packets" and the "pkts matched" counters; under normal circumstances, the "packets" counter is much larger than the "pkts matched" counter. If the values of the two counters are nearly equal, then the interface is receiving a large number of process-switched packets or is heavily congested.

The following sample output for the **show policy-map interface command** is based on the configuration in Step 1:

```
Router# show policy-map interface serial 1/1

 Serial1/1

  Service-policy output:shaper

    Class-map:class-default (match-any)
      12617 packets, 1321846 bytes
      5 minute offered rate 33000 bps, drop rate 0 bps
      Match:any
      Traffic Shaping
           Target/Average   Byte   Sustain   Excess    Interval  Increment
             Rate           Limit  bits/int  bits/int  (ms)      (bytes)
           192000/96000     1992   7968      7968      83        1992

        Adapt  Queue     Packets   Bytes     Packets   Bytes     Shaping
        Active Depth                         Delayed   Delayed   Active
        -      0         12586     1321540   0         0         no
```

```
Service-policy :llq

  Class-map:voice (match-all)
    3146 packets, 283140 bytes
    5 minute offered rate 7000 bps, drop rate 0 bps
    Match:ip precedence 1
    Weighted Fair Queueing
      Strict Priority
      Output Queue:Conversation 24
      Bandwidth 64 (kbps) Burst 1600 (Bytes)
      (pkts matched/bytes matched) 0/0
      (total drops/bytes drops) 0/0

  Class-map:class-default (match-any)
    9471 packets, 1038706 bytes
    5 minute offered rate 26000 bps
    Match:any
```

Step 3 Enter the **show interfaces serial** command to display information about the queueing strategy, priority queue interleaving, and the type of fragmentation configured on the interface. You can determine whether the interface has reached a congestion condition and packets have been queued by looking at the "Conversations" fields. A non-zero value for "max active" counter shows whether any queues have been active. If the "active" counter is a non-zero value, you can use the **show queue** command to view the contents of the queues.

The following sample output for the **show interfaces serial** command is based on the configuration in Step 1:

```
Router# show interfaces serial 1/1

Serial1/1 is up, line protocol is up
  Hardware is M4T
  Internet address is 10.0.0.1/24
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
     reliability 255/255, txload 5/255, rxload 1/255
  Encapsulation FRAME-RELAY, crc 16, loopback not set
  Keepalive set (10 sec)
  Restart-Delay is 0 secs
  LMI enq sent  40, LMI stat recvd 40, LMI upd recvd 0, DTE LMI up
  LMI enq recvd 0, LMI stat sent  0, LMI upd sent  0
  LMI DLCI 1023  LMI type is CISCO  frame relay DTE
  Fragmentation type:end-to-end, size 80, PQ interleaves 0
  Broadcast queue 0/64, broadcasts sent/dropped 0/0, interface broadcasts 0
  Last input 00:00:03, output 00:00:00, output hang never
  Last clearing of "show interface" counters 00:06:34
  Input queue:0/75/0/0 (size/max/drops/flushes); Total output drops:0
  Queueing strategy:weighted fair
  Output queue:0/1000/64/0 (size/max total/threshold/drops)
     Conversations  0/1/256 (active/max active/max total)
     Reserved Conversations 0/0 (allocated/max allocated)
     Available Bandwidth 1158 kilobits/sec
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 33000 bits/sec, 40 packets/sec
     40 packets input, 576 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     15929 packets output, 1668870 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions     DCD=up  DSR=up  DTR=up  RTS=up  CTS=up
```

Monitoring and Maintaining Frame Relay Queueing and Fragmentation at the Interface

To monitor and maintain Frame Relay queueing and fragmentation at the interface, use the following commands in privileged EXEC mode:

Command	Purpose
Router# **debug frame-relay fragment** [**event** | **interface** *type number dlci*]	Displays information related to Frame Relay fragmentation on a PVC.
Router# **show frame-relay fragment** [**interface** *type number* [*dlci*]]	Displays information about the Frame Relay fragmentation.
Router# **show interfaces serial** *number*	Displays information about a serial interface.
Router# **show queue** *interface-type interface-number*	Displays the contents of packets inside a queue for a particular interface.
Router# **show policy-map interface** *number* [**input** | **output**]	Displays the packet statistics of all classes that are configured for all service policies on the specified interface.

Configuration Examples

This section provides the following configuration example:

- Frame Relay Queueing, Shaping, and Fragmentation at the Interface Example
- Frame Relay Queueing and Fragmentation at the Interface Example

Frame Relay Queueing, Shaping, and Fragmentation at the Interface Example

The following example shows the configuration of a hierarchical policy for low-latency queueing, FRF.12 fragmentation, and shaping on serial interface 3/2. Note that traffic from the priority queue will not be interleaved with fragments from the class-default queue because shaping is configured.

```
class-map voice
 match access-group 101

policy-map llq
 class voice
  priority 64

policy-map shaper
 class class-default
  shape average 96000
  service-policy llq

interface serial 3/2
 ip address 10.0.0.1 255.0.0.0
 encapsulation frame-relay
 bandwidth 128
 clock rate 128000
 service-policy output shaper
 frame-relay fragment 80 end-to-end

 access-list 101 match ip any host 10.0.0.2
```

Frame Relay Queueing and Fragmentation at the Interface Example

The following example shows the configuration of low-latency queueing and FRF.12 fragmentation on serial interface 3/2. Because shaping is not being used, a hierarchical traffic policy is not needed and traffic from the priority queue will be interleaved with fragments from the other queues. Without shaping, the output rate of the interface is equal to the line rate or configured clock rate. In this example, the clock rate is 128,000 bps.

```
class-map voice
 match access-group 101

policy-map llq
 class voice
  priority 64
 class video
  bandwidth 32

interface serial 3/2
 ip address 10.0.0.1 255.0.0.0
 encapsulation frame-relay
 bandwidth 128
 clock rate 128000
 service-policy output llq
 frame-relay fragment 80 end-to-end

 access-list 101 match ip any host 10.0.0.2
```

Command Reference

This section documents modified commands. All other commands used with this feature are documented in the Cisco IOS Release 12.2 command reference publications.

- **frame-relay fragment end-to-end**
- **show interfaces serial**

frame-relay fragment end-to-end

To enable fragmentation of Frame Relay frames on an interface, use the **frame-relay fragment end-to-end** command in interface configuration mode. To disable Frame Relay fragmentation, use the **no** form of this command.

frame-relay fragment *fragment-size* **end-to-end**

no frame-relay fragment

Syntax Description

fragment-size	Specifies the number of payload bytes from the original Frame Relay frame that will go into each fragment. This number excludes the Frame Relay header of the original frame. All the fragments of a Frame Relay frame except the last will have a payload size equal to *fragment-size*; the last fragment will have a payload less than or equal to *fragment-size*. Valid values are from 16 to 1600 bytes; the default is 53.

Defaults

Disabled

Command Modes

Interface configuration

Command History

Release	Modification
12.2(14)S	This command was introduced to enable fragmentation on a Frame Relay interface.

Usage Guidelines

Interface fragmentation and class-based fragmentation cannot be configured at the same time. To configure class-based fragmentation that can be applied to individual permanent virtual circuits (PVCs), use the **frame-relay fragment** command in map-class configuration mode.

Interface fragmentation supports the following types of fragment formats:

- End-to-end FRF.12 format
- FRF.11 Annex C format
- Cisco proprietary format

When fragmentation is enabled on an interface, all PVCs on the main interface and its subinterfaces will have fragmentation enabled with the same configured fragment size.

When configuring fragmentation on an interface with low- latency queueing, configure the fragment size to be greater than the largest high-priority frame that would be expected. This configuration will prevent higher priority traffic from being fragmented and queued up behind lower priority fragmented frames. If the size of a priority frame is larger than the configured fragment size, the priority frame will be fragmented.

Local Management Interface (LMI) traffic will not be fragmented.

Note the following interface fragmentation restrictions:

- Interface fragmentation and Frame Relay traffic shaping cannot be configured at the same time.
- Interface fragmentation and class-based fragmentation cannot be configured at the same time.

Examples

The following example shows the configuration of low-latency queueing, FRF.12 fragmentation, and shaping on serial interface 3/2. Note that traffic from the priority queue will not be interleaved with fragments from the class-default queue because shaping is configured.

```
class-map voice
 match access-group 101

policy-map llq
 class voice
  priority 64

policy-map shaper
 class class-default
  shape average 96000
  service-policy llq

interface serial 3/2
 ip address 10.0.0.1 255.0.0.0
 encapsulation frame-relay
 bandwidth 128
 clock rate 128000
 service-policy output shaper
 frame-relay fragment 80 end-to-end

 access-list 101 match ip any host 10.0.0.2
```

Related Commands

Command	Description
class (policy-map)	Specifies the name of the class whose policy you want to create or change or specifies the default class (commonly known as the class-default class) before you configure its policy.
debug frame-relay fragment	Displays information related to Frame Relay fragmentation on a PVC.

show interfaces serial

To display information about a serial interface, use the **show interfaces serial** command in privileged EXEC mode. When using Frame Relay encapsulation, use the **show interfaces serial** command in user EXEC or privileged EXEC mode to display information about the multicast data-link connection identifier (DLCI), the DLCIs used on the interface, and the DLCI used for the Local Management Interface (LMI).

Cisco 4000 Series

show interfaces serial [*number*[**:***channel-group*]] [**accounting**]

Cisco 7200 Series

show interfaces serial [*slot*/*port*] [**accounting**]

Cisco 7000 and Cisco 7500 Series with the RSP7000, RSP7000CI, or Ports on VIPs

show interfaces serial [*slot*/*port-adapter*/*port*]

Cisco 7500 Series

show interfaces serial [*slot*/*port*[**:***channel-group*]] [**accounting**]

Cisco 7500 Series with a CT3IP

show interfaces serial [*slot*/*port-adapter*/*port*][**:***t1-channel*] [**accounting | crb**]

Cisco AS5350 and Cisco AS5400 Universal Gateways

show interfaces serial *slot*/*port*

Cisco AS5800 Access Servers

show interfaces serial *dial-shelf*/*slot*/*t3-port*:*t1-num*:*chan-group*

Syntax Description

number	(Optional) Number of the port being displayed.
:*channel-group*	(Optional) On the Cisco 4000 series with a Network Management Processor (NPM) or the Cisco 7500 series routers with a MultiChannel Interface Processor (MIP), specifies the T1 channel-group number in the range of 0 to 23 defined with the **channel-group** controller configuration command.
accounting	(Optional) Displays the number of packets of each protocol type that have been sent through the interface.
slot	(Optional) Number of the slot being displayed. Refer to the appropriate hardware manual for slot and port information.
/port	(Optional) Number of the port being displayed. Refer to the appropriate hardware manual for slot and port information.
/port-adapter	(Optional) Number of the port adapter being displayed. Refer to the appropriate hardware manual for information about port adapter compatibility.

:*t1-channel*	(Optional) T1 channel number. For the CT3IP, the T1 channel is a number between 1 and 28. T1 channels on the CT3IP are numbered 1 to 28 rather than the more traditional zero-based scheme (0 to 27) used with other Cisco products. This scheme ensures consistency with telco numbering schemes for T1 channels within channelized T3 equipment.
crb	(Optional) Displays interface routing and bridging information.
dial-shelf	Dial shelf chassis in the Cisco AS5800 access server that contains the CT3 interface card.
slot	Location of the CT3 interface card in the dial shelf chassis.
t3-port	T3 port number. The only valid value is 0.
:*t1-num*	T1 time slot in the T3 line. The value can be from 1 to 28.
:*chan-group*	Channel group identifier.

Command Modes

User EXEC (when Frame Relay encapsulation is used)
Privileged EXEC

Command History

Release	Modification
10.0	This command was introduced on the Cisco 4000 series routers.
11.0	This command was implemented on the Cisco 7000 series routers.
11.1 CA	This command was modified to include sample output for the PA-2JT2, PA-E3, and PA-T3 serial port adapters.
11.3	This command was modified to include the CT3IP.
12.0(3)T	This command was implemented on the Cisco AS5800 access servers.
12.0(4)T	This command was modified to include enhanced display information for dialer bound interfaces.
12.2(11)T	This command was implemented on the Cisco AS5350 and Cisco AS5400.
12.2(13)T	This command was modified to display information about Frame Relay interface queueing and fragmentation.

Usage Guidelines

Frame Relay

Use this command to determine the status of the Frame Relay link. This display also indicates Layer 2 status if switched virtual circuits (SVCs) are configured.

Channel Groups as Virtual Serial Interfaces

To find out about channel groups configured as virtual serial interfaces, to verify that the router has High-Level Data Link Control (HDLC) encapsulation on the interface, and to verify that the interface sees the loopback, use the **show interfaces serial** command in privileged EXEC mode.

Examples

Example of Synchronous Serial Interface

The following is sample output from the **show interfaces serial** command for a synchronous serial interface:

```
Router# show interfaces serial

Serial 0 is up, line protocol is up
   Hardware is MCI Serial
   Internet address is 192.168.10.203, subnet mask is 255.255.255.0
   MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
   Encapsulation HDLC, loopback not set, keepalive set (10 sec)
   Last input 0:00:07, output 0:00:00, output hang never
   Output queue 0/40, 0 drops; input queue 0/75, 0 drops
   Five minute input rate 0 bits/sec, 0 packets/sec
   Five minute output rate 0 bits/sec, 0 packets/sec
       16263 packets input, 1347238 bytes, 0 no buffer
       Received 13983 broadcasts, 0 runts, 0 giants
       2 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 2 abort
1 carrier transitions

     22146 packets output, 2383680 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets, 0 restarts
```

Table 1 describes significant fields shown in the display.

Table 1 show interfaces serial Field Descriptions—Synchronous Serial Interface

Field	Description
Serial ... is {up | down} ... is administratively down	Indicates whether the interface hardware is currently active (whether carrier detect is present), is currently inactive, or has been taken down by an administrator.
line protocol is {up | down}	Indicates whether the software processes that handle the line protocol consider the line usable (that is, whether keepalives are successful) or whether the line has been taken down by an administrator.
Hardware is	Specifies the hardware type.
Internet address is	Specifies the Internet address and subnet mask.
MTU	Maximum transmission unit of the interface.
BW	Indicates the value of the bandwidth parameter that has been configured for the interface (in kbps). If the interface is attached to a serial line with a line speed that does not match the default (1536 or 1544 kbps for T1 and 56 kbps for a standard synchronous serial line), use the **bandwidth** command to specify the correct line speed for this serial line.
DLY	Delay of the interface, in microseconds.
rely	Reliability of the interface as a fraction of 255 (255/255 is 100 percent reliability), calculated as an exponential average over 5 minutes.
load	Load on the interface as a fraction of 255 (255/255 is completely saturated), calculated as an exponential average over 5 minutes.
Encapsulation	Encapsulation method assigned to interface.
loopback	Indicates whether or not loopback is set.
keepalive	Indicates whether or not keepalives are set.

Table 1 show interfaces serial Field Descriptions—Synchronous Serial Interface (continued)

Field	Description
Last input	Number of hours, minutes, and seconds since the last packet was successfully received by an interface and processed locally on the router. Useful for knowing when a dead interface failed. This counter is updated only when packets are process-switched, not when packets are fast-switched.
Last output	Number of hours, minutes, and seconds since the last packet was successfully transmitted by an interface. This counter is updated only when packets are process-switched, not when packets are fast-switched.
output hang	Number of hours, minutes, and seconds (or never) since the interface was last reset because of a transmission that took too long. When the number of hours in any of the "last" fields exceeds 24 hours, the number of days and hours is printed. If that field overflows, asterisks are printed.
Output queue, drops input queue, drops	Number of packets in output and input queues. Each number is followed by a slash, the maximum size of the queue, and the number of packets dropped because of a full queue.
5 minute input rate 5 minute output rate	Average number of bits and packets transmitted per second in the last 5 minutes. The 5-minute input and output rates should be used only as an approximation of traffic per second during a given 5-minute period. These rates are exponentially weighted averages with a time constant of 5 minutes. A period of four time constants must pass before the average will be within two percent of the instantaneous rate of a uniform stream of traffic over that period.
packets input	Total number of error-free packets received by the system.
bytes	Total number of bytes, including data and MAC encapsulation, in the error-free packets received by the system.
no buffer	Number of received packets discarded because there was no buffer space in the main system. Compare with ignored count. Broadcast storms on Ethernet networks and bursts of noise on serial lines are often responsible for no input buffer events.
Received... broadcasts	Total number of broadcast or multicast packets received by the interface.
runts	Number of packets that are discarded because they are smaller than the minimum packet size of the medium.
giants	Number of packets that are discarded because they exceed the maximum packet size of the medium.
input errors	Total number of no buffer, runts, giants, CRCs, frame, overrun, ignored, and abort counts. Other input-related errors can also increment the count, so that this sum might not balance with the other counts.
CRC	Cyclic redundancy checksum generated by the originating station or far-end device does not match the checksum calculated from the data received. On a serial link, CRCs usually indicate noise, gain hits, or other transmission problems on the data link.

Table 1 show interfaces serial Field Descriptions—Synchronous Serial Interface (continued)

Field	Description
frame	Number of packets received incorrectly having a CRC error and a noninteger number of octets. On a serial line, this is usually the result of noise or other transmission problems.
overrun	Number of times the serial receiver hardware was unable to hand received data to a hardware buffer because the input rate exceeded the receiver's ability to handle the data.
ignored	Number of received packets ignored by the interface because the interface hardware ran low on internal buffers. Broadcast storms and bursts of noise can cause the ignored count to be increased.
abort	Illegal sequence of one bits on a serial interface. This usually indicates a clocking problem between the serial interface and the data link equipment.
carrier transitions	Number of times the carrier detect signal of a serial interface has changed state. For example, if data carrier detect (DCD) goes down and comes up, the carrier transition counter will increment two times. Indicates modem or line problems if the carrier detect line is changing state often.
packets output	Total number of messages transmitted by the system.
bytes output	Total number of bytes, including data and MAC encapsulation, transmitted by the system.
underruns	Number of times that the transmitter has been running faster than the router can handle. This might never be reported on some interfaces.
output errors	Sum of all errors that prevented the final transmission of datagrams out of the interface from being examined. Note that this might not balance with the sum of the enumerated output errors because some datagrams can have more than one error, and others can have errors that do not fall into any of the specifically tabulated categories.
collisions	Number of messages retransmitted because of an Ethernet collision. Some collisions are normal. However, if your collision rate climbs to around 4 or 5 percent, you should consider verifying that there is no faulty equipment on the segment and/or moving some existing stations to a new segment. A packet that collides is counted only once in output packets.
interface resets	Number of times an interface has been completely reset. This can happen if packets queued for transmission were not sent within several seconds' time. On a serial line, this can be caused by a malfunctioning modem that is not supplying the transmit clock signal or by a cable problem. If the system notices that the carrier detect line of a serial interface is up, but the line protocol is down, it periodically resets the interface in an effort to restart it. Interface resets can also occur when an interface is looped back or shut down.
restarts	Number of times the controller was restarted because of errors.
alarm indications, remote alarms, rx LOF, rx LOS	Number of CSU/DSU alarms and number of occurrences of receive loss of frame and receive loss of signal.
BER inactive, NELR inactive, FELR inactive	Status of G.703-E1 counters for bit-error rate (BER) alarm, near-end loop remote (NELR), and far-end loop remote (FELR). Note that you cannot set the NELR or FELR.

Example of PA-2JT2 Serial Interface

The following is sample output from the **show interfaces serial** command for a PA-2JT2 serial interface:

```
Router# show interfaces serial 3/0/0

Serial3/0/0 is up, line protocol is up
  Hardware is cyBus Serial
  Internet address is 10.0.0.1/8
  MTU 1500 bytes, BW 6312 Kbit, DLY 20000 usec, rely 255/255, load 26/255
  Encapsulation HDLC, loopback not set, keepalive not set
  Last input 00:04:31, output 00:04:31, output hang never
  Last clearing of "show interface" counters 00:06:07
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 162000 bits/sec, 8 packets/sec
  5 minute output rate 162000 bits/sec, 8 packets/sec
     20005 packets input, 20080520 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     20005 packets output, 20080520 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
     0 cv errors, 0 crc5 errors, 0 frame errors
     rxLOS inactive, rxLOF inactive, rxPAIS inactive
     rxAIS inactive, rxRAI inactive, rxHBER inactive
```

Table 2 describes significant fields shown in the display that are different from the fields described in Table 1 on page 16.

Table 2 show interfaces serial Field Descriptions—PA-2JT2

Field	Description
Last clearing of "show interface" counters	Time the counters were last cleared.
Queueing strategy	First-in, first-out queueing strategy (other queueing strategies that you might see are priority-list, custom-list, and weighted fair).
output buffer failures	Number of "no resource" errors received on the output.
output buffers swapped out	Number of packets swapped to DRAM.
carrier transitions	Number of times the carrier detect signal of a serial interface has changed state. For example, if data carrier detect (DCD) goes down and comes up, the carrier transition counter will increment two times. Indicates modem or line problems if the carrier detect line is changing state often.
cv errors	B8ZS/B6ZS (zero suppression) coding violation counter.
crc5 errors	CRC-5 error counter.
frame errors	Framing error counter.
rxLOS	Receive loss of signal alarm. Values are active or inactive.
rxLOF	Receive loss of frame alarm. Values are active or inactive.
rxPAIS	Receive loss of payload alarm indication signal (AIS). Values are active or inactive.
rxAIS	Receive loss of physical AIS. Values are active or inactive.

Table 2 show interfaces serial Field Descriptions—PA-2JT2 (continued)

Field	Description
rxRAI	Receive remote AIS. Values are active or inactive.
rxHBER	Receive high bit-error rate alarm. Values are active or inactive.

Example of PA-E3 Serial Port Adapter

The following is sample output from the **show interfaces serial** command for a PA-E3 serial port adapter installed in chassis slot 2:

```
Router# show interfaces serial 2/0

Serial2/0 is up, line protocol is up
  Hardware is M1T-E3 pa
  Internet address is 172.17.1.1/24
  MTU 4470 bytes, BW 34010 Kbit, DLY 200 usec, rely 128/255, load 1/255
  Encapsulation HDLC, loopback not set, keepalive not set
  Last input 1w0d, output 00:00:48, output hang never
  Last clearing of "show interface" counters 1w0d
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     20 packets input, 2080 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 parity
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     11472 packets output, 3824748 bytes, 0 underruns
     0 output errors, 0 applique, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
   rxLOS inactive, rxLOF inactive, rxAIS inactive
   txAIS inactive, rxRAI inactive, txRAI inactive
```

Table 3 describes significant fields shown in the display that are different from the fields described in Table 1 on page 16.

Table 3 show interfaces serial Field Descriptions—PA-E3

Field	Description
Last clearing of "show interface" counters	Time the counters were last cleared.
Queueing strategy	First-in, first-out queueing strategy (other queueing strategies that you might see are priority-list, custom-list, and weighted fair).
parity	Number of the parity errors on the interface.
applique	Indicates that an unrecoverable error has occurred on the E3 applique. The router then invokes an interface reset.
output buffer failures	Number of "no resource" errors received on the output.
output buffers swapped out	Number of packets swapped to DRAM.

Table 3 show interfaces serial Field Descriptions—PA-E3 (continued)

Field	Description
rxLOS, rxLOF, rxAIS	Receive loss of signal, loss of frame, and alarm indication signal status. Values are inactive or active.
txAIS, rxRAI, txRAI	Transmit alarm indication signal, receive remote alarm indicator, and transmit remote alarm indicator status. Values are inactive or active. When the router receives an LOS, LOF, or AIS, the txRAI is active. When the remote router receives an LOS, LOF, or AIS, the rxRAI is active.

Example of 1-Port PA-T3 Serial Port Adapter Installed in a VIP2

The following is sample output from the **show interfaces serial** command for a 1-port PA-T3 serial port adapter installed in a VIP2 in chassis slot 1, in port adapter slot 0:

```
Router# show interfaces serial 1/0/0

Serial1/0/0 is up, line protocol is up
  Hardware is cyBus PODS3 Serial
  Internet address is 172.18.1.1/24
  MTU 4470 bytes, BW 44736 Kbit, DLY 200 usec, rely 255/255, load 1/255
  Encapsulation HDLC, loopback not set, keepalive set (10 sec)
  Last input 00:00:05, output 00:00:02, output hang never
  Last clearing of "show interface" counters 5d02h
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 27269 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     79039 packets input, 14195344 bytes, 0 no buffer
     Received 84506 broadcasts, 0 runts, 0 giants
              0 parity
     9574 input errors, 6714 CRC, 0 frame, 1 overrun, 0 ignored, 2859 abort
     62472 packets output, 13751644 bytes, 0 underruns
     0 output errors, 0 applique, 10 interface resets
     0 output buffer failures, 0 output buffers swapped out
     16 carrier transitions
   rxLOS inactive, rxLOF inactive, rxAIS inactive
   txAIS inactive, rxRAI inactive, txRAI inactive
```

Table 4 describes significant fields shown in the display that are different from the fields described in Table 1 on page 16.

Table 4 show interfaces serial Field Descriptions—PA-T3

Field	Description
Last clearing of "show interface" counters	Time the counters were last cleared.
Queueing strategy	First-in, first-out queueing strategy (other queueing strategies that you might see are priority-list, custom-list, and weighted fair).
parity	Number of the parity errors on the interface.
applique	Indicates that an unrecoverable error has occurred on the T3 applique. The router then invokes an interface reset.
output buffer failures	Number of "no resource" errors received on the output.

Table 4 show interfaces serial Field Descriptions—PA-T3 (continued)

Field	Description
output buffers swapped out	Number of packets swapped to DRAM.
rxLOS, rxLOF, rxAIS	Receive loss of signal, loss of frame, and alarm indication signal status. Values are inactive or active.
txAIS, rxRAI, txRAI	Transmit alarm indication signal, receive remote alarm indicator, and transmit remote alarm indicator status. Values are inactive or active. When the router receives an LOS, LOF, or AIS, the txRAI is active. When the remote router receives an LOS, LOF, or AIS, the rxRAI is active.

Example of CT3IP Serial Interface

The following is sample output from the **show interfaces serial** command for the CT3IP serial interface:

```
Router# show interfaces serial 3/0/0:25

Serial3/0/0:25 is up, line protocol is up
  Hardware is cyBus T3
  Internet address is 10.25.25.2/24
  MTU 1500 bytes, BW 1536 Kbit, DLY 20000 usec, rely 255/255, load 12/255
  Encapsulation HDLC, loopback not set, keepalive not set
  Last input 00:19:01, output 00:11:49, output hang never
  Last clearing of "show interface" counters 00:19:39
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/64/0 (size/threshold/drops)
     Conversations 0/1 (active/max active)
     Reserved Conversations 0/0 (allocated/max allocated)
  5 minute input rate 69000 bits/sec, 90 packets/sec
  5 minute output rate 71000 bits/sec, 90 packets/sec
     762350 packets input, 79284400 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants
     150 input errors, 0 CRC, 0 frame, 150 overrun, 0 ignored, 0 abort
     763213 packets output, 80900472 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions no alarm present
  Timeslot(s) Used:1-24, Transmitter delay is 0 flags, transmit queue length 5
  non-inverted data
```

Table 5 describes significant fields relevant to the CT3IP shown in the display that are different from the fields described in Table 1 on page 16.

Table 5 show interfaces serial Field Descriptions—CT3IP

Field	Description
Timeslot(s) Used	Number of time slots assigned to the T1 channel.
Transmitter delay	Number of idle flags inserted between each HDLC frame.
transmit queue length	Number of packets allowed in the transmit queue.
non-inverted data	Indicates whether or not the interface is configured for inverted data.

Example of an HDLC Synchronous Serial Interface on a Cisco 7500 Series Router

The following is sample output from the **show interfaces serial** command for an HDLC synchronous serial interface on a Cisco 7500 series router:

```
Router# show interfaces serial 1/0

Serial1/0 is up, line protocol is up
  Hardware is cxBus Serial
  Internet address is 172.19.190.203, subnet mask is 255.255.255.0
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation HDLC, loopback not set, keepalive set (10 sec)
  Last input 0:00:07, output 0:00:00, output hang never
  Last clearing of "show interface" counters 2w4d
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  Five minute input rate 0 bits/sec, 0 packets/sec
  Five minute output rate 0 bits/sec, 0 packets/sec
     16263 packets input, 1347238 bytes, 0 no buffer
     Received 13983 broadcasts, 0 runts, 0 giants
     2 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 2 abort
     22146 packets output, 2383680 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets, 0 restarts
     1 carrier transitions
```

Table 1 on page 16 describes significant fields shown in the display.

Example of HDLC Encapsulation

The following example displays High-Level Data Link Control (HDLC) encapsulation on serial interface 0:

```
Router# show interfaces serial 0

Serial0 is up, line protocol is up (looped)
Hardware is HD64570
Internet address is 10.1.1.1, subnet mask is 255.255.255.0
MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
Encapsulation HDLC, loopback set, keepalive set (10 sec)
```

Table 1 on page 16 describes significant fields shown in the display.

Example of a G.703 Interface with Framing

The following is sample output from the **show interfaces serial** command for a G.703 interface on which framing is enabled:

```
Router# show interfaces serial 2/3

Serial2/3 is up, line protocol is up
  Hardware is cxBus Serial
  Internet address is 10.4.4.1, subnet mask is 255.255.255.0
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation HDLC, loopback not set, keepalive not set
  Last input 0:00:21, output 0:00:21, output hang never
  Last clearing of "show interface" counters never
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  Five minute input rate 0 bits/sec, 0 packets/sec
  Five minute output rate 0 bits/sec, 0 packets/sec
     53 packets input, 7810 bytes, 0 no buffer
     Received 53 broadcasts, 0 runts, 0 giants
     2 input errors, 2 CRC, 0 frame, 0 overrun, 0 ignored, 2 abort
     56 packets output, 8218 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets, 0 restarts
     1 carrier transitions
```

```
     2 alarm indications, 333 remote alarms, 332 rx LOF, 0 rx LOS
     RTS up, CTS up, DTR up, DCD up, DSR up
     BER inactive, NELR inactive, FELR inactive
```

Table 1 on page 16 describes significant fields shown in the display.

Example with Frame Relay Encapsulation

When using Frame Relay encapsulation, use the **show interfaces serial** command to display information on the multicast data-link connection identifier (DLCI), the DLCI of the interface, and the DLCI used for the local management interface (LMI).

The multicast DLCI and the local DLCI can be set using the **frame-relay multicast-dlci** and **frame-relay local-dlci** configuration commands. The status information is taken from the LMI, when active.

The following is sample output from the **show interfaces serial** command when Frame Relay encapsulation and LMI are enabled:

```
Router# show interfaces serial

Serial 2 is up, line protocol is up
   Hardware type is MCI Serial
   Internet address is 172.20.122.1, subnet mask is 255.255.255.0
   MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
   Encapsulation FRAME-RELAY, loopback not set, keepalive set (10 sec)
   multicast DLCI 1022, status defined, active
   source DLCI    20, status defined, active
   LMI DLCI 1023, LMI sent 10, LMI stat recvd 10, LMI upd recvd 2
   Last input 7:21:29, output 0:00:37, output hang never
   Output queue 0/100, 0 drops; input queue 0/75, 0 drops
   Five minute input rate 0 bits/sec, 0 packets/sec
   Five minute output rate 0 bits/sec, 0 packets/sec
       47 packets input, 2656 bytes, 0 no buffer
       Received 5 broadcasts, 0 runts, 0 giants
       5 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 57 abort
       518 packets output, 391205 bytes
       0 output errors, 0 collisions, 0 interface resets, 0 restarts
       1 carrier transitions
```

In this display, the multicast DLCI has been changed to 1022 using the **frame-relay multicast-dlci** interface configuration command.

The display shows the statistics for the LMI as the number of status inquiry messages sent (LMI sent), the number of status messages received (LMI recvd), and the number of status updates received (upd recvd). Refer to the *Frame Relay Interface* specification for additional explanations of this output.

Example with Frame Relay Queueing and Fragmentation at the Interface

The following is sample output from the **show interfaces serial** command when low-latency queueing and FRF.12 end-to-end fragmentation are configured on a Frame Relay interface:

```
Router# show interfaces serial 3/2

Serial3/2 is up, line protocol is up
  Hardware is M4T
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation FRAME-RELAY, crc 16, loopback not set
  Keepalive set (10 sec)
  LMI enq sent  0, LMI stat recvd 0, LMI upd recvd 0, DTE LMI up
  LMI enq recvd 0, LMI stat sent  0, LMI upd sent  0
  LMI DLCI 1023  LMI type is CISCO  frame relay DTE
```

```
Fragmentation type: end-to-end, size 80, PQ interleaves 0
Broadcast queue 0/64, broadcasts sent/dropped 0/0, interface broadcasts 0
Last input 2d15h, output 2d15h, output hang never
Last clearing of "show interface" counters 00:01:31
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: weighted fair
Output queue: 0/1000/64/0 (size/max total/threshold/drops)
   Conversations  0/0/256 (active/max active/max total)
   Reserved Conversations 0/0 (allocated/max allocated)
   Available Bandwidth 1094 kilobits/sec
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
   0 packets input, 0 bytes, 0 no buffer
   Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
   0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
   0 packets output, 0 bytes, 0 underruns
   0 output errors, 0 collisions, 1 interface resets
   0 output buffer failures, 0 output buffers swapped out
   1 carrier transitions     DCD=up  DSR=up  DTR=up  RTS=up  CTS=up
```

Table 6 describes significant fields shown in the display that are different from the fields described in Table 1 on page 16.

Table 6 show interfaces serial Field Descriptions—Frame Relay Interface Queueing and Fragmentation

Field	Description
txload	Interface load in the transmit direction.
rxload	Interface load in the receive direction.
crc	Length the cyclic redundancy check (CRC) used on the interface.
LMI enq sent	Number of Frame Relay status inquiry messages sent.
LMI stat recvd	Number of Frame Relay status request messages received.
LMI upd recvd	Number of single PVC asynchronous status messages received.
DTE LMI up	LMI peers are synchronized.
LMI enq recvd	Number of Frame Relay status inquiry messages received.
LMI stat sent	Number of Frame Relay status request messages sent.
LMI upd sent	Number of single PVC asynchronous status messages sent.
Fragmentation type	Type of fragmentation: end-to-end, Cisco, or VoFR
size	Fragmentation size.
PQ interleaves	Number of priority queue frames that have interleaved data fragments.
Broadcast queue	Number on queue/queue depth.
broadcasts sent/dropped	Number of broadcasts sent and dropped.
interface broadcasts	Number of broadcasts sent on interface.
Input queue	size—Current size of the input queue. max—Maximum size of the queue. drops—Number of messages discarded. flushes—Number of times that data on queue has been discarded.
Queueing strategy	Type of queueing configured on the interface.

Table 6 show interfaces serial Field Descriptions—Frame Relay Interface Queueing and Fragmentation (continued)

Field	Description
Output queue	size—Current size of the output queue. max total—Maximum number of frames that can be queued. threshold—Congestive-discard threshold. Number of messages in the queue after which new messages for high-bandwidth conversations are dropped. drops—Number of dropped messages.
Conversations	active—Number of currently active conversations. max active—Maximum number of conversations that have ever occurred at one time. max total—Maximum number of active conversations allowed.
throttles	Number of times the receiver on the port was disabled, possibly because of processor or buffer overload.
output buffer failures	Number of “no resource” errors received on the output.
output buffers swapped out	Number of packets swapped to DRAM.

Example with ANSI LMI

For a serial interface with the ANSI Local Management Interface (LMI) enabled, use the **show interfaces serial** command to determine the LMI type implemented. The following is sample output from the **show interfaces serial** command for a serial interface with the ANSI LMI enabled:

```
Router# show interfaces serial

Serial 1 is up, line protocol is up
   Hardware is MCI Serial
   Internet address is 172.18.121.1, subnet mask is 255.255.255.0
   MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
   Encapsulation FRAME-RELAY, loopback not set, keepalive set
   LMI DLCI    0, LMI sent 10, LMI stat recvd 10
   LMI type is ANSI Annex D
   Last input 0:00:00, output 0:00:00, output hang never
   Output queue 0/40, 0 drops; input queue 0/75, 0 drops


   Five minute input rate 0 bits/sec, 1 packets/sec
   Five minute output rate 1000 bits/sec, 1 packets/sec
       261 packets input, 13212 bytes, 0 no buffer
       Received 33 broadcasts, 0 runts, 0 giants
       0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
       238 packets output, 14751 bytes, 0 underruns
       0 output errors, 0 collisions, 0 interface resets, 0 restarts
```

Notice that the **show interfaces serial** output for a serial interface with ANSI LMI shown in this display is very similar to that for encapsulation set to Frame Relay, as shown in the previous display. Table 7 describes the few differences that exist.

Table 7 show interfaces serial Field Descriptions—ANSI LMI

Field	Description
LMI DLCI 0	Identifies the DLCI used by the LMI for this interface. The default is 1023.
LMI sent 10	Number of LMI packets that the router sent.
LMI type is ANSI Annex D	Indicates that the interface is configured for the ANSI-adopted Frame Relay specification T1.617 Annex D.

Example with LAPB Encapsulation

Use the **show interfaces serial** command to display operation statistics for an interface that uses Link Access Procedure, Balanced (LAPB) encapsulation. The following is partial sample output from the **show interfaces serial** command for a serial interface that uses LAPB encapsulation:

```
Router# show interfaces serial 1

LAPB state is SABMSENT, T1 3000, N1 12056, N2 20, k7,Protocol ip
VS 0, VR 0, RCNT 0, Remote VR 0, Retransmissions 2
IFRAMEs 0/0 RNRs 0/0 REJs 0/0 SABMs 3/0 FRMRs 0/0 DISCs 0/0
```

Table 8 shows the fields relevant to all LAPB connections.

Table 8 show interfaces serial Field Descriptions—LAPB

Field	Description
LAPB state is	State of the LAPB protocol.
T1 3000, N1 12056, ...	Current parameter settings.
Protocol	Protocol encapsulated on a LAPB link; this field is not present on interfaces configured for multiprotocol LAPB or X.25 encapsulations.
VS	Modulo 8 frame number of the next outgoing information frame.
VR	Modulo 8 frame number of the next information frame expected to be received.
RCNT	Number of received information frames that have not yet been acknowledged.
Remote VR	Number of the next information frame that the remote device expects to receive.
Retransmissions	Count of current retransmissions because of expiration of T1.
Window is closed	No more frames can be transmitted until some outstanding frames have been acknowledged. This message should be displayed only temporarily.
IFRAMEs	Count of information frames in the form of sent/received.
RNRs	Count of Receiver Not Ready frames in the form of sent/received.
REJs	Count of Reject frames in the form of sent/received.
SABMs	Count of Set Asynchronous Balanced Mode commands in the form of sent/received.
FRMRs	Count of Frame Reject frames in the form of sent/received.
DISCs	Count of Disconnect commands in the form of sent/received.

```
Router# show interfaces serial 1
```

Table 9 show the fields relevant to PPP connections.

Table 9 show interfaces serial Field Descriptions—PPP Encapsulation

Field	Description
lcp state	Link Control Protocol.
ncp ipcp state	Network Control Protocol Internet Protocol Control Protocol.
ncp osicp state	Network Control Protocol OSI (CLNS) Control Protocol.
ncp ipxcp state	Network Control Protocol IPX (Novell) Control Protocol.
ncp deccp state	Network Control Protocol DECnet Control Protocol.
ncp bridgecp state	Network Control Protocol Bridging Control Protocol.
ncp atalkcp state	Network Control Protocol AppleTalk Control Protocol.

Example with SDLC Connections

Use the **show interfaces serial** command to display the Synchronous Data Link Control (SDLC) information for a given SDLC interface. The following is sample output from the **show interfaces serial** command for an SDLC primary interface that supports the SDLLC function:

```
Router# show interfaces serial

Serial 0 is up, line protocol is up
Hardware is MCI Serial
MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
Encapsulation SDLC-PRIMARY, loopback not set
    Timers (msec): poll pause 100 fair poll 500. Poll limit 1
    [T1 3000, N1 12016, N2 20, K 7] timer: 56608 Last polled device: none
    SDLLC [ma: 0000.0C01.14--, ring: 7 bridge: 1, target ring: 10
               largest token ring frame 2052]
SDLC addr C1 state is CONNECT
     VS 6, VR 3, RCNT 0, Remote VR 6, Current retransmit count 0
     Hold queue: 0/12 IFRAMEs 77/22 RNRs 0/0 SNRMs 1/0 DISCs 0/0
     Poll: clear, Poll count: 0, chain: p: C1 n: C1
     SDLLC [largest SDLC frame: 265, XID: disabled]
 Last input 00:00:02, output 00:00:01, output hang never
 Output queue 0/40, 0 drops; input queue 0/75, 0 drops
 Five minute input rate 517 bits/sec, 30 packets/sec
 Five minute output rate 672 bits/sec, 20 packets/sec
     357 packets input, 28382 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     926 packets output, 77274 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets, 0 restarts
     2 carrier transitions
```

Table 10 shows the fields relevant to all SDLC connections.

Table 10 show interfaces serial Field Descriptions—SDLC Enabled

Field	Description
Timers (msec): poll pause, fair poll, Poll limit	Current values of these timers for the primary SDLC interface.
T1, N1, N2, K	Values for these parameters for the primary SDLC interface.

Table 11 shows other data given for each SDLC secondary interface configured to be attached to the serial interface.

Table 11 SDLC Secondary Interface Descriptions

Field	Description
addr	Address of this SDLC secondary interface.
state is	Current state of this connection, which is one of the following: • DISCONNECT—No communication is being attempted to this secondary. • CONNECT—A normal connect state exists between this router and this secondary. • DISCSENT—This router has sent a disconnect request to this secondary and is awaiting its response. • SNRMSENT—This router has sent a connect request (SNRM) to this secondary and is awaiting its response. • THEMBUSY—This secondary has told this router that it is temporarily unable to receive any more information frames. • USBUSY—This router has told this secondary that it is temporarily unable to receive any more information frames. • BOTHBUSY—Both sides have told each other that they are temporarily unable to receive any more information frames. • ERROR—This router has detected an error and is waiting for a response from the secondary acknowledging this.
VS	Sequence number of the next information frame that this station sends.
VR	Sequence number of the next information frame from this secondary that this station expects to receive.
Remote VR	Last frame transmitted by this station that has been acknowledged by the other station.
Current retransmit count:	Number of times the current I-frame or sequence of I-frames has been retransmitted.
Hold Queue	Number of frames in hold queue and maximum size of hold queue.
IFRAMEs, RNRs, SNRMs, DISCs	Sent/received count for these frames.
Poll	“Set” if this router has a poll outstanding to the secondary; “clear” if it does not.
Poll Count	Number of polls in a row that have been given to this secondary at this time.
Chain	Shows the previous (p) and next (n) secondary address on this interface in the *round robin loop* of polled devices.

Example with SDLLC

Use the **show interfaces serial** command to display the SDLLC statistics for SDLLC-configured interfaces. The following is sample output from the **show interfaces serial** command for a serial interface configured for SDLLC:

```
Router# show interfaces serial

Serial 0 is up, line protocol is up
   Hardware is MCI Serial
   MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
   Encapsulation SDLC-PRIMARY, loopback not set
       Timers (msec): poll pause 100 fair poll 500. Poll limit 1
       [T1 3000, N1 12016, N2 20, K 7] timer: 56608 Last polled device: none
       SDLLC [ma: 0000.0C01.14--, ring: 7 bridge: 1, target ring: 10
              largest token ring frame 2052]
   SDLC addr C1 state is CONNECT
       VS 6, VR 3, RCNT 0, Remote VR 6, Current retransmit count 0
       Hold queue: 0/12 IFRAMEs 77/22 RNRs 0/0 SNRMs 1/0 DISCs 0/0
       Poll: clear, Poll count: 0, chain: p: C1 n: C1
       SDLLC [largest SDLC frame: 265, XID: disabled]
   Last input 00:00:02, output 00:00:01, output hang never
   Output queue 0/40, 0 drops; input queue 0/75, 0 drops
   Five minute input rate 517 bits/sec, 30 packets/sec
   Five minute output rate 672 bits/sec, 20 packets/sec
       357 packets input, 28382 bytes, 0 no buffer
       Received 0 broadcasts, 0 runts, 0 giants
       0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
       926 packets output, 77274 bytes, 0 underruns
       0 output errors, 0 collisions, 0 interface resets, 0 restarts
       6608 Last polled device: none
       SDLLC [ma: 0000.0C01.14--, ring: 7 brid2 carrier transitions
```

Most of the output shown in the display is generic to all SDLC-encapsulated interfaces and is described in the *Cisco IOS Bridging and IBM Networking Command Reference*, *Volume 2 of 2: IBM Networking*. Table 12 shows the parameters specific to SDLLC.

Table 12 SDLLC Parameter Descriptions

Field	Description
SDLLC ma	Lists the MAC address configured for this interface. The last byte is shown as "--" to indicate that it is filled in with the SDLC address of the connection.
ring, bridge, target ring	Lists the parameters as configured by the **sdllc traddr** command.
largest token ring frame	Shows the largest Token Ring frame that is accepted on the Logical Link control, type 2 (LLC2) side of the connection.
largest SDLC frame	Shows the largest SDLC frame that is accepted and will be generated on the SDLC side of the connection.
XID	Enabled or disabled: Shows whether XID processing is enabled on the SDLC side of the connection. If enabled, it will show the XID value for this address.

Example with X.25

The following is partial sample output from the **show interfaces serial** command for a serial X.25 interface:

```
Router# show interfaces serial 1
```

```
X25 address 000000010100, state R1, modulo 8, idle 0, timer 0, nvc 1
  Window size: input 2, output 2, Packet size: input 128, output 128
  Timers: T20 180, T21 200, T22 180, T23 180, TH 0
  Channels: Incoming-only none, Two-way 1-1024, Outgoing-only none
(configuration on RESTART: modulo 8,
  Window size: input 2 output 2, Packet size: input 128, output 128
  Channels: Incoming-only none, Two-way 5-1024, Outgoing-only none)
  RESTARTs 3/2 CALLs 1000+2/1294+190/0+0/ DIAGs 0/0
```

The stability of the X.25 protocol requires that some parameters not be changed without a restart of the protocol. Any change to these parameters is held until a restart is sent or received. If any of these parameters changes, information about the router configuration at restart will be displayed as well as the values that are currently in effect.

Table 13 describes significant fields shown in the display.

Table 13 show interfaces serial Field Descriptions—X.25 Enabled

Field	Description
X25 address	Address used to originate and accept calls.
state	State of the interface. Possible values follow: • R1 is the normal ready state. • R2 is the DTE restarting state. • R3 is the DCE restarting state. If the state is R2 or R3, the interface is awaiting acknowledgment of a Restart packet.
modulo	Modulo value; determines the packet sequence numbering scheme used.
idle	Number of minutes for which the Cisco IOS software waits before closing idle virtual circuits that it originated or accepted.
timer	Value of the interface timer, which is zero unless the interface state is R2 or R3.
nvc	Default maximum number of simultaneous virtual circuits permitted to and from a single host for a particular protocol.
Window size: input, output	Default window sizes (in packets) for the interface. The **x25 facility** interface configuration command can be used to override these default values for the switched virtual circuits originated by the router.
Packet size: input, output	Default maximum packet sizes (in bytes) for the interface. The **x25 facility** interface configuration command can be used to override these default values for the switched virtual circuits originated by the router.
Timers:	Values of the X.25 timers: • T10 through T13 for a DCE device • T20 through T23 for a DTE device

Table 13 show interfaces serial Field Descriptions—X.25 Enabled (continued)

Field	Description
TH	Packet acknowledgment threshold (in packets). This value determines how many packets are received before an explicit acknowledgment is sent. The default value (0) sends an explicit acknowledgment only when the incoming window is full.
Channels: Incoming-only, Two-way, Outgoing-only	Displays the virtual circuit ranges for this interface.
RESTARTs	Shows Restart packet statistics for the interface using the format Sent/Received.
CALLs	Successful calls sent + failed calls/calls received + calls failed/calls forwarded + calls failed. Calls forwarded are counted as calls sent.
DIAGs	Diagnostic messages sent and received.

Example with Accounting Option

The following example illustrates the **show interfaces serial** command with the **accounting** option on a Cisco 7500 series routers:

```
Router# show interfaces serial 1/0 accounting

Serial1/0
       Protocol    Pkts In   Chars In   Pkts Out  Chars Out
             IP       7344    4787842       1803    1535774
      Appletalk      33345    4797459      12781    1089695
        DEC MOP          0          0        127       9779
            ARP          7        420         39       2340
```

Table 14 describes the fields shown in the display.

Table 14 show interfaces serial Field Descriptions—Accounting

Field	Description
Protocol	Protocol that is operating on the interface.
Pkts In	Number of packets received for that protocol.
Chars In	Number of characters received for that protocol.
Pkts Out	Number of packets transmitted for that protocol.
Chars Out	Number of characters transmitted for that protocol.

Example with Cisco AS5800 Access Server

The following example shows the activity that occurred on the serial interface in shelf 1, slot 4, port 0 for time slot 2 in group 23:

```
Router# show interfaces serial 1/4/0:2:23

Serial1/4/0:2:23 is up, line protocol is up (spoofing)
 Hardware is DS-T1
 MTU 1500 bytes, BW 64 Kbit, DLY 20000 usec, rely 255/255, load 1/255
 Encapsulation HDLC, loopback not set
 Last input 00:00:01, output 00:00:01, output hang never
 Last clearing of "show interface" counters 22:24:30
 Queueing strategy: fifo
 Output queue 0/40, 0 drops; input queue 0/75, 0 drops
 5 minute input rate 0 bits/sec, 0 packets/sec

 5 minute output rate 0 bits/sec, 0 packets/sec
     5274 packets input, 20122 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     5274 packets output, 30836 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
     2 carrier transitions no alarm present
 Timeslot(s) Used:24, subrate: 64Kb/s, transmit delay is 0 flags
```

Table 15 describes the significant fields shown in the display that are different from the fields described in Table 1 on page 16.

Table 15 show interfaces serial Command Field Descriptions—Cisco AS5800

Field	Description
Last clearing of “show interface” counters	Time at which the counters that measure cumulative statistics (such as number of bytes transmitted and received) were last reset to zero.
Queueing strategy	Displays the type of queueing configured for this interface. In the example output, the type of queueing configured is FIFO.
throttles	Number of times that the receiver on the port was disabled, possibly because of buffer or processor overload.
output buffer failures	Number of times that the output buffer has failed.
output buffer swapped out	Number of times that the output buffer has been swapped out.
Timeslot(s) Used	Number of time slots assigned to the T1 channel.

Table 15 show interfaces serial Command Field Descriptions—Cisco AS5800 (continued)

Field	Description
subrate	Bandwidth of each time slot.
transmit delay is ...	Number of idle flags inserted between each frame.

Related Commands

Command	Description
show controllers serial	Displays information about the virtual serial interface.