CHAPTER 19

Configuring Frame Relay to ATM Interworking Port Adapter Interfaces

This chapter describes Frame Relay to ATM interworking and the required steps to configure the channelized Frame Relay port adapters in the Catalyst 8510 MSR and LightStream 1010 ATM switch routers. These port adapters facilitate interworking between a Frame Relay network, an ATM network, and network users. Existing Frame Relay users can also migrate to higher bandwidth ATM using channelized Frame Relay port adapters. Additionally, these port adapters extend the ATM network across a wide area over a frame-based serial line or intervening Frame Relay WAN.

Note This chapter provides advanced configuration instructions for the Catalyst 8540 MSR, Catalyst 8510 MSR, and LightStream 1010 ATM switch routers. For an overview of Frame Relay to ATM interworking, refer to the *Guide to ATM Technology.* For complete descriptions of the commands mentioned in this chapter, refer to the *ATM Switch Router Command Reference* publication. For hardware installation and cabling instructions, refer to the *ATM Port Adapter and Interface Module Installation Guide*.

For a more information on how to configure your Frame Relay specific network equipment, refer to the Cisco IOS 12.0 publications on the Documentation CD-ROM.

This chapter includes the following sections:

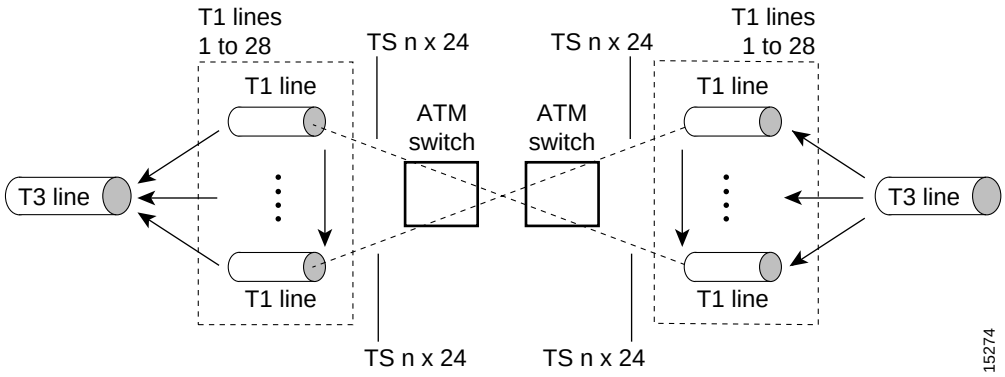
Configuring the Channelized DS3 Frame Relay Port Adapter

The channelized DS3 (CDS3) Frame Relay port adapter provides one physical port (45 Mbps). Each DS3 interface consists of 28 T1 lines multiplexed through a single T3 trunk. Each T1 line operates at 1.544 Mbps, which equates to 24 time slots (DS0 channels). A DS0 time slot provides 56 or 64 kbps of

usable bandwidth. You can combine one or more DS0 time slots into a channel group to form a serial interface. A channel group provides *n* x 56 or 64 kbps of usable bandwidth, where *n* is the number of time slots, from 1 to 24. You can configure a maximum of 127 serial interfaces, or channel groups, per port adapter.

Figure 19-1 illustrates how a T3 trunk demultiplexes into 28 T1 lines that provide single or multiple time slots mapped across the ATM network. These time slots are then multiplexed to form an outgoing T3 bit stream.

Figure 19-1 T3/T1 Time Slot Mapping



Configuration Guidelines

In order to configure the CDS3 Frame Relay port adapter physical interface you need the following information:

- Digital transmission link information, for example, T3 and T1 clock source and framing type
- Channel information and time slot mapping
- Protocols and encapsulations you plan to use on the new interfaces

Default CDS3 Frame Relay Port Adapter Interface Configuration

The following defaults are assigned to all CDS3 Frame Relay port adapter interfaces:

- Framing — M23
- Clock source — loop-timed
- Cable length — 224

The following defaults are assigned to all T1 lines on the CDS3 Frame Relay port adapter:

- Framing — esf
- Speed — 64 kbps
- Clock source — internal
- Line coding — b8zs
- T1 yellow alarm — detection and generation

Configuring the CDS3 Frame Relay Port Adapter Interface

To manually change any of your default configuration values, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **controller t3** *card/subcard/port* Switch(config-controller)#	Specifies the controller interface port and enters controller configuration mode.
Step 2	Switch(config-controller)# **clock source** {**free-running** | **loop-timed** | **network-derived** | **reference**}	Configures the type of clocking.
Step 3	Switch(config-controller)# **framing** {**c-bit** | **m23**}	Configures the CDS3 Frame Relay port adapter framing type.
Step 4	Switch(config-controller)# **cablelength** *cablelength*	Configures the CDS3 Frame Relay port adapter cable length.
Step 5	Switch(config-controller)# **mdl** {**transmit** {**path** | **idle-signal** | **test-signal**} | **string** {**eic** | **lic** | **fic** | **unit** | **pfi** | **port** | **generator** *string*}[1]	Configures the maintenance data link (MDL) message.

1. MDL messages are only supported when framing on the CDS3 Frame Relay port adapter is set for c-bit parity.

Example

The following example shows how to change the cable length configuration to 300 using the **cablelength** command.

```
Switch(config)# controller t3 3/0/0
Switch(config-controller)# cablelength 300
```

When using the cable length option, note that user-specified T3 cable lengths are structured into ranges as follows: 0 to 224 and 225 to 450. If you enter a cable length value that falls into one of these ranges, the range for that value is used.

For example, if you enter 150 feet, the 0 to 224 range is used. If you later change the cable length to 200 feet, there is no change because 200 is within the 0 to 224 range. However, if you change the cable length to 250, the 225 to 450 range is used. The actual number you enter is stored in the configuration file.

Configuring the T1 Lines on the CDS3 Frame Relay Port Adapter

To configure the T1 lines, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **controller t3** *card*/*subcard*/*port* Switch(config-controller)#	Specifies the controller interface port and enters controller configuration mode.
Step 2	Switch(config-controller)# **t1** *line-number* **framing** {**esf** | **sf**}	Configures the T1 framing type.
Step 3	Switch(config-controller)# **t1** *line-number* **yellow** {**detection** | **generation**}	Configures yellow alarms for the T1 line.

Configuring the Channel Group on the CDS3 Frame Relay Port Adapter

A channel group, also referred to as a serial interface, is configured on a T1 line by associating time slots to it. The channel group can have from 1 to 24 time slots (DS0s). The transmission rate or bandwidth of the channel group is calculated by multiplying the number of time slots times 56 kbps or 64 kbps.

Note A time slot can be part of only one channel group. Additionally, all time slots within a channel group must be on the same T1 line.

To configure the channel group on a T1 line, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **controller t3** *card*/*subcard*/*port*	Specifies the controller interface port and enters controller configuration mode.
Step 2	Switch(config-controller)# **channel-group** *number* **t1** *line-number* **timeslots** *list* [**speed** {**56** | **64**}]	Creates the channel group with the specified time slots and speed.

Note You can group either contiguous or noncontiguous time slots on a T1 line.

Example

The following example shows how to configure a channel group (with identifier 5), assigning time slots 1 through 5 on T1 line 1 using the **channel-group** command.

```
Switch(config)# controller t3 0/1/0
Switch(config-controller)# channel-group 5 t1 1 timeslots 1-5
Switch(config-controller)#
```

Note The example above creates the serial interface 0/1/0:5.

Displaying the CDS3 Frame Relay Port Adapter Controller Information

To display the controller configuration, use one of the following EXEC commands:

Command	Purpose
show controllers t3 *card*/*subcard*/*port*[**:***t1-line*] [**brief** | **tabular**]	Displays T3 and T1 configuration.

Example

The following example displays the configuration, status, and statistics of T1 line number 1 on controller 0/1/0:

```
Switch# show controllers t3 0/1/0:1 tabular
➔ T3 0/1/0:1 is up.
  PAM state is Up
  1CT3 H/W Version: 1.7
  1CT3 F/W Version: 2.7
➔ T3 0/1/0 T1 1
    Transmitter is sending LOF Indication (RAI).
    Receiver has loss of frame.
    Framing is ESF, Line Code is B8ZS, Clock Source is line.
    INTERVAL      LCV   PCV   CSS  SELS   LES    DM    ES   BES   SES   UAS    SS
    12:43-12:51     0     0     0     0     0     0     0     0     0   434     0
    12:28-12:43     0     0     0     0     0     0     0     0     0   900     0
    12:13-12:28     0     0     0     0     0     0     0     0     0   900     0
    11:58-12:13     0     0     0     0     0     0     0     0     0   900     0
    11:43-11:58     0     0     0     0     0     0     0     0     0   900     0
    11:28-11:43     0     0     0     0     0     0     0     0     0   900     0
    11:13-11:28     0     0     0     0     0     0     0     0     0   900     0
    10:58-11:13     0     0     0     0     0     0     0     0     0   900     0
    Total           0     0     0     0     0     0     0     0     0  6300     0
```

Deleting a Channel Group on the CDS3

This section describes two ways to delete a channel group on the CDS3 after it has been configured.

If you want to delete individual channel groups without shutting down the controller, use method one.

If you want to delete several channels groups on a controller, use method two. However, if you use method two, you must first shut down the controller, which shuts down all channel groups on the controller.

Method One

Perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn*	Selects the Frame Relay serial port and channel group number to be deleted.
Step 2	Switch(config-if)# **shutdown**	Shuts down the serial interface.
Step 3	Switch(config-if)# **exit** Switch(config)#	Exits serial interface configuration mode.
Step 4	Switch(config)# **controller t3** *card*/*subcard*/*port* Switch(config-controller)#	Selects the controller interface port and enters controller configuration mode.
Step 5	Switch(config-controller)# **no channel-group** *cgn*	Deletes the selected channel group number.

Method Two

Perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **controller t3** *card*/*subcard*/*port* Switch(config-controller)#	Selects the controller interface port and enters controller configuration mode.
Step 2	Switch(config-controller)# **shutdown**	Shuts down the controller interface.
Step 3	Switch(config-controller)# **no channel-group** *cgn*	Deletes the selected channel group number.
Step 4	Switch(config-controller)# **no shutdown**	Reenables the controller interface.

Examples

The following example shuts down the serial interface and deletes channel group 1:

```
Switch(config)# interface serial 4/0/0:1
Switch(config-if)# shutdown
Switch(config-if)# exit
Switch(config)# controller t3 4/0/0
Switch(config-controller)# no channel-group 1
Switch(config-controller)# end
Switch#
```

The following example shuts down the T3 controller, deletes channel group 1, and then reenables the T3 controller:

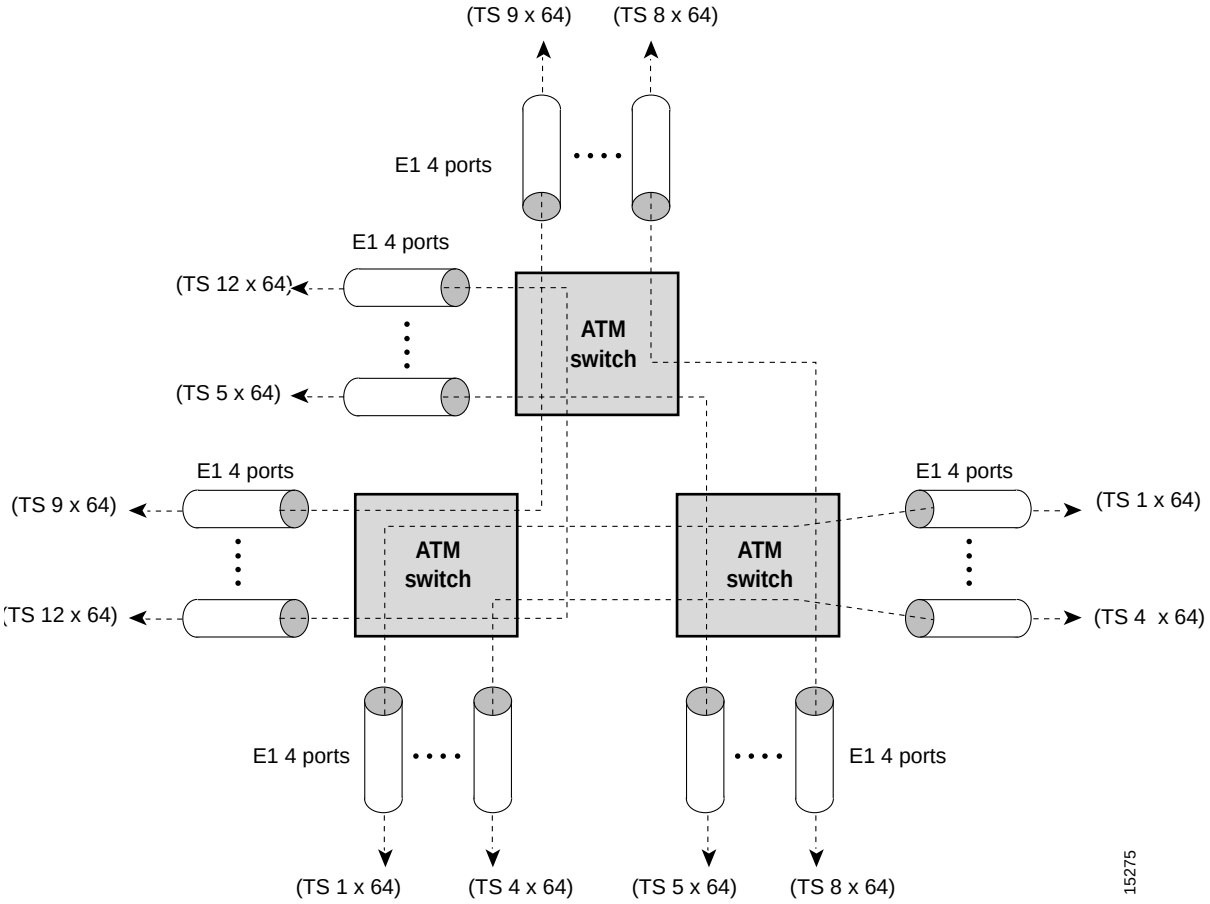
```
Switch(config)# controller t3 4/0/0
Switch(config-controller)# shutdown
Switch(config-controller)# no channel-group 1
Switch(config-controller)# no shutdown
Switch(config-controller)# end
Switch#
```

Configuring the Channelized E1 Frame Relay Port Adapter

The channelized E1 (CE1) Frame Relay port adapter provides four physical ports. Each port supports up to 31 E1 serial interfaces, also referred to as channel groups, totalling 124 serial interfaces per port adapter. The E1 line operates at 2.048 Mbps, which is equivalent to 31 time slots (DS0 channels). The E1 time slot provides usable bandwidth of *n* x 64 kbps, where *n* is the time slot from 1 to 31.

Figure 19-2 illustrates how an E1 trunk (with four ports) provides single or multiple time slots mapped across the ATM network. Each time slot represents a single *n* x 64 circuit that transmits data at a rate of 64 kbps. Multiple *n* x 64 circuits can be connected to a single port, using separate time slots.

Figure 19-2 E1 Time Slot Mapping



Default CE1 Frame Relay Port Adapter Interface Configuration

The following defaults are assigned to all CE1 Frame Relay port adapter interfaces:

- Framing—crc4
- Clock source—loop-timed
- Line coding—HDB3

Configuring the CE1 Frame Relay Port Adapter Interface

If your CE1 Frame Relay port adapter needs to be configured, you must have the following information:

- Digital transmission link information, for example, E1 clock source and framing type
- Channel information and time slot mapping
- Protocols and encapsulations you plan to use on the new interfaces

To manually change any of your default configuration values, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **controller e1** *card*/*subcard*/*port* Switch(config-controller)#	Specifies the controller interface port and enters controller configuration mode.
Step 2	Switch(config-controller)# **clock source** {**free-running** | **loop-timed** | **reference** | **network-derived**}	Configures the type of clocking.
Step 3	Switch(config-controller)# **framing** {**crc4** | **no-crc4**}	Configures the E1 framing type.

Example

The following example shows how to change the clock source to free-running using the **clock source** command.

```
Switch(config)# controller e1 1/0/0
Switch(config-controller)# clock source free-running
```

Configuring the Channel Group on the CE1 Frame Relay Port Adapter

A channel group, also referred to as a serial interface, is configured on an E1 line by associating time slots to it. The channel group can have from 1 to 31 time slots (DS0s). The transmission rate or bandwidth of the channel group is calculated by multiplying the number of time slots times 64 kbps.

To configure the channel group, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **controller e1** *card*/*subcard*/*port* Switch(config-controller)#	Specifies the controller interface port and enters controller configuration mode.
Step 2	Switch(config-controller)# **channel-group** *number* {**timeslots** *range* | **unframed**}	Configures the identifier and range of E1 time slot number(s) that comprise the channel group. The keyword **unframed** configures a CE1Frame Relay interface as clear channel (unframed).

Example

The following example shows how to configure time slots 1 through 5 and 20 through 23 on E1 channel group 5 using the **channel-group** command.

```
Switch(config)# controller e1 0/1/0
Switch(config-controller)# channel-group 5 timeslots 1-5, 20-23
```

Displaying the CE1 Frame Relay Port Adapter Controller Information

To display your controller configuration, use the following EXEC command:

Command	Purpose
show controllers e1 *card*/*subcard*/*port* [**brief** | **tabular**]	Displays E1 controller configuration.

Example

The configuration for controller E1 is displayed in the following example:

```
Switch# show controllers e1 0/0/0 tabular
E1 0/0/0 is up.
E1 0/0/0 is up.
 PAM state is Up
 4CE1 H/W Version: 3.1
  4CE1 F/W Version: 2.0
  No alarms detected.
  Framing is crc4, Line Code is HDB3, Clock Source is line.
  INTERVAL       LCV  PCV  CS  SELS LES  DM   ES  BES  SES  UAS  SS
  18:38-18:51     0    0   0    0    0    0    2    0   10  704   0
```

Configuring Frame Relay to ATM Interworking Functions

You must follow the required steps to enable Frame Relay to ATM interworking on your ATM switch router. In addition, you can customize Frame Relay to ATM for your particular network needs and monitor Frame Relay-to-ATM connections. The following sections outline these tasks:

- Enabling Frame Relay Encapsulation on an Interface on page 19-10
- Configuring Frame Relay Serial Interface Type on page 19-11

For information on how to customize your Frame Relay-to-ATM connections, see the “Configuring LMI” section on page 19-12 and the “Configuring Frame Relay to ATM Resource Management” section on page 19-16.

Enabling Frame Relay Encapsulation on an Interface

To set Frame Relay encapsulation on the serial interface, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **encapsulation frame-relay ietf**	Configures Frame Relay encapsulation.

Frame Relay supports encapsulation of all supported protocols in conformance with RFC 1490, allowing interoperability between multiple vendors.

Note You must shut down the interface prior to Frame Relay encapsulation.

Example

```
Switch(config)# interface serial 0/1/0:5
Switch(config-if)# shutdown
Switch(config-if)# encapsulation frame-relay ietf
Switch(config-if)# no shutdown
```

Displaying Frame Relay Encapsulation

To display Frame Relay encapsulation, use the following user EXEC command:

Command	Purpose
show interfaces serial *card*/*subcard*/*port*:*cgn*	Displays Frame Relay encapsulation.

Example:

The following example displays the Frame Relay encapsulation configuration on serial interface 0/1/0:5:

```
Switch# show interfaces serial 0/1/0:5
Serial0/1/0:5 is up, line protocol is up
  Hardware is FRPAM-SERIAL
  MTU 4096 bytes, BW 320 Kbit, DLY 0 usec, rely 0/255, load 1/255
Encapsulation FRAME-RELAY IETF, loopback not set, keepalive not set
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops:
<information deleted>
```

Configuring Frame Relay Serial Interface Type

To configure an interface as a data communications equipment (DCE) or Network-Network Interface (NNI) type, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **frame-relay intf-type** {**dce** | **nni**}	Selects a Frame Relay interface type.

Example

The following example shows how to configure Frame Relay interface type NNI for serial interface 0/1/0:5:

```
Switch(config)# interface serial 0/1/0:5
Switch(config-if)# frame-relay intf-type nni
```

Displaying Frame Relay Interface Configuration

To display the Frame Relay interface configuration, use the following EXEC command:

Command	Purpose
more system:running-config	Displays the Frame Relay interface configuration.

Example

The Frame Relay configuration is displayed in the following example:

```
Switch# more system:running-config
Building configuration...

Current configuration:
!
version 11.3
no service pad
no service password-encryption
!
hostname Switch
!
<information deleted>
!
interface Serial0/1/0:5
 no ip address
 no ip directed-broadcast
 encapsulation frame-relay IETF
 no arp frame-relay
→ frame-relay intf-type nni
<information deleted>
```

Configuring LMI

Three industry-accepted standards are supported for addressing the Local Management Interface (LMI), including the Cisco specification. By default, the Cisco ILMI option is active on your Frame Relay interface.

Configuring the LMI Type

To manually set an LMI type on your Frame Relay port adapter, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **frame-relay lmi-type** [**cisco** | **ansi** | **q933a**]	Selects Frame Relay LMI type.
Step 3	Switch(config-if)# **end** Switch#	Exits interface configuration mode.
Step 4	Switch# **copy system:running-config nvram:startup-config**	Writes the LMI type to NVRAM.

Example

The following example changes the LMI type to ansi on serial interface 1/1/0:1:

```
Switch(config)# interface serial 1/1/0:1
Switch(config-if)# frame-relay lmi-type ansi
Switch(config-if)# end
Switch# copy system:running-config nvram:startup-config
```

Displaying LMI Type

To display the LMI type configuration, perform the following task in user EXEC mode:

Command	Purpose
show frame-relay lmi interface serial *card*/*subcard*/*port*:*cgn*	Displays LMI type configuration.

Example

The following example displays the LMI type configuration of a Frame Relay port adapter:

```
Switch> show frame-relay lmi interface serial 1/1/0:1

→ LMI Statistics for interface Serial1/1/0:1 (Frame Relay NNI) LMI TYPE = ANSI
  Invalid Unnumbered info 0             Invalid Prot Disc 0
  Invalid dummy Call Ref 0              Invalid Msg Type 0
  Invalid Status Message 0              Invalid Lock Shift 0
  Invalid Information ID 0              Invalid Report IE Len 0
  Invalid Report Request 0              Invalid Keep IE Len 0
  Num Status Enq. Rcvd 5103             Num Status msgs Sent 5103
  Num Update Status Rcvd 0              Num St Enq. Timeouts 10
  Num Status Enq. Sent 5118             Num Status msgs Rcvd 5103
  Num Update Status Sent 0              Num Status Timeouts 14
```

Configuring the LMI Keepalive Interval

A keepalive interval must be set to configure the LMI. By default, this interval is 10 seconds and, per the LMI protocol, must be set as a positive integer that is less than the lmi-t392dce interval set on the interface of the neighboring switch.

To set the keepalive interval, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **keepalive** *number*	Selects the keepalive interval.

Example

The following example configures the LMI keepalive interval to 30 seconds:

```
Switch(config)# interface serial 1/1/0:1
Switch(config-if)# keepalive 30
```

Displaying LMI Keepalive Interval

To display the LMI keepalive interval, perform the following task in user EXEC mode:

Command	Purpose
show frame-relay lmi interface serial *card*/*subcard*/*port*:*cgn*	Displays LMI keepalive interval.

Example

The following example displays the LMI keepalive interval of a Frame Relay port adapter:

```
Switch> show interfaces serial 1/1/0:1
Serial1/1/0:1 is up, line protocol is up
  Hardware is FRPAM-SERIAL
  MTU 4096 bytes, BW 640 Kbit, DLY 0 usec, rely 255/255, load 1/255
→ Encapsulation FRAME-RELAY IETF, loopback not set, keepalive set (30 sec)
  LMI enq sent  5163, LMI stat recvd 5144, LMI upd recvd 0, DTE LMI up
  LMI enq recvd 5154, LMI stat sent  5154, LMI upd sent  0, DCE LMI up
  LMI DLCI 1023  LMI type is CISCO  frame relay NNI
  Last input 00:00:04, output 00:00:20, output hang never

<Information Deleted>
```

Configuring the LMI Polling and Timer Intervals (Optional)

You can set various optional counters, intervals, and thresholds to fine-tune the operation of your LMI on your Frame Relay devices. Set these attributes by performing one or more of the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **frame-relay lmi-n391dte** *keep-exchanges*	Configures an NNI full status polling interval.
Step 3	Switch(config-if)# **frame-relay lmi-n392dce** *threshold*	Configures the DCE and the NNI error threshold.
Step 4	Switch(config-if)# **frame-relay lmi-n392dte** *threshold*	Configures the NNI error threshold.
Step 5	Switch(config-if)# **frame-relay lmi-n393dce** *events*	Configures the DCE and NNI monitored events count.
Step 6	Switch(config-if)# **frame-relay lmi-n393dte** *events*	Configures the monitored event count on an NNI interface.
Step 7	Switch(config-if)# **frame-relay lmi-t392dce** *seconds*	Configures the polling verification timer on a DCE or NNI interface.

Example

The following example shows how to change the default polling verification timer on a Frame Relay interface to 20 seconds using the **frame-relay lmi-t392dce** command.

```
Switch(config)# interface serial 0/1/0:5
Switch(config-if)# frame-relay lmi-t392dce 20
```

Displaying Frame Relay Serial Interface

To display information about a serial interface, perform the following task in user EXEC mode:

Command	Purpose
show interfaces serial *card*/*subcard*/*port*:*cgn*	Displays Frame Relay serial interface configuration.

Example

The following example displays serial interface configuration information for an interface with Cisco LMI enabled:

```
Switch> show interfaces serial 0/1/0:5
Serial 0/1/0:5 is up, line protocol is up
Hardware is FRPAM-SERIAL
MTU 4096 bytes, BW 1536 Kbit, DLY 0 usec, rely 229/255, load 14/255
Encapsulation FRAME-RELAY IETF, loopback not set, keepalive set (10 sec)
LMI enq sent 0, LMI stat recvd 0, LMI upd recvd 0
→ LMI DLCI 1023 LMI type is CISCO frame relay DCE
<information deleted>
```

Displaying LMI Statistics

To display statistics about the LMI, perform the following task in user EXEC mode:

Command	Purpose
show frame-relay lmi interface serial *card*/*subcard*/*port*:*cgn*	Displays LMI statistics.

Example

The following example displays the LMI statistics of a Frame Relay port adapter with an NNI interface:

```
Switch> show frame-relay lmi interface serial 0/1/0:5
LMI Statistics for interface serial 0/1/0:5 (Frame Relay NNI) LMI Type = Cisco
Invalid Unnumberred info 0Invalid Prot Disc 0
Invalid dummy Call Ref 0Invalid msg Type 0
Invalid Status Message 0Invalid Lock Shift 0
Invalid Information ID 0Invalid Report IE Len 0
Invalid Report Request 0Invalid Keep IE Len 0
Num Status Enq. Rcvd 11Num Status msgs Sent 11
Num Update Status Rcvd 0Num St Enq Timeouts 0
Num Status Enq. Sent 10Num Status msgs Rcvd 10
Num Update Status Sent 0Num Status Timeouts 0
```

Configuring Frame Relay to ATM Resource Management

This section describes the following resource management tasks specifically for your Frame Relay to ATM interworking network needs:

- Configuring Frame Relay-to-ATM Connection Traffic Table Rows on page 19-16
- Creating a Frame Relay-to-ATM CTT Row on page 19-17
- Configuring the Interface Resource Management Tasks on page 19-18

For information about how to configure your ATM Connection Traffic Table rows, see the "Configuring the Connection Traffic Table" section in the "Configuring Resource Management" chapter.

Configuring Frame Relay-to-ATM Connection Traffic Table Rows

A row in the Frame Relay-to-ATM Connection Traffic Table (CTT) must be created for each unique combination of Frame Relay traffic parameters. All Frame Relay to ATM interworking virtual connections then provide traffic parameters for each row in the table per flow (receive and transmit). Multiple virtual connections can refer to the same traffic table row.

The Frame Relay traffic parameters (specified in the command used to create the row) are converted into equivalent ATM traffic parameters. Both parameters are stored internally and used for interworking virtual connections.

The formula used for Frame Relay to ATM traffic conversions are specified in the B-ICI specification, V2.0. Use a frame size (*n*) of 250 bytes and a header size of 2 bytes. See Table 19-1.

Table 19-1 Frame Relay to ATM Traffic Conversion

Peak Cell Rate (0+1) (Cells Per Second) =	Peak Information Rate[1] /8 * (6/260)
Sustainable Cell Rate (0) (Cells Per Second) =	Committed Information Rate[1] /8 * (6/250)
Maximum Burst Size (0) (Cells) =	(Committed Burst Size[2] /8 * (1/(1-Committed InformationRate/PeakInformationRate))+1)*(6/250)

1. In bits per second.
2. In bits.

PVC Connection Traffic Rows

Permanent virtual channel (PVC) connection traffic rows, or stable rows, are used to specify traffic parameters for PVCs.

Note PVC connection traffic rows cannot be deleted while in use by a connection.

SVC Connection Traffic Rows

SVC connection traffic rows, or transient rows, are used by the signalling software to obtain traffic parameters for soft SVCs.

Note SVC connection traffic rows cannot be deleted from the CLI or SNMP. They are automatically deleted when the connection is removed.

To make the CTT management software more efficient, the CTT row-index space is split into space allocated by the CLI/SNMP and signalling. See Table 19-2.

Table 19-2 CTT Row-Index Allocation

Allocated By	Row-Index Range
CLI/SNMP	1 through 1,073,741,823
Signalling	1,073,741,824 through 2,147,483,647

Predefined Rows

Table 19-3 describes the predefined row:

Table 19-3 Default Frame Relay to ATM Connection Traffic Table Row

CTT Row-Index	CIR (bits/s)	Bc (bits)	Be (bits)	PIR (bits/s)	Service Category	ATM Row-Index
100	64,000	32,768	32,768	64,000	VBR-NRT	100

Creating a Frame Relay-to-ATM CTT Row

To create a Frame Relay-to-ATM CTT row, perform the following task in global configuration mode:

Command	Purpose
frame-relay connection-traffic-table-row [**index** *row-index*] *cir-value bc-value pir-value be-value* {**abr** | **vbr-nrt** | **ubr**} [*atm-row-index*]	Configures a Frame Relay-to-ATM CTT row.

If you do not specify an index row number, the system software determines if one is free. The index row number is then displayed in the allocated index field if the command is successful.

If the ATM row index is not specified, system software tries to use the same row index used by Frame Relay. If not possible, a free ATM row index is used.

Example

The following example shows how to configure a Frame Relay-to-ATM CTT row with non-real-time variable bit rate (VBR-NRT) service category, committed information rate of 64000 bits per second, a peak information rate of 1536000 bits per second, and a committed burst size of 8192 bits per second:

```
Switch(config)# frame-relay connection-traffic-table-row 64000 8192 1536000 vbr-nrt
Allocated index = 64000
Switch(config)#
```

Displaying the Frame Relay-to-ATM Connection Traffic Table

To display the Frame Relay-to-ATM CTT configuration, use the following EXEC command:

Command	Purpose
show frame-relay connection-traffic-table-row [**from-row** *row* | **row** *row*]	Displays the Frame Relay-to-ATM CTT configuration.

Example

The following example shows how to display the Frame Relay-to-ATM CTT configuration table:

```
Switch# show frame-relay connection-traffic-table-row
Row      cir       bc        be       pir      FR-ATM    Service Category  ATM row
100      64000   32768     32768     64000                    vbr-nrt        100
```

Configuring the Interface Resource Management Tasks

The following resource management tasks configure queue thresholds, committed burst size, and service overflow on Frame Relay interfaces. To change any of these interface parameters, perform the following steps, in interface configuration mode:

	Command	Purpose
Step 1	Switch(config-if)# **frame-relay input-queue** {**abr** | **ubr** | **vbr-nrt**} {**discard-threshold** | **marking-threshold**} *threshold*	Configures discard and marking thresholds for the inbound direction.
Step 2	Switch(config-if)# **frame-relay output-queue** {**abr** | **ubr** | **vbr-nrt**} {**discard-threshold** | **marking-threshold**} *threshold*	Configures discard and marking thresholds for the outbound direction.
Step 3	Switch(config-if)# **frame-relay bc-default** *bc-value*	Configures the committed burst size (in bits) used for ABR/UBR soft VCs on the destination interface.

	Command	Purpose
Step 4	Switch(config-if)# **frame-relay accept-overflow**	Configures to accept or discard overflow traffic (exceeding CIR) for VBR circuits. **Note** Unavailable on CE1 Frame Relay interfaces.
Step 5	Switch(config-if)# **frame-relay overbooking** *percent*	Configures the percentage of CIR overbooking.

Note Steps 1, 2, 4, and 5 affect existing and future connections on the Frame Relay interface, but Step 3 affects only future connections.

Displaying Frame Relay Interface Resources

To display your Frame Relay interface resource configuration, use the following EXEC command:

Command	Purpose
show frame-relay interface resource serial *card*/*subcard*/*port*:*cgn*	Displays resource allocation on a Frame Relay interface.

Example

The resource information for Frame Relay serial interface 0/1/0:5 is displayed in the following example:

```
Switch# show frame-relay interface resource serial 0/1/0:5
Encapsulation: FRAME-RELAY
Input queues (PAM to switch fabric):
              Discard threshold: 87% vbr-nrt, 87% abr, 87% ubr
              Marking threshold: 75% vbr-nrt, 75% abr, 75% ubr
        Output queues (PAM to line):
              Discard threshold: 87% vbr-nrt, 87% abr, 87% ubr
              Marking threshold: 75% vbr-nrt, 75% abr, 75% ubr
            Overflow servicing for VBR: enabled
Resource Management state:
          Available bit rates (in bps):
             320000 vbr-nrt RX, 320000 vbr-nrt TX
             320000 abr RX,     320000 abr TX
             320000 ubr RX,     320000 ubr TX
          Allocated bit rates (in bps):
             0 vbr-nrt RX, 0 vbr-nrt TX
             0 abr RX,     0 abr TX
             0 ubr RX,     0 ubr TX
```

Configuring Frame Relay-to-ATM Virtual Connections

This section describes how to configure virtual connections (VCs) for Frame Relay to ATM interworking and Frame Relay-to-Frame Relay switching.

The tasks to configure virtual connections are described in the following sections:

Configuration Guidelines

Perform the following tasks in a prescribed order before configuring a Frame Relay to ATM interworking permanent virtual channel (PVC), soft PVC, or a Frame Relay-to-Frame Relay PVC:

Step 1 Configure the controller on the Frame Relay port adapter.

Step 2 Configure the T1 channel or E1 interface and channel group on the Frame Relay port adapter.

Step 3 Configure Frame Relay encapsulation and Frame Relay LMI on the serial port corresponding to the channel group configured in Step 2.

Step 4 Configure Frame Relay resource management tasks including Frame Relay connection traffic table rows.

Step 5 Configure Frame Relay to ATM interworking VC tasks.

Characteristics and Types of Virtual Connections

The characteristics of the Frame Relay to ATM interworking VC, established when the VC is created, include the following:

- Frame Relay to ATM interworking parameters
- Committed information rate (CIR), committed burst size (Bc), excess burst size (Be), peak information rate (PIR) (that is, access rate [AR]) for Frame Relay
- Peak and average transmission rates for ATM
- Service category
- Cell sequencing integrity
- ATM adaption Layer 5 (AAL5) for terminating interworking PVC

These switching features can be turned off with the interface configuration commands.

Note For information about ATM VCCs, refer to Chapter 6, “Configuring Virtual Connections.”

Note You can configure a maximum of 2000 virtual connections on a CDS3 or CE1 Frame Relay port adapter.

Table 19-4 lists the types of supported virtual connections.

Table 19-4 Supported Frame Relay to ATM Virtual Connection Types

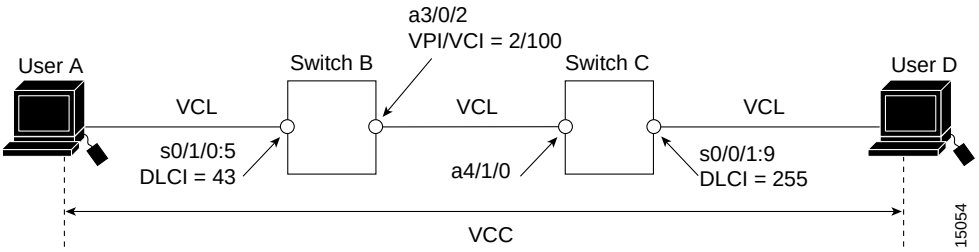
Connection	Point-to-Point	Point-to-Multipoint	Transit	Terminate
Permanent virtual channel	3	–	3	3
Soft permanent virtual channel	3	–	3	–

Configuring Frame Relay to ATM Network Interworking PVCs

This section describes configuring Frame Relay to ATM network interworking PVCs. This type of connection establishes a bidirectional facility that transfers Frame Relay traffic between two Frame Relay users through an ATM network.

Figure 19-3 shows an example of a Frame Relay to ATM network interworking PVC between Frame Relay User A and ATM User D through an ATM network.

Figure 19-3 Network Interworking PVC Example



To configure a Frame Relay to ATM network interworking PVC, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn*[1] Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **frame-relay pvc** *dlci*[2] [**upc** {**pass** | **drop**}] [**rx-cttr** *index*] [**tx-cttr** *index*] **network** [**clp-bit** {**0** | **1** | **map-de**}] [**de-bit** {**map-de** | **map-clp-or-de**}] [**interface atm** *card*/*subcard*/*port vpi vci* [**upc** *upc*] [**pd** {**off** | **on**}] [**rx-cttr** *index*] [**tx-cttr** *index*]]	Configures a Frame Relay to ATM network interworking PVC.

1. The serial interface is created with the **channel-group** command and configured using the **encapsulation frame-relay ietf** command. *cgn* is the channel group number of a channel group configured using the **channel-group** command.
2. The *dlci* value appears in the **Conn-Id** and **X-Conn-Id** columns of the **show vc** command.

Note The row index for **rx-cttr** and **tx-cttr** must be configured before using this optional parameter. See the "Configuring the Connection Traffic Table" section on page 8-10.

Note When configuring PVC connections, configure the lowest virtual path identifier (VPI) and virtual channel identifier (VCI) numbers first.

Examples

The following example shows how to configure the internal cross-connect Frame Relay to ATM network interworking PVC on Switch B between serial interface 0/1/0:5, DLCI = 43 and ATM interface 3/0/2, VPI = 2, VCI = 100 (see Figure 19-3):

```
Switch-B(config)# interface serial 0/1/0:5
Switch-B(config-if)# frame-relay pvc 43 network interface atm 3/0/2 2 100
```

The following example shows how to configure the internal cross-connect PVC on Switch C between serial interface 0/0/1:9, DLCI = 255 and ATM interface 4/1/0, VPI = 2, VCI = 100:

```
Switch-C(config)# interface serial 0/0/1:9
Switch-C(config-if)# frame-relay pvc 255 network interface atm 4/1/0 2 100
```

Note The Frame Relay to ATM network interworking PVC must be configured from the serial interface and cross-connected to the ATM interface.

Displaying Frame Relay to ATM Network Interworking PVCs

To display the network interworking configuration, use the following EXEC command:

Command	Purpose
show vc [**interface** {**atm** *card*/*subcard*/*port* [*vpi vci*] | **serial** *card*/*subcard*/*port*:*cgn* [*dlci*]}]	Shows the PVC interface configuration.

Example

The following example displays the Switch B PVC configuration for serial interface 0/1/0:5:

```
Switch-B# show vc interface serial 0/1/0:5
Interface      Conn-Id    Type   X-Interface     X-Conn-Id   Encap  Status
Serial0/1/0:5     43      PVC     ATM3/0/2          2/100             UP
```

The following example displays the configuration of the Switch B PVC on serial interface 0/1/0:5, DLCI = 43:

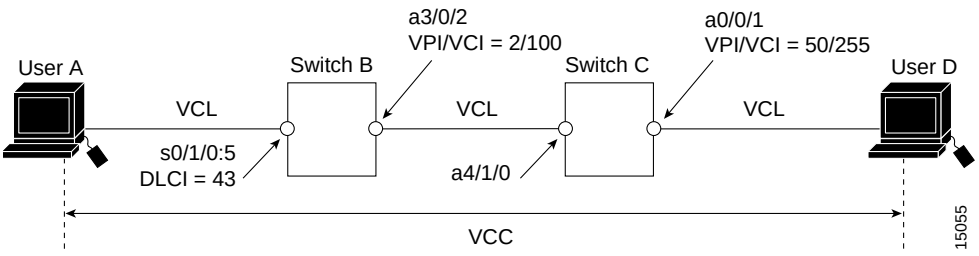
```
Switch-B# show vc interface serial 0/1/0:5 43
Interface: Serial0/1/0:5, Type: FRPAM-SERIAL
DLCI = 43     Status : ACTIVE
Connection-type: PVC
Cast-type: point-to-point
Usage-Parameter-Control (UPC): tag-drop
pvc-create-time : 00:00:10      Time-since-last-status-change : 00:00:03
Interworking Function Type : network
de-bit Mapping : map-clp-or-de       clp-bit Mapping : map-de
ATM-P Interface: ATM-P0/1/0, Type: ATM-PSEUDO
ATM-P VPI = 82  ATM-P VCI = 11
ATM-P Connection Status: UP
Cross-connect-interface: ATM0/0/0, Type: oc3suni
Cross-connect-VPI = 2
Cross-connect-VCI = 100
Cross-connect-UPC: pass
Cross-connect OAM-configuration: disabled
Cross-connect OAM-state:  Not-applicable
tx Frames : 0   Rx Frames : 0
tx Bytes : 0    Rx Bytes : 0
tx Frames Discarded : 0         Rx Frames Discarded : 0
tx Bytes Discarded  : 0         Rx Bytes Discarded  : 0
Rx connection-traffic-table-index: 100
Rx service-category: VBR-NRT (Non-Realtime Variable Bit Rate)
Rx pir: 64000
Rx cir: 64000
Rx Bc : 32768
Rx Be : 32768
Tx connection-traffic-table-index: 100
Tx service-category: VBR-NRT (Non-Realtime Variable Bit Rate)
Tx pir: 64000
Tx cir: 64000
Tx Bc : 32768
Tx Be : 32768
```

Configuring Frame Relay to ATM Service Interworking PVCs

This section describes configuring Frame Relay to ATM service interworking permanent virtual channels (PVCs). A Frame Relay to ATM service interworking PVC is established as a bidirectional facility to transfer Frame Relay to ATM traffic between a Frame Relay user and an ATM user. The upper user protocol encapsulation (FRF.3, RFC 1483, RFC 1490, RFC 1577) mapping can be enabled with the translation option of the **frame-relay pvc** command.

Figure 19-4 shows an example of a Frame Relay to ATM service interworking PVC between Frame Relay User A and ATM User D through an ATM network.

Figure 19-4 Service Interworking PVC Example



Note VPI and VCI values can change when traffic is relayed through the ATM network.

To configure a Frame Relay to ATM service interworking PVC, perform the following steps beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **frame-relay pvc** *dlci* [**upc** {**pass** | **drop**}] [**rx-cttr** *index*] [**tx-cttr** *index*] **service** {**transparent** | **translation**} [**clp-bit** {**0** | **1** | **map-de**}] [**de-bit** {**0** | **1** | **map-clp**}] [**efci-bit** {**0** | **map-fecn**}] [**interface atm** *card*/*subcard*/*port vpi* [*vci* | **any-vci**[1]] [**upc** {**pass** | **drop**}] [**pd** {**off** | **on**}] [**rx-cttr** *index*] [**tx-cttr** *index*] [**encap** *aal-encap*] [**inarp** *minutes*]]	Configures a Frame Relay to ATM service interworking PVC.

1. The **any-vci** option is only available on interface atm0. See note below.

Note Since release 12.0(1a)W5(5b) of the ATM switch software, addressing the interface on the route processor has changed. The ATM interface is now called atm0, and the Ethernet interface is now called ethernet0. Old formats (atm 2/0/0 and ethernet 2/0/0) are still supported.

Note The row index for **rx-cttr** and **tx-cttr** must be configured before using this optional parameter. See the "Configuring the Connection Traffic Table" section on page 8-10.

Examples

The following example shows how to configure the internal cross-connect PVC on Switch B between serial interface 0/1/0:5, DLCI = 43, and ATM interface 3/0/2, VPI = 2, VCI = 100 (with the translation option):

```
Switch-B(config)# interface serial 0/1/0:5
Switch-B(config-if)# frame-relay pvc 43 service translation interface atm 3/0/2 2 100
```

The following example shows how to configure the internal cross-connect PVC on Switch C between ATM interface 4/1/0, VPI = 2, VCI = 100 and ATM interface 0/0/1, VPI 50, VCI = 255:

```
Switch-C(config)# interface atm 4/1/0
Switch-C(config-if)# atm pvc 2 100 interface atm 0/0/1 50 255
```

Each subsequent VC cross connection and link must be configured until the VC is terminated to create the entire PVC.

Note The Frame Relay to ATM service interworking PVC must be configured from the serial interface and then cross-connected to the ATM interface.

Displaying Frame Relay to ATM Service Interworking PVCs

To display the service interworking PVC configuration, use the following EXEC commands:

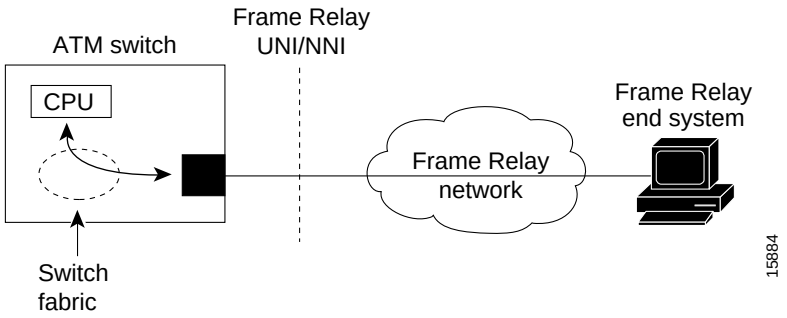
Command	Purpose
show interfaces [**serial** *card*/*subcard*/*port*:*cgn*]	Shows the serial interface configuration.
show vc [**interface** {**atm** *card*/*subcard*/*port* [*vpi vci*] | **serial** *card*/*subcard*/*port*:*cgn* [*dlci*]}]	Shows the PVC interface configuration.

Configuring Terminating Frame Relay to ATM Service Interworking PVCs

This section describes configuring terminating Frame Relay to ATM service interworking permanent virtual channels (PVCs). This type of terminating connection provides the connection from IP over Frame Relay to the ATM switch router used for IP over ATM and network management.

Figure 19-5 shows an example of transmit and terminating connections.

Figure 19-5 Frame Relay to ATM Transmit and Terminating Connections



Terminating connections are configured using the **frame-relay pvc** command; however, all switch terminating connections use atm0 to connect to the ATM switch route processor.

To configure terminating Frame Relay to ATM service interworking PVC connections, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **frame-relay pvc** *dlci* [**upc** {**pass** | **drop**}] [**rx-cttr** *index*] [**tx-cttr** *index*] **service** {**transparent** | **translation**} [**clp-bit** {**0** | **1** | **map-de**}] [**de-bit** {**0** | **1** | **map-clp**}] [**efci-bit** {**0** | **map-fecn**}] [**interface atm** *card*/*subcard*/*port* *vpi vci* | **any-vci**[1]] [**upc** {**pass** | **drop**}] [**pd** {**off** | **on**}] [**rx-cttr** *index*] [**tx-cttr** *index*] [**encap** *aal-encap*] [**inarp** *minutes*]]	Configures a Frame Relay to ATM service interworking PVC.

1. The **any-vci** option is only available on interface atm0.

Example

The following example shows how to configure the internal cross-connect PVC on Switch B between serial interface 0/1/0:5, DLCI = 50, and the terminating connection on ATM interface 0, VPI = 0, and an unspecified VCI:

```
Switch-B(config)# interface serial 0/1/0:5
Switch-B(config-if)# frame-relay pvc 50 service translation interface atm 0 0 any-vci encap aal5snap
```

Note The Frame Relay to ATM service interworking PVC must be configured from the serial interface and then cross connected to the ATM interface.

Displaying Terminating Frame Relay to ATM Service Interworking PVCs

To display the service interworking PVC configuration, use the following EXEC commands:

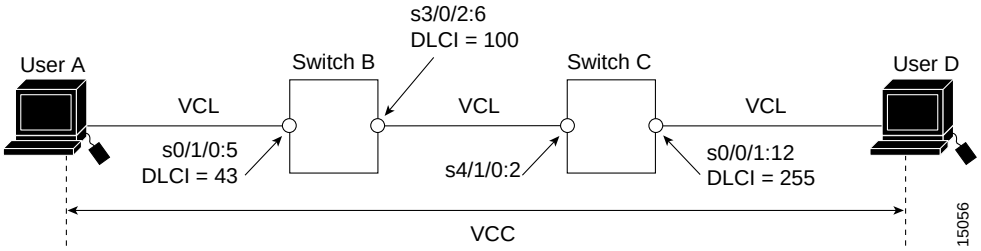
Command	Purpose
show interfaces [**serial** *card*/*subcard*/*port*:*cgn*]	Shows the serial interface configuration.
show vc [**interface** {**atm** *card*/*subcard*/*port* [*vpi vci*] | **serial** *card*/*subcard*/*port*:*cgn* [*dlci*]}]	Shows the PVC interface configuration.

Note See the "Displaying Frame Relay to ATM Network Interworking PVCs" section on page 19-22 for examples of the **show vc** command.

Configuring Frame Relay Transit PVCs

This section describes configuring internal cross-connect Frame Relay-to-Frame Relay transit permanent virtual channels (PVCs). This type of PVC is used to establish a bidirectional facility to transfer Frame Relay traffic between two Frame Relay users. Figure 19-6 shows a Frame Relay transit PVC between Frame Relay users A and D.

Figure 19-6 Transit PVC Example



To configure a Frame Relay transit PVC, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **frame-relay pvc** *dlci* [**upc** {**pass** | **drop**}] [**rx-cttr** *index*] [**tx-cttr** *index*] **interface serial** *card*/*subcard*/*port*:*cgn* **dlci** *dlci* [**upc** {**pass** | **drop**}] [**rx-cttr** *index*] [**tx-cttr** *index*]	Configures a Frame Relay-to-Frame Relay transit PVC.

Examples

The following example shows how to configure the internal cross-connect Frame Relay PVC on Switch B between serial interface 0/1/0:5, DLCI = 43, and serial interface 3/0/2:6, DLCI = 100:

```
Switch-B(config)# interface serial 0/1/0:5
Switch-B(config-if)# frame-relay pvc 43 interface serial 3/0/2:6 100
```

The following example shows how to configure the internal cross-connect Frame Relay on Switch C between serial interface 4/1/0:2, DLCI = 100,0 and serial interface 0/0/1:12, DLCI = 255:

```
Switch-C(config)# interface serial 4/1/0:2
Switch-C(config-if)# frame-relay pvc 100 interface serial 0/0/1:12 255
```

Each subsequent VC cross-connection and link must be configured until the VC is terminated to create the entire VCC.

To display Frame Relay transit PVCs, use the **show interfaces** and **show vc** commands.

Configuring Frame Relay Soft PVC Connections

This section describes configuring Frame Relay to ATM interworking soft permanent virtual channels (soft PVC) connections.

You can configure the following soft PVC connections:

- Frame Relay-to-Frame Relay soft PVC connection, configured as network interworking
- Frame Relay to ATM soft PVC connection, configured as network interworking
- Frame Relay to ATM soft PVC connection, configured as service interworking

Configuration Guidelines

These guidelines are appropriate for both network and service interworking soft PVC connections.

Note Frame Relay interworking soft PVCs can only be configured from a Frame Relay interface.

Perform the following steps, and refer to Figure 19-7:

Step 1 Determine which two switches you want to define as participants in the soft PVC.

Step 2 Determine the source (active) side of the soft PVC.

Step 3 Determine an available data-link connection identifier (DLCI) for value *dlci_a* on the source end of the soft PVC.

Step 4 Determine the destination (passive) side of the soft PVC.

Step 5 Determine the ATM address of the destination side of the soft PVC. Use the **show atm addresses** command on the destination switch.

Step 6 If the destination side of the soft PVC is a Frame Relay interface, choose an available DLCI value. Use the **show vc interface serial** command.

If the destination side of the soft PVC is an ATM interface, choose an available VPI/VCI value.

Step 7 Choose the interworking function type, and the relevant interworking parameters (for example, de-bit/clp-bit mapping options).

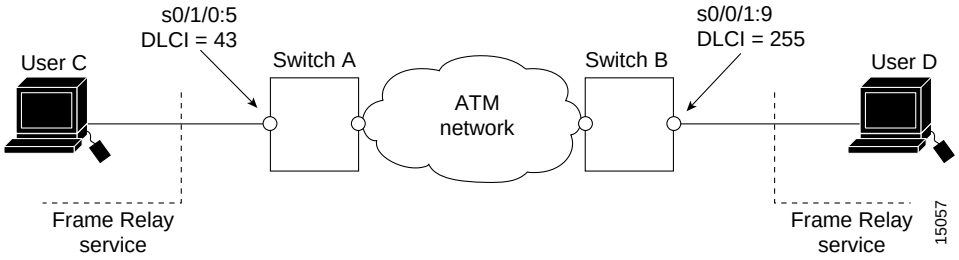
Note If the soft PVC terminates on a Frame Relay interface, the soft PVC can only be configured as a network interworking connection. If the soft PVC terminates on an ATM interface, the soft PVC can be configured either as a network interworking connection or a service interworking connection.

Step 8 Configure the Frame Relay interworking soft PVC on the source side. See the following sections for configuration steps and examples.

Configuring Frame Relay-to-Frame Relay Network Interworking Soft PVCs

This section describes how to configure a Frame Relay-to-Frame Relay network interworking soft PVC terminating on two Frame Relay interfaces. Figure 19-7 shows a Frame Relay-to-Frame Relay network interworking soft PVC between Switch A and Switch B.

Figure 19-7 Frame Relay-to-Frame Relay Network Interworking Soft PVC Example



To configure a Frame Relay-to-Frame Relay network interworking soft PVC, perform the following steps, beginning in EXEC mode:

	Command	Purpose
Step 1	Switch# **show interfaces**	Determines source and destination interfaces.
Step 2	Switch# **show vc interface serial** *card*/*subcard*/*port*:*cgn* [*dlci*]	Determines the DLCI available for Step 3.
Step 3	Switch# **show vc interface serial** *card*/*subcard*/*port*:*cgn* [*dlci*]	Determines the DLCI available for Step 7.
Step 4	Switch# **show atm addresses**	Determines soft PVC destination address.
Step 5	Switch# **configure terminal** Switch(config)#	From the source (active) side at the privileged EXEC prompt, enter configuration mode from the terminal.
Step 6	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn* Switch(config-if)#	Selects the source Frame Relay port and channel group number.
Step 7	Switch(config-if)# **frame-relay soft-vc** *dlci-a* **dest-address** *address* **dlci** *dlci_b* [**upc** {**pass** | **drop**}] [**rx-cttr** *index*] [**tx-cttr** *index*] [**retry-interval** [**first** *first-retry-interval*] [**maximum** *max-retry-interval*]] [**network** [**clp-bit** {**0** | **1** | **map-de**}] **de-bit** {**map-de** | **map-clp-or-de**}]]	Configures a network interworking soft PVC terminating on a Frame Relay serial interface.

The previous configuration steps are illustrated in the following section.

Note The row index for **rx-cttr** and **tx-cttr** must be configured before using this optional parameter. See the "Configuring the Connection Traffic Table" section on page 8-10.

Frame Relay-to-Frame Relay Interworking Soft PVC Configuration Example

This section provides an example of a Frame Relay-to-Frame Relay network interworking soft PVC configured between Switch A and Switch B, as shown in Figure 19-7. The source (active) side is serial interface 0/1/0:5 on Switch A.

Step 1 Use the **show vc interface serial** command to determine that data-link connection identifier (DLCI) 43 is available on serial interface 0/1/0:5 on Switch A:

```
Switch-A# show vc interface serial 0/1/0:5
Interface      Conn-Id Type    X-Interface    X-Conn-Id  Encap  Status
Serial0/1/0:5     54  SoftVC   Serial3/0/0:3    54       SoftVC  UP
Serial0/1/0:5     55  SoftVC   Serial3/0/0:2    55       SoftVC  UP
Serial0/1/0:5     56  SoftVC   ATM0/1/3        0/45      SVC     UP
Serial0/1/0:5     66  SoftVC   ATM1/1/0        0/100     SoftVC  UP
```

Step 2 The destination (passive) side is a Frame Relay serial interface 0/0/1:9 on Switch B.

Step 3 The ATM address for the destination serial interface 0/0/1:9 on Switch B is 47.0091.8100.0000.00e0.1e79.8803.4000.0c81.8010.00.

```
Switch-B# show atm addresses
Switch Address(es):
47.00918100000000E01E798803.00E01E808601.00 active

Soft VC Address(es) :
47.0091.8100.0000.00e0.1e79.8803.4000.0c80.0000.00 ATM1/0/0
47.0091.8100.0000.00e0.1e79.8803.4000.0c80.0010.00 ATM1/0/1
47.0091.8100.0000.00e0.1e79.8803.4000.0c80.0020.00 ATM1/0/2
47.0091.8100.0000.00e0.1e79.8803.4000.0c80.0030.00 ATM1/0/3
<information deleted>

Soft VC Address(es) for Frame Relay Interfaces :
47.0091.8100.0000.00e0.1e79.8803.4000.0c81.8010.00 Serial0/0/1:9
47.0091.8100.0000.00e0.1e79.8803.4000.0c81.8020.00 Serial0/0/1:10

ILMI Switch Prefix(es):
47.0091.8100.0000.00e0.1e79.8803
<information deleted>
```

Step 4 DLCI 255 is available on serial interface 0/0/1:9 Switch B.

```
Switch-B# show vc interface serial 0/0/1:9
Interface Conn-Id Type X-Interface X-Conn-Id Encap Status
Serial0/0/1:9 44 SoftVC Serial3/0/0:3 54 SoftVC UP
Serial0/0/1:9 45 SoftVC Serial3/0/0:2 55 SoftVC UP
Serial0/0/1:9 76 SoftVC ATM0/1/3 0/45 SVC UP
Serial0/0/1:9 86 SoftVC ATM1/1/0 0/100 SoftVC UP
```

Step 5 Configure the network interworking soft PVC from Switch A beginning in global configuration mode.

```
Switch-A(config)# interface serial 0/1/0:5
Switch-A(config-if)# frame-relay soft-vc 43 dest-address
47.0091.8100.0000.00e0.1e79.8803.4000.0c81.8010.00 dlci 255
```

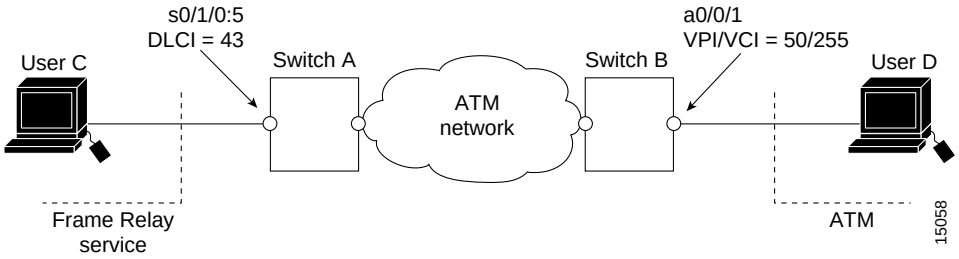
Note If the soft PVC originates and terminates on a Frame Relay interface, the default interworking type is network interworking. You do not need to specify the interworking type explicitly.

After you complete the soft VC configuration, proceed to the "Display Frame Relay Internetworking Soft PVCs" section on page 19-35 and verify the connection.

Configuring Frame Relay to ATM Network Interworking Soft PVCs

This section describes how to configure a Frame Relay to ATM network interworking soft permanent virtual channel (soft PVC). Figure 19-8 shows a Frame Relay to ATM network interworking soft PVC between Switch A and Switch B.

Figure 19-8 Frame Relay to ATM Network Interworking Soft PVC Example



To configure a Frame Relay to ATM network interworking soft PVC, perform the following steps, beginning in EXEC mode:

	Command	Purpose
Step 1	Switch# **show interfaces**	Determines source and destination interfaces.
Step 2	Switch# **show vc interface serial** *card*/*subcard*/*port*:*cgn* [*dlci*]	Determines the DLCI available for Step 3.
Step 3	Switch# **show vc interface serial** *card*/*subcard*/*port*:*cgn* [*dlci*]	Determines the DLCI available for Step 7.
Step 4	Switch# **show atm addresses**	Determines soft PVC destination address.
Step 5	Switch# **configure terminal** Switch(config)#	From the source (active) side, at the privileged EXEC prompt, enter configuration mode from the terminal.
Step 6	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn* Switch(config-if)#	Selects the source Frame Relay port and channel group number.
Step 7	Switch(config-if)# **frame-relay soft-vc** *dlci-a* **dest-address** *address* **dlci** *dlci_b* [**upc** {**pass** | **drop**}] [**rx-cttr** *index*] [**tx-cttr** *index*] [**retry-interval** [**first** *first-retry-interval*] [**maximum** *max-retry-interval*]] [**network** [**clp-bit** {**0** | **1** | **map-de**}] **de-bit** {**map-de** | **map-clp-or-de**}]] [**explicit-path** *precedence* {**name** *path-name* | **identifier** *path-id*} [**upto** *partial-entry-index*]] [**only-explicit**]	Configures a network interworking soft PVC terminating on an ATM interface.

The previous configuration steps are illustrated in the following section.

Note The row index for **rx-cttr** and **tx-cttr** must be configured before using this optional parameter. See the "Configuring the Connection Traffic Table" section on page 8-10.

Frame Relay to ATM Network Interworking Soft PVC Configuration Example

This section provides an example of a network interworking soft PVC configured between switch A and Switch B and shown in Figure 19-9. The source (active) side is serial interface 0/1/0:5 on Switch A.

Step 1 Use the **show vc interface serial** command to determine that DLCI 43 is available on serial interface 0/1/0:5 Switch A.

```
Switch-A# show vc interface serial 0/1/0:5
Interface      Conn-Id Type    X-Interface    X-Conn-Id  Encap  Status
Serial0/1/0:5     54  SoftVC   Serial3/0/0:3    54       SoftVC  UP
Serial0/1/0:5     55  SoftVC   Serial3/0/0:2    55       SoftVC  UP
Serial0/1/0:5     56  SoftVC   ATM0/1/3        0/45      SVC     UP
Serial0/1/0:5     66  SoftVC   ATM1/1/0        0/100     SoftVC  UP
```

Step 2 On Switch B, use the **show atm addresses** command to determine the destination ATM address for ATM interface 0/0/1, which is 47.0091.8100.0000.00e0.1e19.9904.4000.0c80.0010.00.

```
Switch-B# show atm addresses
Switch Address(es):
47.00918100000000E01E199904.00E01E808601.00 active
Soft VC Address(es) :
47.0091.8100.0000.00e0.1e19.9904.4000.0c80.0000.00 ATM0/0/0
47.0091.8100.0000.00e0.1e19.9904.4000.0c80.0010.00 ATM0/0/1
47.0091.8100.0000.00e0.1e19.9904.4000.0c80.0020.00 ATM0/0/2
47.0091.8100.0000.00e0.1e19.9904.4000.0c80.0030.00 ATM0/0/3
<information deleted>
```

Step 3 On Switch B, use the **show vc interface atm** command to determine that VPI/VCI 50/255 is available for use on ATM interface 0/0/1.

```
Switch-B# show vc interface atm 0/0/1
Interface    Conn-Id    Type   X-Interface     X-Conn-Id   Encap  Status
ATM0/0/1      0/5       PVC     ATM2/0/0          0/58     QSAAL    UP
ATM0/0/1      0/16      PVC     ATM2/0/0          0/44     ILMI     UP
ATM0/0/1      0/18      PVC     ATM2/0/0          0/71     PNNI     UP
```

Step 4 Configure the network interworking soft PVC from Switch A beginning in global configuration mode.

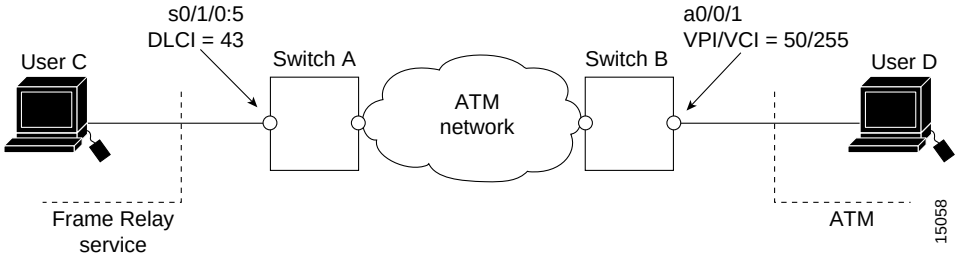
```
Switch-A(config)# interface serial0/1/0:5
Switch-A(config-if)# frame-relay soft-vc 43 dest-address
47.0091.8100.0000.00e0.1e19.9904.4000.0c80.0010.00 vc 50 255 network
```

After you complete the soft VC configuration, go to the "Display Frame Relay Internetworking Soft PVCs" section on page 19-35 and verify the connection.

Configuring Frame Relay to ATM Service Interworking Soft PVCs

This section describes configuring a Frame Relay to ATM service interworking soft PVC terminating on an ATM interface. Figure 19-9 shows a Frame Relay to ATM service interworking soft PVC between Switch A and Switch B.

Figure 19-9 Frame Relay to ATM Service Interworking Soft PVC Example



To configure a Frame Relay to ATM service interworking soft PVC, perform the following steps, beginning in EXEC mode:

	Command	Purpose
Step 1	Switch# **show interfaces**	Determines source and destination interfaces.
Step 2	Switch# **show vc interface serial** *card*/*subcard*/*port*:*cgn* [*dlci*]	Determines the DLCI available for Step 3.
Step 3	Switch# **show vc interface serial** *card*/*subcard*/*port*:*cgn* [*dlci*]	Determines the DLCI available for Step 7.
Step 4	Switch# **show atm addresses**	Determines the soft PVC destination address.
Step 5	Switch# **configure terminal** Switch(config)#	From the source (active) side, at the privileged EXEC prompt, enter configuration mode from the terminal.
Step 6	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn* Switch(config-if)#	Selects the Frame Relay serial port and channel group number.
Step 7	Switch(config-if)# f**rame-relay soft-vc** *dlci_a* **dest-address** *address* **vc** *vpi vci* [**upc** {**pass** | **drop**}] [**rx-cttr** *index*] [**tx-cttr** *index*] [**retry-interval** [**first** *first-retry-interval*] [**maximum** *max-retry-interval*]] [**service** [**translation** | **transparent**]] [**clp-bit** {**0** | **1** | **map-de**}] [**de-bit** {**0** | **1** | **map-clp**}] [**efci-bit** {**0** | **map-fecn**}] [**explicit-path precedence** {**name** *path-name* | **identifier** *path-id*} [**upto** *partial-entry-index*]] [**only-explicit**]	Configures a service interworking soft PVC.

Note The row index for **rx-cttr** and **tx-cttr** must be configured before using this optional parameter. See the "Configuring the Connection Traffic Table" section on page 8-10.

Note If the interworking soft PVC terminates on an ATM interface, the default interworking type is service interworking in translation mode.

Frame Relay to ATM Service Interworking Soft PVC Configuration Example

Use the following steps to configure the service interworking soft PVC between Switch A and switch B as shown in Figure 19-9.

Note In the following process the source (active) side is serial interface 0/1/0:5 on Switch A and the destination (passive) side is ATM interface 0/0/1 on Switch B.

Step 1 On Switch A, use the **show vc interface serial** command to determine that DLCI 43 is available for use on serial interface 0/1/0:5 Switch A:

```
Switch-A# show vc interface serial 0/1/0:5
Interface      Conn-Id Type    X-Interface    X-Conn-Id  Encap  Status
Serial0/1/0:5     54  SoftVC   Serial3/0/0:3    54       SoftVC  UP
Serial0/1/0:5     55  SoftVC   Serial3/0/0:2    55       SoftVC  UP
Serial0/1/0:5     56  SoftVC   ATM0/1/3        0/45      SVC     UP
Serial0/1/0:5     66  SoftVC   ATM1/1/0        0/100     SoftVC  UP
```

Step 2 On Switch B, use the **show atm addresses** command to determine the destination ATM address for ATM interface 0/0/1, which is 47.0091.8100.0000.00e0.1e19.9904.4000.0c80.0010.00.

```
Switch-B# show atm addresses
Switch Address(es):
47.00918100000000E01E199904.00E01E808601.00 active
Soft VC Address(es) :
47.0091.8100.0000.00e0.1e19.9904.4000.0c80.0000.00 ATM0/0/0
→ 47.0091.8100.0000.00e0.1e19.9904.4000.0c80.0010.00 ATM0/0/1
47.0091.8100.0000.00e0.1e19.9904.4000.0c80.0020.00 ATM0/0/2
47.0091.8100.0000.00e0.1e19.9904.4000.0c80.0030.00 ATM0/0/3
<information deleted>
```

Step 3 On Switch B, use the **show vc interface atm** command to determine that VPI/VCI 50/255 is available for use on ATM interface 0/0/1:

```
Switch-B# show vc interface atm 0/0/1
Interface    Conn-Id    Type   X-Interface     X-Conn-Id   Encap  Status
ATM0/0/1      0/5       PVC     ATM2/0/0          0/58     QSAAL    UP
ATM0/0/1      0/16      PVC     ATM2/0/0          0/44     ILMI     UP
ATM0/0/1      0/18      PVC     ATM2/0/0          0/71     PNNI     UP
```

Step 4 The following example configures a service interworking soft PVC in transparent mode on Switch A using the information obtained in the previous steps:

```
Switch-A(config)# interface serial 0/1/0:5
Switch-A(config-if)# frame-relay soft-vc 43 dest-address
47.0091.8100.0000.00e0.1e19.9904.4000.0c80.0010.00 vc 50 255 service transparent
```

After you complete the soft VC configuration, go to the "Display Frame Relay Internetworking Soft PVCs" section on page 19-35 and verify the connection.

Display Frame Relay Internetworking Soft PVCs

To display your Frame Relay internetworking soft PVCs configuration, use the following EXEC command:

Command	Purpose
show vc [**interface** {**atm** *card*/*subcard*/*port* [*vpi vci*] | **serial** *card*/*subcard*/*port*:*cgn* [*dlci*]}]	Shows the PVC interface configuration.

Examples

The following example displays serial interface 1/1/0:2 soft PVC status:

```
Switch# show vc interface serial 1/1/0:2
Interface      Conn-Id    Type   X-Interface     X-Conn-Id   Encap  Status
→ Serial1/1/0:2     34      SoftVC  ATM0/0/0        100/255            UP
```

The following example displays ATM interface 0/0/0 soft PVC status:

```
Switch# show vc interface atm 0/0/0
Interface      Conn-Id    Type   X-Interface     X-Conn-Id   Encap  Status
ATM0/0/0          0/5      PVC     ATM2/0/0          0/43     QSAAL    UP
ATM0/0/0          0/16     PVC     ATM2/0/0          0/35     ILMI     UP
ATM0/0/0          0/200    PVC     ATM0/0/1          0/200              DOWN
→ ATM0/0/0        100/255    SoftVC  Serial1/1/0:2       34                UP
```

Configuring the Soft PVC Route Optimization Feature

This section describes the soft permanent virtual channel (soft PVC) route optimization feature for Frame Relay interfaces. Most soft PVCs have a much longer lifetime than switched virtual channels (SVCs). The route chosen during the soft connection setup remains the same even though the network topology might change.

Soft connections, with the route optimization percentage threshold set, provide the following features:

- When a better route is available, soft permanent virtual paths (soft PVPs) or soft PVCs are dynamically rerouted.
- Route optimization can be triggered manually.

Note Soft PVC route optimization should not be configured with constant bit rate (CBR) connections.

Configuring a Frame Relay Interface with Route Optimization

Soft PVC route optimization must be enabled and configured to determine the point at which a better route is found and the old route is reconfigured.

To enable and configure a Frame Relay interface with route optimization, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **atm route-optimization percentage-threshold** *value*	Configures the ATM route optimization threshold.
Step 2	Switch(config)# **interface serial** *card*/*subcard*/*port*:*cgn* Switch(config-if)#	Selects the interface to configure. Enter the interface number of the source end of the soft PVC. Route optimization works for the source end of a soft PVC only and is ignored if configured on the destination interface.
Step 3	Switch(config-if)# **atm route-optimization soft-connection** [**interval** *minutes*] [**time-of-day** {**anytime** | *start-time end-time*}]	Configures the interface for route optimization.

Example

The following example shows how to configure an interface with a route optimization interval configured as every 30 minutes between the hours of 6:00 P.M. and 5:00 A.M.:

```
Switch(config)# atm route-optimization percentage-threshold 45
Switch(config)# interface serial 1/0/0:1
Switch(config-if)# atm route-optimization soft-connection interval 30 time-of-day 18:00 5:00
```

Displaying a Frame Relay Interface Route Optimization Configuration

To display the Frame Relay interface route optimization configuration, use the following privileged EXEC commands:

Command	Purpose
show running-config	Shows the serial interface configuration route optimization configuration.
show interfaces [**serial** *card*/*subcard*/*port*:*cgn*]	Shows the serial interface configuration.

Example

The following example shows the route optimization configuration of serial interface 1/0/0:1:

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

<information deleted>

!
interface Serial1/0/0:1
 description Engineering connections
 no ip address
 no ip directed-broadcast
 encapsulation frame-relay IETF
 no arp frame-relay
 no snmp trap link-status
 frame-relay intf-type nni

atm route-optimization soft-connection interval 30 time-of-day 18:0 5:0
!

Switch# show interfaces serial 3/0/0:1
Serial3/0/0:1 is up, line protocol is up
  Hardware is FRPAM-SERIAL
  MTU 4096 bytes, BW 1536 Kbit, DLY 0 usec, rely 128/255, load 1/255
  Encapsulation FRAME-RELAY IETF, loopback not set, keepalive not set
  Last input 00:00:08, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); 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)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     12963 packets input, 12963 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     12963 input errors, 7638 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
     2 carrier transitions
  Timeslots(s) Used: 1-24 on T1 1
  Frames Received with:
   DE set: 0, FECN set :0, BECN set: 0
  Frames Tagged :
   DE: 0, FECN: 0 BECN: 0
  Frames Discarded Due to Alignment Error: 0
  Frames Discarded Due to Illegal Length: 0
  Frames Received with unknown DLCI: 0
  Frames with illegal Header : 0
  Transmit Frames with FECN set :0,  BECN Set :0
  Transmit Frames Tagged FECN : 0 BECN : 0
  Transmit Frames Discarded due to No buffers : 0
  Default Upc Action : tag-drop
  Default Bc (in Bits) : 32768
➔ Soft vc route optimization is enabled
    Soft vc route optimization interval = 50 minutes
    Soft vc route optimization time-of-day range = (20:10 - 23:40)
```

Respecifying Existing Frame Relay to ATM Interworking Soft PVCs

For existing Frame Relay to ATM interworking soft permanent virtual channels (soft PVCs), a connection is disabled to prevent an explicit path from being used for routing while it is reconfigured. The **redo_explicit** keyword is used to allow respecifying of the explicit path configuration without bringing down connections. Existing connections remain unaffected unless a reroute takes place. If rerouting occurs, the new explicit path configuration takes affect.

To enable or disable soft PVC and respecify explicit-path configuration, use the following interface command:

Command	Purpose
frame-relay soft-vc *dlci_a* [**enable** | **disable**] [**redo-explicit** [**explicit-path** *precedence* {**name** *path-name* | **identifier** *path-id*} [**upto** *partial-entry-index*]] [**only-explicit**]]	Respecifies the explicit path on a Frame Relay to ATM interworking soft PVC.