Frame Relay

Teldat-Dm 703-I

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Table of Contents

I Related Documents

Teldat-Dm701-I ARP & InARP Protocol

Teldat-Dm711-I Frame Relay Backup Configuration over ISDN

Teldat-Dm731-I Frame Relay over ISDN BRI

Teldat-Dm732-I Dial Profiles

Teldat-Dm772-I Common Configurations for Interfaces

Chapter 1 Frame Relay Interface

1.1 Introduction

This chapter describes the Frame Relay interface software and includes the following sections:

- Frame Relay Overview
- Frame Relay Network Frame Forwarding
- Frame Relay Network Management
- Circuit Congestion
- Frame Relay Network Data Rates
- Frame Relay Interface Data Encryption
- Frame Relay Interface Backup Features
- Frame Relay *Switching*

1.2 Frame Relay Overview

The Frame Relay (FR) protocol is a method of transmitting internetworking packets by combining the port sharing and packet switching of X.25 with the high speed and minimal delay of *Time Division Multiplexing* (TDM) circuit switching. Frame Relay allows you to connect multiple *local area networks* (LAN) to a single high-speed *wide area network* (WAN) link with multiple point-to-point permanent virtual circuits (PVCs). Frame Relay offers the following features:

- **High throughput and low delay.** Utilizing the core aspects (error detection, addressing, and synchronization) of the *D-channel Link Access Protocol* (LAPD), Frame Relay eliminates all network layer (Layer 3) processing. By using only the core aspects, Frame Relay reduces the delay of processing each frame.
- **Congestion detection and control.** Upon receiving a *Backward Explicit Congestion Notification* (BECN), the router initiates a controlled slowdown of data traffic, thereby avoiding a complete Frame Relay network shutdown.
- **Circuit access and control.** As the router dynamically learns about the availability of non-configured circuits, you can control access to those circuits at all times.
- **Network management option.** As your network requires, the Frame Relay protocol can operate with or without a local network management interface.
- **Multiplexing protocols.** The Teldat router supports simultaneous traffic from multiple protocols in each PVC (IP, SNA, Bridge, etc.).

Frame Relay does not provide error correction. Error-correction functions (such as data retransmission), are left to the *host* devices connected to the network.

1.2.1 Frame Relay Network

The Frame Relay network consists of the Frame Relay backbone (made up of switches provided by the Frame Relay carrier) providing the Frame Relay service. The router acts as a Frame Relay connection device.

The router encapsulates Frame Relay frames and routes them through the network using a *Data Link Connection Identifier* (DLCI). The DLCI is the *Media Access Control* (MAC) address that is used to identify a *Permanent Virtual Circuit* (PVC) between the router and the Frame Relay destination device. For example, in Figure 1, a packet routed by router B to router D would have a DLCI of 19, while a packet from router D to router B would have a DLCI of 16.

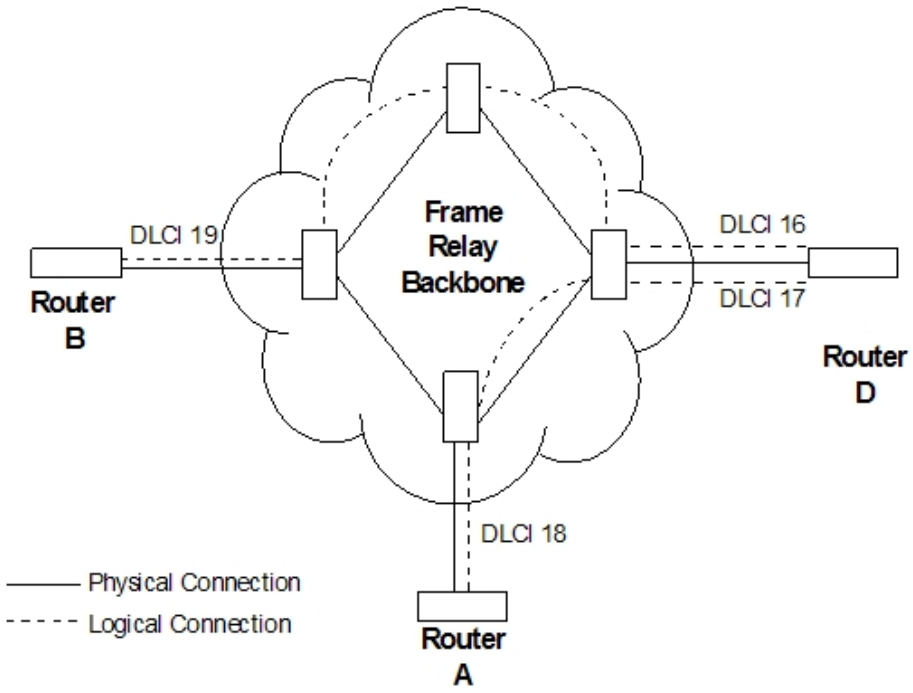

Fig. 1: **DLCIs in a Frame Relay network**

A DLCI can have either local or global significance. Local DLCIs are significant only at points of entry to the Frame Relay network, while global DLCIs are significant throughout the entire network. To the user, however, the DLCI that the router uses to route a packet is the DLCI that the user associates with the frame's global or local destination. DLCIs are configured through the Frame Relay configuration process or learned through Frame Relay management.

A Frame Relay network has the following characteristics:

- **Transports frames transparently.** The network can modify only the DLCI, congestion bits and frame check sequence. *High-level Data Link Control*(HDLC) flags and *zero bit insertion* provide frame delimiting, alignment and transparency in communications.
- **Detects transmission, format, and operational errors.**
- **Preserves the ordering of frame transfer on individual PVCs.**
- **Does not acknowledge or retransmit frames.**

1.2.2 Frame Relay Interface Initialization

The Frame Relay interface is active when a successful exchange takes place with the *Local Management Interface* (LMI). However, no data can be transmitted or received until a status message indicates that the PVC status to the other router is active.

PVC status appears for all PVCs as either active or inactive. An active PVC has a completed connection to an end system. An inactive PVC does not have a completed connection to an end system because either an end system or a Frame Relay switch is off-line.

For example, in Figure 2 router B has a configured PVC to router D. Router B is successfully interacting with Frame Relay management through Frame Relay switch B. Because either another Frame Relay switch is down or the end system is down, the end-to-end PVC connection is not established. Router B receives an inactive status for that PVC.

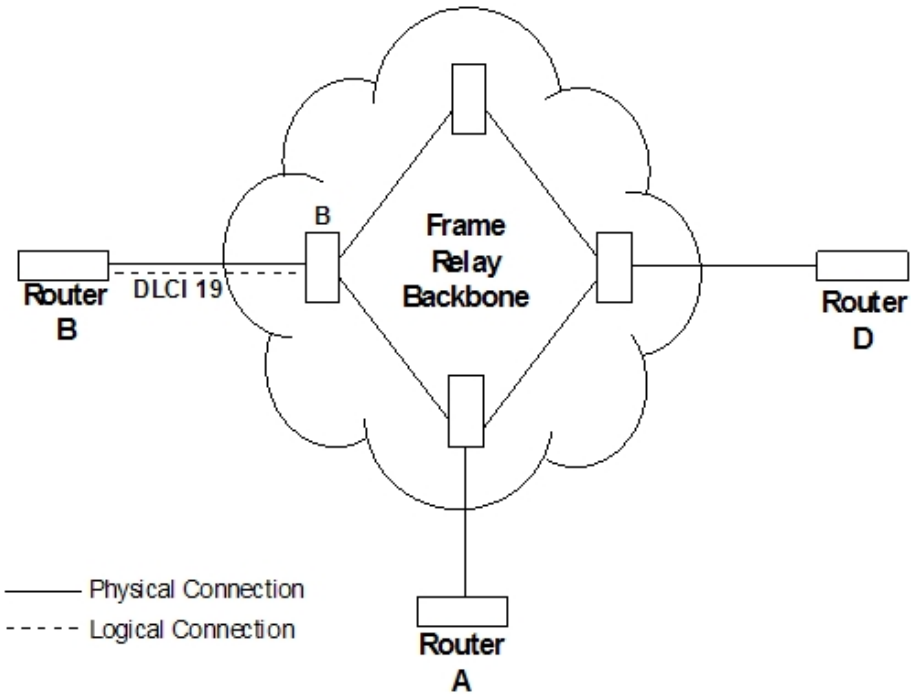

Fig. 2: **DLCIs in a Frame Relay network**

1.2.3 Orphan Circuits

An *orphan circuit* is any PVC that is not configured for your router but is learned indirectly through the actions of the network management entity. For example, Figure 3 assumes that router B has a configured PVC to router D, but none to router A. Router A configures a PVC to router B. Router B would then learn about the PVC to router A and classify it as an orphan.

Orphan circuits are treated the same as configured circuits except that you can enable or disable their use with the **ORPHAN-CIRCUITS** and **NO ORPHAN-CIRCUITS** commands.

Disabling orphan circuits adds a measure of security to your network by preventing unauthorized entry from a non-configured circuit.

Enabling orphans circuits allows the router to forward packets over circuits you did not configure. Packets that would normally be dropped are now forwarded.

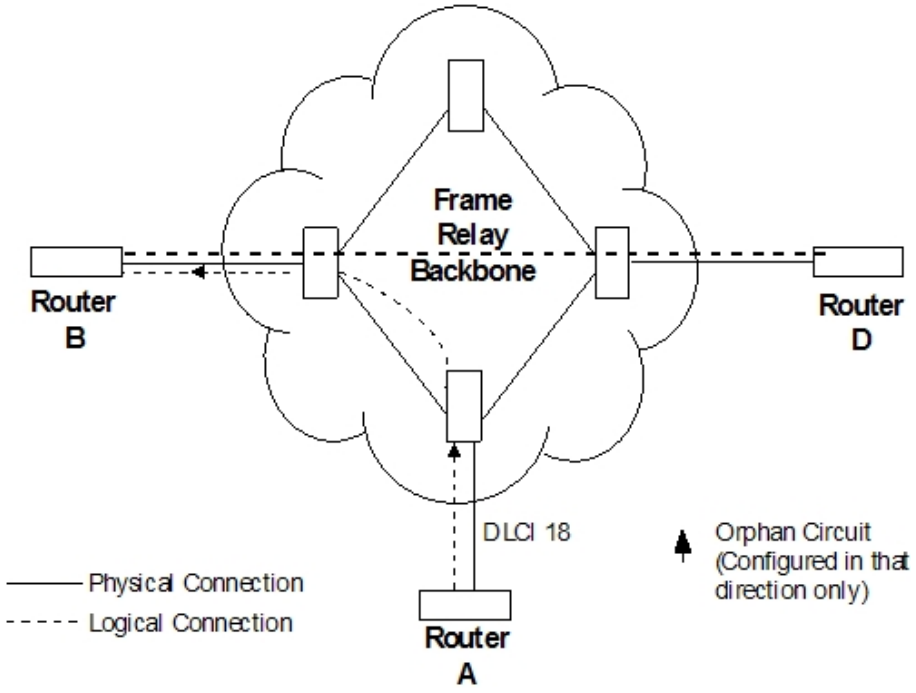

Fig. 3: **Orphan Circuit**

1.2.4 Frame Relay Frame

A Frame Relay frame consists of a fixed-size control field with variable-sized encapsulated user data.

Octet	8	7	6	5	4	3	2	1
1	HDLC Flag = 0x7e							
2	Data Link MSB/LSB (DL)						C/R	EA
3	Connection ID (CI)				FECN	BECN	DE	EA
	User data							
	Frame Check Sequence (FCS) = 16 bits (2 octets)							
N	HDLC Flag = 0x7E							

Fig. 4: **LAPD Frame Format**

1.2.4.1 HDLC flags

Located in the first and last octet, these flags indicate the beginning and end of the frame.

1.2.4.2 Data Link Connector Identifier (DLCI)

This 10-bit routing ID resides in bits 3 to 8 of octet 2 and bits 5 to 8 of octet 3. The DLCI is the MAC address of the circuit. The DLCI allows the user and network management to identify the frame as being from a particular PVC. The DLCI enables multiplexing of several PVCs over one physical circuit.

1.2.4.3 Command/Response (C/R)

This is LAPD-specific. It is not used by this version of Frame Relay.

1.2.4.4 Extended Address (EA)

This version of Frame Relay does not support extended addressing.

1.2.4.5 Forward Explicit Congestion Notification (FECN)

When this bit is set to 1, the Frame Relay backbone network notifies the user receiving the frames that congestion is occurring in the direction the frame is being sent.

1.2.4.6 Backward Explicit Congestion Notification (BECN)

When this bit is set to 1, the Frame Relay backbone network notifies the user sending the frames that congestion is occurring in the opposite direction. The router then *throttles down* the rate at which frames are delivered to the network to a rate equal to or less than the user-defined CIR (*Committed Information Rate*). A PVC's CIR is supplied by the Frame Relay service provider and is configured using the *PVC* command.

1.2.4.7 Discard Eligibility (DE)

The network may discard data that exceeds a PVC's CIR. The network end-node sets the DE bit to indicate discard eligibility.

1.2.4.8 User Data

This field contains the protocol packet being transmitted. This field can contain a maximum of 8,189 octets; however, the *Frame Check Sequence* (FCS) can effectively detect errors only on a maximum of 4,096 octets of data.

1.2.4.9 Frame Check Sequence (FCS)

This field is the standard 16-bit Cyclic Redundancy Check (CRC) that HDLC and LAPD frames use. This field detects bit errors occurring in the bits of the frame between the opening flag and Frame Check Sequence (FCS).

1.3 Frame Relay Network Frame Forwarding

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1.3.1 Protocol Addresses

Protocol addresses can be mapped statically to Frame Relay network PVC addresses (i.e., to DLCIs) through ARP (or ND for IPv6).

Note

Static protocol addresses are also referred to as static ARP entries. A static ARP entry is added to the configuration with the PROTOCOL-ADDRESS command.

Static IPv6 protocol addresses are also referred to as static Neighbors. A static Neighbor is added to the configuration with the PROTOCOL-ADDRESS command.

1.3.2 Multicast Emulation

Multicast Emulation is an optional feature that allows protocols requiring multicast such as ARP to function properly over the Frame Relay interface.

With multicast emulation, a frame is transmitted on each active PVC. This feature can be turned on or off with the **MULTICAST-EMULATION** and **NO MULTICAST-EMULATION** commands.

1.4 Frame Relay Network Management

The supplier of the Frame Relay network backbone provides Frame Relay network management. It is management's responsibility to provide Frame Relay end-stations (routers) with status and configuration information concerning PVCs available at the physical interface.

The Frame Relay protocol supports three types of management: the ANSI Annex D management, CCITT (now known as UIT) and the Interim Local Management Interface (LMI). You can turn management on or off using the **LMI** and **NO LMI** configuration commands and selecting the entity or type of management with the **SET LMI-TYPE** command. Specifically, Frame Relay network management provides the following information:

- Notification of additional PVC's (orphans) and whether they are active or inactive, or notification of any PVC deletions.
- Notification of PVC status separate from a router's polled status request.
- Notification of flow control through the FECN and BECN bit settings.
- Notification of the availability of a configured PVC. The availability of a PVC is indirectly related to the successful participation of a PVC end-point in the *heartbeat polling* process, which is detailed in the 4.3 "Link Integrity Verification Report" section.
- Verification of the integrity of the physical link between the end station and network by using a *keep alive* sequence number interchange.
- Inclusion of CIR as part of the PVC status information.

Please note that you can disable management for back-to-back testing.

1.4.1 Management Status Reporting

Upon request, Frame Relay management provides two types of status reports: a full status report and a link integrity verification report. A full status report provides information about all the PVCs the interface knows about. A link integrity verification report verifies the connection between a specific end station and a network switch. All status inquiries and responses are sent over DLCI 0 for ANSI Annex D and CCITT (ITU) or DLCI 1023 for interim *Local Management Interface* (LMI) management.

1.4.2 Full Status Report

When the Frame Relay interface on the router requires a full status report, it sends a full status inquiry message to management requesting one. A status inquiry message is a request for the status of all the PVCs on the interface. In response to this request, Frame Relay management sends a full status report containing the link integrity verification element (discussed in the next section) and a PVC status information element for each PVC configured on the interface.

The PVC status information element contains the following information: the local DLCI number for the PVC; the state of the PVC (active or inactive); and whether the PVC is new or an existing PVC that management already knows about.

Note

The number of PVCs supplied at the Frame Relay interface is restricted by the network frame size and the amount of individual PVC information elements that can fit into a full status report. For example, 202 is the maximum number of PVCs for a network with a 1K frame size.

1.4.3 Link Integrity Verification Report

The link integrity verification report, sometimes referred to as *heartbeat polling*, contains the link integrity verification element.

This element is where the exchange of the send and receive sequence numbers takes place. By exchanging sequence numbers, management and the end station can evaluate the integrity of the synchronous link. The send sequence number is the current send sequence number of the message originator. The receiver looks at this number and compares it to the last send sequence number to verify that this number is incrementally correct. The receive sequence number is the last send sequence number that the originator sent out over the interface. It is the receiver's responsibility to place a copy of the send sequence number into the receive sequence number field. This way the originator can ensure that the receiver receives and interprets the frames correctly.

When an end station fails to participate in this polling process, all remote end-stations with logically attached PVCs are notified through management's full status report mechanism.

1.5 Frame Relay Network Data Rates

This section introduces data rates for Frame Relay permanent virtual circuits (PVCs).

1.5.1 Committed Information Rate (CIR)

Any PVC that is configured or learned is assigned a committed information rate (CIR) by the Frame Relay service provider. This is the data rate that the network commits to support for the PVC under normal conditions (i.e., when there is no network congestion). The CIR is a portion of the total bandwidth of the physical link of between 300 and 52428800 bps. A value of 64 Kbps for a single DS0 channel is most common. The CIR is defined through the **PVC** command.

1.5.2 Orphan Circuit CIR

When an orphan circuit is learned, the router assigns it a CIR of 64,000 bps. If you are relying on the orphan circuit to route important data, we recommend defining a PVC instead of an orphan circuit. Doing this, you can assign a CIR that the network commits to support.

1.5.3 Committed Burst Size

Committed data is the data the network commits to deliver under normal conditions (i.e., when there is no network congestion). The Committed Burst Size is the maximum amount of committed data (in bits) that the network commits to deliver on a PVC during a specified time period. This parameter is an expression of the CIR applied to a time period.

For example, if you set a PVC's CIR to 9,600 bps, and the committed burst size to 14,400 bits, the time period is 1.5 sec. (14,400 bits /9,600 bps = 1.5 sec.). This means that the PVC is allowed to transmit a maximum of 14,400 bits over a 1.5-second period.

This parameter is important because of the relationship between the committed burst size and the maximum frame size. If the maximum frame size in bits is greater than the committed burst size, the network may discard frames

whose size exceeds the committed burst size. Therefore, the committed burst size should be the same as, or greater than, the maximum frame size. It should also match the burst size set up with the network provider.

The default value for orphan circuits is 64,000 bits.

1.5.4 Excess Burst Size

For a brief period of time, the router can send more traffic than that specified by the committed burst size. The excess information (in bits) is the Excess Burst Size. The network delivers this excess data with a lower probability of success than committed burst size data. You could choose to have the network discard this excess data.

You should only set the excess burst size to a value greater than zero if you are willing to accept the risk of data being discarded and its effect on higher layer protocol performance. The excess burst size should be the same as the value set up with your network provider.

Use the **PVC** command during Frame Relay configuration to set the excess burst size. A default of 0 applies to orphan PVCs.

1.6 Circuit Congestion

Circuit congestion occurs either because the sender is transmitting faster than the allowable throughput, the receiver is processing frames to slowly, or an intermediate backbone link is congested. If circuit congestion occurs, the network must drop packets and/or shut down.

In response to circuit congestion, the router throttles down its transmission rate to less than 0.25 times the CIR. Throttle down occurs during the following conditions:

- Circuit congestion is occurring.
- The router is the sender of frames.
- CIR monitoring or congestion monitoring is enabled.

1.6.1 CIR Monitoring

CIR monitoring is an optional Frame Relay feature that you can set for each interface to prevent a PVC's information rate from exceeding its maximum value of committed burst size plus excess burst size.

The information rate is called the Variable Information Rate (VIR). Depending on network congestion, the VIR ranges from a minimum of 0.25 times the CIR to a maximum of committed burst size plus excess burst size.

To avoid overloading of the network, the router initially sets the VIR to CIR when the PVC becomes active.

The VIR can exceed the maximum value if the length of a frame in bits is greater than the committed plus excess burst sizes. In this case, Frame Relay transmits the frame irrespective of its size.

CIR monitoring is configured with the **CIR-MONITOR** configuration command and is disabled by default. When CIR monitoring is enabled, it overrides congestion monitoring.

1.6.2 Congestion Monitoring

Congestion monitoring is an optional feature, set per interface, that allows a PVC's VIR to vary in response to network congestion. The VIR assumes values between a minimum of 0.25 times the CIR and a maximum of line speed. Congestion monitoring is disabled by default. It can be enabled with the **CONGESTION-MONITOR** configuration command and disabled again with the **NO CONGESTION-MONITOR** command.

CIR monitoring, if enabled, overrides congestion monitoring (if, in turn, this is enabled). If both CIR monitoring and congestion monitoring are disabled, the VIR for each PVC on the interface is set to line speed and does not decrease in response to network congestion.

1.6.3 Congestion Notification and Avoidance

If congestion occurs, management is responsible for notifying the sender and receiver by sending out a *Forward Explicit Congestion Notification* (FECN) or a *Backward Explicit Congestion Notification* (BECN). The FECN and BECN are bits set in the frame to notify the receiver and sender, respectively, of congestion.

In the example in Figure 5, switch B has become congested. Management notifies the downstream or upstream node, depending on the direction of the transmission (switch C), and the end station (router) of the congestion by setting the FECN bit on all outgoing frames. Management must also notify switch A and the other end station of the con-

gestion by setting the BECN bit.

When the router receives a frame with the BECN bit set, and CIR monitoring or congestion monitoring is enabled, it takes action by throttling down the the PVC's Variable Information Rate (VIR). The router does this gradually while receiving a continuous sequence of frames with the BECN bit set until either the minimum VIR is reached or a frame is received with the BECN bit cleared. After a continuous sequence of frames with the BECN bit cleared, the VIR is gradually increased until it reaches its maximum value.

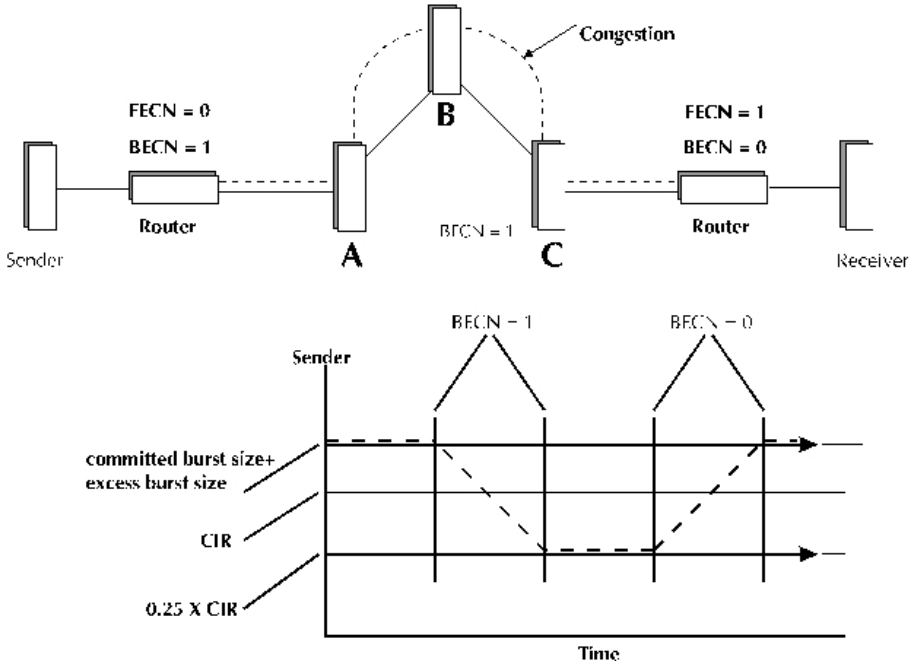

Fig. 5: **Congestion Notification and Throttle Down**

Note

If you have multiple DLCIs between two end-stations and congestion occurs, a second DLCI may be used to transmit data at a higher throughput until the congestion on the first DLCI subsides.

1.7 Frame Relay Interface Data Encryption

The Teldat router not only provides all the functions to connect and exchange traffic through Frame Relay networks, but also has the ability to encrypt the data field content of Frame Relay frames. This provides security for data transmitted in private communications across public networks, preventing staff and devices that lie outside that private network from reading the real content of the data transmitted.

All that is required in order to carry out an encrypted transmission between two terminal devices in a Frame Relay network is to configure the same encryption key on both devices.

Data encryption is not performed on the entire Frame Relay interface, but rather, it is associated with each circuit defined on the device. Thus, each circuit (PVC) can be configured to perform plain or encrypted data transmission, independently of how transmission is done on other circuits.

1.8 Frame Relay Interface Backup Features

Backing up Frame Relay links ensures data transmission when there is a problem with a router interface or network link.

The Teldat router offers two ways of backing up Frame Relay interfaces:

(1) Back up one PVC using another PVC (both from the same Frame Relay interface).

(2) Back up a Frame Relay interface using an ISDN interface.

The implementation of one backup method or the other depends on the severity of the problems that arise in frame relay communications.

The Frame Relay network generates Local Management Interface (LMI) messages containing status and configuration information about the PVCs available on a physical interface. Based on these messages, the router can determ-

ine the nature of the problem occurring in the network and switch to the backup type required to continue transmitting data.

A circuit's communications can go down at any time, either because the circuit has passed to an inactive state or been deleted by the network, with the consequence that the device would be unable to continue transmitting frames over that circuit. In order to ensure that the frames for that circuit (called the main circuit) can continue to be sent and received, it can be associated with another circuit (called a secondary or backup circuity) that can carry the main circuit's data in case it goes down. The only thing required to perform this type of backup is to activate the secondary circuit. This situation is where you would be performing a backup from PVC to PVC, which allows configuring pairs of PVCs, so that if the main PVC is disabled, the backup PVC can be used to maintain communications.

The second type of backup is reserved for adverse situations, which can basically be summarized into two kinds: first, if the two configured circuits (main and secondary) are both unavailable at a particular time (this is learned via LMI messages); and second, if the physical interface is down. In either case, it would be impossible to continue transmitting data over the circuits configured on this Frame Relay interface. The solution is to opt for an alternative backup network, which at the present time is the ISDN network.

To perform this type of backup, you will need to make sure you configure it correctly. We therefore recommend reading the the following manual: Teldat-Dm711-I “Frame Relay Backup Configuration over ISDN”.

1.9 Frame Relay Switching

This consists of switching packets between PVCs from different interfaces based on the DLCI. Frame Relay considers the DLCI to be the equivalent of a MAC address.

When configuring packet switching between DLCIs, the following applies:

- Switching cannot be configured between DLCIs that are on the same interface.
- Switching cannot be configured on point-to-point interfaces.
- Switching cannot be configured on a DLCI if it has a route assigned to it.

Chapter 2 Configuring Frame Relay Interfaces

2.1 Introduction

This chapter describes the Frame Relay configuration commands and includes the following sections:

- Adding a Frame Relay interface.
- Displaying the Frame Relay Configuration Prompt.
- Frame Relay Basic Configuration Procedure.
- Enabling Frame Relay Management.
- Frame Relay Configuration Commands.
- Frame Relay *Switching*.

For more information on Frame Relay, refer to Chapter 1 "The Frame Relay Interface".

2.2 Adding a Frame Relay Interface

There are two ways of adding a new Frame Relay interface. (The second is only valid for Frame Relay over serial interfaces).

- **Option 1:** Adding a Generic Frame Relay interface. In this case, carry out the following steps:

(1) Add the Frame Relay device. To do this, use the **ADD DEVICE FR <interface_id>** command from the main configuration menu:

```
*config


Config>add device fr X

Config>list devices

Interface            Connector     Type of interface
ethernet0/0          LAN1          Fast Ethernet interface
serial0/0            SERIAL0/WAN1  X25
serial0/1            SERIAL1/WAN2  X25
serial0/2            SERIAL2/WAN3  X25
bri0/0               BRI/ISDN1     ISDN Basic Rate Int
x25-node             ---           Router->Node
frX                  ---           Generic FR
Config>
```

(2) Associate a base interface with the Frame Relay interface. If you want the Frame Relay interface to be established over a serial line, then you need to have previously configured that serial line in the device you want to use as the synchronous interface (SYNC):

```
Config>set data-link sync serialX/X

Config>network frX


-- Generic FR User Configuration --
frX config>base-interface

-- Base Interface Configuration --
frX Base IFC config>base-interface serialX/X link
frX Base IFC config>
```

Alternatively, you could configure Frame Relay over an ISDN BRI:

```
Config>network frX


-- Generic FR User Configuration --
frX config>base-interface
```

```
-- Base Interface Configuration --
frX Base IFC config>base-interface briX/X <circuit_id> {link | profile <profile_name>}
frX Base IFC config>
```

To obtain further information on Generic FR interfaces, particularly on those configured over ISDN BRI, please see the the following manual: Teldat-Dm731-I, “Frame Relay over ISDN BRI”.

(3) If the interface is Frame Relay over BRI ISDN and the ISDN channels are switch (i.e., the link is established through calls), you also need to create a call profile to control the connection. The call profile contains data on, for example, permitted call types, outgoing call destinations, permitted incoming calls, idle-time length and so forth. For further information, please see the following manual: Teldat-Dm731-I “Call Profiles”.

- **Option 2:** Set one of the device's serial interfaces as a Frame Relay interface. To do this, simply enter the **SET DATA-LINK FRAME-RELAY <interface_name>** command in the main configuration menu:

```
Config>set data-link frame-relay serialX/X

Config>
```

Obviously, this method of adding Frame Relay interfaces is only valid when the interfaces run over a serial line. If you want to configure a Frame Relay interface over ISDN BRI, you must carry out the steps given in the previous option (Generic FR interfaces).

Example:

```
*config



Config>set data-link frame-relay serial0/0
Config>list devices

Interface            Connector     Type of interface
ethernet0/0          LAN1          Fast Ethernet interface
serial0/0            SERIAL0/WAN1  Frame Relay
serial0/1            SERIAL1/WAN2  X25
serial0/2            SERIAL2/WAN3  X25
bri0/0               BRI/ISDN1     ISDN Basic Rate Int
x25-node             ---           Router->Node
Config>
```

2.2.1 Adding Frame Relay subinterfaces

With this command you can group one or more Frame Relay circuits under separate subinterfaces, allowing you to manage them separately from the other circuits on a link. This can be useful, for example, to assign different circuits to different VRFs.

Some commands (e.g., those used to define the LMI process) are not available in a Frame Relay subinterface, and can only be configured in the base interface.

The Frame Relay subinterfaces are created in generic Frame Relay interfaces through the ADD DEVICE FR-SUBINTERFACE <generic Frame Relay interface> <subinterface identifier> configuration command.

Example:

```
Config>add device fr-subinterface fr1 16

Config>list devices

Interface            Connector     Type of interface
ethernet0/0          GE0/FE0/LAN1  GigabitEthernet interface
ethernet0/1          GE1/FE1/LAN2  GigabitEthernet interface
ethernet0/2          EXP/SWITCH    GigabitEthernet Switch interface
x25-node             ---           Router->Node
fr1                  ---           Generic FR

fr1.16 --- FR subinterface

loopback1            ---           Loopback
Config>
```

2.3 Displaying the Frame Relay configuration prompt

To access the Frame Relay configuration environment, do the following:

(1) At the GESTCON prompt (*), type **PROCESS 4** (or **P 4**), or **CONFIG**.

(2) At the configuration prompt (Config>), type **NETWORK <interface_name>**, where **interface_name** is the name of the interface over which you want to run Frame Relay.

(3) To configure specific Frame Relay parameters, simply use the commands described in this chapter. These can be found in the Frame Relay configuration menu. This menu is accessed differently depending on the type of interface configured:

a) If it is a *Generic FR* interface, once in the interface configuration, enter the **FR** command to enter the menu corresponding to the specific Frame Relay parameters.

```
*config


Config>network frX


-- Generic FR User Configuration --
frX config>?
  base-interface    Access the base interface configuration menu
  bfd               Interface Bidirectional Forwarding Detection config
                    commands
  description       Enter interface description
  fr                Takes you to the Frame Relay configuration prompt
  ip                Interface Internet Protocol config commands
  ipv6              Interface Internet Protocol version 6 config commands
  load-interval     Specify interval for load calculation for an interface
  no                Negate a command or set its defaults
  service-policy    Configure QoS Service Policy
  shutdown          Change state to administratively down
  update            Update a level indicator
  exit
frX config>fr

-- Frame Relay user configuration --
frX FR config>
```

Command history:

Release	Modification
11.00.03, 11.00.01.01.02	This command has been changed to include the *ipv6* option. The IPv6 protocol is supported on Frame Relay.

b) In the case of an FR interface over a serial line added through the **SET DATA-LINK FRAME-RELAY <interface_name>** command, accessing the interface configuration menu (previous step) takes you directly to the Frame Relay configuration page. At this level, you may use all the commands described in section 6 of this chapter.

```
*config


Config>network serialX/X


-- Frame Relay user configuration --
serialX/X FR config>
```

c) In the case of FR subinterfaces, accessing the interface configuration menu (previous step) takes you straight to the Frame Relay configuration page. At this level, you may use all the commands described in section 6 of this chapter.

```
*config


Config>network frX.Y


-- Frame Relay user configuration --
frX.Y FR config>
```

2.4 Frame Relay Basic Configuration Procedure

This section describes the minimum configuration steps required to get the Frame Relay protocol up and running. This process includes selecting the type of Frame Relay management to use, adding a Permanent Virtual Circuit (PVC) and establishing the addressing or association between IP or IPv6 addresses and DLCIs. For more information on configuring Frame Relay, refer to the configuration commands described in section 6 of this chapter.

- **Selecting Frame Relay management.** The default Frame Relay Local Management Interface is CCITT, but your other options are LMI-Rev.1 management, ANSI Annex D management, or CCITT management. Use the **LMI** and **SET LMI-TYPE** commands to enable and set the required management.
- **Adding a PVC.** Any required permanent virtual circuits (PVCs) must be added when Frame Relay management or orphan circuits are disabled. Use the **PVC** command for this.
- **Configuring Frame Relay destination addresses.** When you are running a communications protocol such as the Internet Protocol (IP), or Internet Protocol version 6 (IPv6), over the Frame Relay interface and you need to interconnect with devices that do not support the Address Resolution Protocol (ARP) on Frame Relay (for IP), or Neighbor Discovery Protocol (ND) on Frame Relay (for IPv6), then you can use the **PROTOCOL-ADDRESS** command to add a static protocol address and associate it with the circuit (DLCI) through which you can reach the device corresponding to this address.

2.5 Enabling Frame Relay Management

There are three different Frame Relay management options: Local Management Interface (LMI) Revision 1, ANSI Annex D, and CCITT. Frame Relay defaults to CCITT. To change to a different management type, or resume CCITT after disabling it, use the two-part procedure described below:

(1) Enter the **LMI** command at the <interface_name> FR config> prompt to enable all management activity (default is enabled).

(2) Enter the **SET LMI-TYPE** command to select the type of management for the interface. Refer to the following table for details of the management types available.

The options available under the **SET LMI-TYPE** command, which establishes the type of Frame Relay management, are listed below. An example of how to set these management modes is shown below the table. Also, refer to the **LMI** and **SET LMI-TYPE** command sections in this chapter for more information.

Command	Options	Description	Default value
SET	LMI-TYPE REV1	Conforms to LMI Revision 1 (Stratacom's Frame Relay Interface Specification)	N/A
	LMI-TYPE ANSI	Conforms to ANSI T1.617USDN-DSS1-Signaling Specification for Frame Relay Bearer Service (known as Annex D)	N/A
	LMI-TYPE CCITT	Conforms to Annex A of ITU (former CCITT) Recommendation Q.933 - DSS1 (Signaling Specification for Frame Mode Basic Call Control)	Enabled

Example:

```
<interface_name> FR config>lmi
<interface_name> FR config>
```

```
<interface_name> FR config>set lmi-type ansi
<interface_name> FR config>
```

2.6 Frame Relay Configuration Commands

This section summarizes and then explains the Frame Relay configuration commands. All these commands must be entered from the Frame Relay configuration menu itself (from the <interface_name> FR config> prompt).

Certain commands are common for all the device's interfaces and are described in the following manual: Teldat-Dm 772-I "Common Configurations for Interfaces".

You must save the configuration and restart the router for new configuration changes to take effect.

Command	Function
? (HELP)	Lists the available commands or their options.
BFD	Configures Bidirectional Forwarding Detection protocol options.
BIT-DISCARD-PROTOCOL	All frames (in the enabled protocol) are transmitted with the DE bit set to one.
BROADCAST	Allows the interface to send out broadcast packets.
CIR-MONITOR	Enables circuit monitoring at a preset transmission rate.
CONGESTION-MONITOR	Enables congestion monitoring.
INVERT-TXC	Inverts the transmission clock (only in FR interfaces over a serial line).
LIST	Shows the current LMI and PVC configurations, the HDLC information, the protocol addresses, the encryption information (if any), and the configuration of the backup, compression, fragmentation, protocol discard bit and Inverse ARP.
LMI	Enables management activity (except in FR subinterfaces).
MULTICAST-EMULATION	Multicast diffusion emulation option in this interface.
NO	Deletes previously added PVCs or protocol addresses, or disables the sending of the protocol discard bit (DE), *broadcast* transmission, *multicast* emulation, local management, CIR monitoring, overflow monitoring, behavior as BIR, use of orphan circuits or interface behaving as point-to-point. In the case of FR over serial line interfaces (not *Generic FR*), you can also disable transmission clock inversion.
ORPHAN- CIRCUITS	Allows orphan circuits (except in FR subinterfaces).
POINT-TO-POINT-LINE	Enables the interface to behave as point-to-point.
PROTOCOL-ADDRESS	Adds protocol destination static addresses to the Frame Relay interface for a PVC.
PVC	Configures a PVC to the Frame Relay interface above the default circuits (15).
SERVICE-POLICY	Applies a Policy-map to the interface.
SET	Configures the properties associated with Frame Relay parameters: the frame size, line-speed, n1, n2 and n3 parameters, p1 and t1 parameters. It also configures the Frame Relay management options, the encryption keys, the inverse ARP, the backup return time, the variable-rate hop size for delivered information (when it encounters congestion and overflow monitoring is enabled) and the physical layer parameters of the serial interface (only in the case of FR over serial line interfaces).
EXIT	Exits the specific Frame Relay configuration menu.

Note

In this section, the terms "circuit number" and "PVC" are synonymous with the term "Data Link Circuit Identifier (DLCI)".

2.6.1 ? (HELP)

Lists available commands or lists the command's options.

Syntax:

```
<interface_name> FR config>?
```

Example 1:

```
frX FR config>?
  bfd                     Interface Bidirectional Forwarding Detection config
                          commands
  bit-discard-protocol    Frames in the enabled prot are marked with DE bit
  broadcast               Interface capable of transmitting broadcast packets
  cir-monitor             Enable the circuit monitor feature
  congestion-monitor      Circuit's CIR rate vary in response to congestion
  list                    List the configuration of the interface
  lmi                     Enable management activity
  multicast-emulation     Multicast emulation option in this interface
  no                      Negate a command or set its defaults
  orphan-circuits         Use of all non configured orphan circuits
  point-to-point-line     Interface acting as a point-to-point line
  protocol-address        Static configured destination protocol addresses
  pvc                     PVC to the Frame Relay interface
  service-policy          Configure QoS Service Policy
  set                     Configure interface parameters
  exit
frX FR config>
```

Example 2:

```
serialX/X FR config>?
  bfd                     Interface Bidirectional Forwarding Detection config
                          commands
  bit-discard-protocol    Frames in the enabled prot are marked with DE bit
  broadcast               Interface capable of transmitting broadcast packets
  cir-monitor             Enable the circuit monitor feature
  congestion-monitor      Circuit's CIR rate vary in response to congestion
  description             Enter interface description
  invert-txc              Invert transmit clock
  ip                      Interface Internet Protocol config commands
  ipv6                    Interface Internet Protocol version 6 config commands
  list                    List the configuration of the interface
  lmi                     Enable management activity
  mtu                     Set the interface maximum transmit unit
  multicast-emulation     Multicast emulation option in this interface
  no                      Negate a command or set its defaults
  orphan-circuits         Use of all non configured orphan circuits
  point-to-point-line     Interface acting as a point-to-point line
  protocol-address        Static configured destination protocol addresses
  pvc                     PVC to the Frame Relay interface
  service-policy          Configure QoS Service Policy
  set                     Configure interface parameters
  shutdown                Change state to administratively down
  update                  Update a level indicator
  exit
serialX/X FR config>
```

Example 3:

```
frX.Y FR config>?
  bfd                     Interface Bidirectional Forwarding Detection config
                          commands
  bit-discard-protocol    Frames in the enabled prot are marked with DE bit
  broadcast               Interface capable of transmitting broadcast packets
  cir-monitor             Enable the circuit monitor feature
  congestion-monitor      Circuit's CIR rate vary in response to congestion
  description             Enter interface description
```

```
  ip                      Interface Internet Protocol config commands
  ipv6                    Interface Internet Protocol version 6 config commands
  list                    List the configuration of the interface
  multicast-emulation     Multicast emulation option in this interface
  no                      Negate a command or set its defaults
  point-to-point-line     Interface acting as a point-to-point line
  protocol-address        Static configured destination protocol addresses
  pvc                     PVC to the Frame Relay interface
  service-policy          Configure QoS Service Policy
  set                     Configure interface parameters
  shutdown                Change state to administratively down
  update                  Update a level indicator
  exit
frX.Y FR config>
```

Command history:

Release	Modification
11.00.03, 11.00.01.01.02	This command has been changed to include the *ipv6* option. The IPv6 protocol is supported on Frame Relay.

2.6.2 BIT-DISCARD-PROTOCOL

If this option is disabled, all frames (in the enabled protocol) are transmitted with the DE bit set to one. This allows the network to preferentially discard low-priority frames when necessary. This option is disabled by default.

Syntax:

```
<interface_name> FR config>bit-discard-protocol <protocol_name>
```

where **protocol_name** is the protocol name where the protocol discard bit is enabled. All frames with packets containing this protocol leave with the DE bit set to one.

Example:

```
<interface_name> FR config>bit-discard-protocol ?
  arp     Access ARP protocol
  asrt    Access ASRT protocol
  bfd     Access BDF protocol
  bgp     Access BGP protocol
  dep     Access DEP protocol
  dhcp    Access DHCP protocol
  dhcpv6  Access DHCPv6 protocol
  dls     Access DLS protocol
  dot1x   Access 802.1X protocol
  gw104   Access GW-104 protocol
  nhrp    Access NHRP protocol
  h323    Access H323 protocol
  igmp    Access IGMP protocol
  ip      Access IP protocol
  ipv6    Access IPv6 protocol
  l2tp    Access L2TP protocol
  mgcp    Access MGCP protocol
  msdp    Access MSDP protocol
  noe     Access NOE protocol
  ospf    Access OSPF protocol
  ospfv3  Access OSPFv3 protocol
  pim     Access PIM protocol
  rip     Access RIP protocol
  ripng   Access RIPNG protocol
  sccp    Access SCCP protocol
  sip     Access SIP protocol
  snmp    Access SNMP protocol
<interface_name> FR config>bit-discard-protocol snmp
<interface_name> FR config>
```

Command history:

Release	Modification
10.08.38, 10.09.04, 11.00.00	This command has been changed to include the *igmp* and *pim* options.
10.08.40, 10.08.38.01.05, 10.09.08, 10.09.05.01.03	This command has been changed to include the *msdp* option.
11.00.01	This command has been changed to include the *msdp*, *ripng* and *ospfv3* options.
11.00.02, 11.00.01.01.01	This command has been changed to obsolete the *dep* option. The DEP protocol is no longer supported.
11.00.03, 11.00.01.01.02	This command has been changed to include the *dhcpv6* option.

2.6.3 BROADCAST

Marks this interface as capable of transmitting broadcast packets. Both this and the **MULTICAST-EMULATION** option must be enabled in order to transmit broadcast packets. If the latter of these two options is disabled, broadcast packets can arrive from higher level entities, but they are discarded at the interface. If the **MULTICAST-EMULATION** option is enabled but the **BROADCAST** option is not, the higher level entity does not forward the broadcast packets to the interface.

Example:

```
<interface_name> FR config>broadcast
<interface_name> FR config>
```

2.6.4 CIR-MONITOR

Enables the CIR monitoring feature that enforces the transmission rate that was previously configured using the **PVC** command. For further details on the CIR monitoring operation, please see the section *CIR Monitoring* on page 8 in this manual. The default is disabled.

Example:

```
<interface_name> FR config>cir-monitor
<interface_name> FR config>
```

2.6.5 CONGESTION-MONITOR

Enables congestion monitoring. This option allows the information transfer rate to vary between 0.25 times the CIR and the line speed in response to network congestion. Please see the section *Congestion Monitoring* on page 8 in this manual for more information on how this type of monitoring works. The default is disabled

Example:

```
<interface_name> FR config>congestion-monitor
<interface_name> FR config>
```

2.6.6 INVERT-TXC

Inverts the transmission clock. This command is only valid (within the FR menu itself) on Frame Relay interfaces that run over a serial line directly created over one of the device serial lines through the **SET DATA-LINK FRAME-RELAY** <**interface_name**> command: it is not applicable on *Generic FR* interfaces or FR subinterfaces, as these types of line parameters are generally configured in the base interface (if necessary).

Example:

```
serialX/X FR config>invert-txc
serialX/X FR config>
```

2.6.7 LIST

This command displays the selected management mode, information about the PVCs, the HDLC parameters, the protocol addresses, information about the encryption (if any), compression and fragmentation, the configuration of the backup, protocol discard bit and inverse ARP.

Syntax:

```
<interface_name> FR config>list ?
  all                     Display circuit, management, and PVCs statistics
  back-up                 Display backup information
  bit-discard-protocol    Display discard bit configuration
  circuits                Display layer stats and configuration for configured
                          PVCs
  compression             Display compression configuration
  encryption              Display cyphering configuration
  flow-configuration      List packet flow parameters
  fragmentation-frf12     Display FRF12 configuration
  hdlc                    Display HDLC configuration
  inverse-arp             Display inverse-arp configuration
  lmi                     Display statistics relative to the management entity
  protocol-addresses      Display interface protocol addresses information
  return-time-back-up     Display backup return time configuration
```

Command history:

Release	Modification
11.00.02, 11.00.01.01.01	This command has been changed to obsolete the *encryption* option. Encryption is no longer supported.

2.6.7.1 LIST ALL

This command displays all information for all parameters displayed with the rest of the commands within the **LIST** command.

Example:

```
serialX/X FR config>list all

                   Frame Relay HDLC Configuration


   Encoding               =     NRZ   IDLE                    = Flag
   Clocking               = External
   Interface Direction    =     DTE
   Line access rate bps   =   64000   Interface MTU in bytes   = 2048
   Transmit delay         =       0
   Invert TxClock         = No


                   Frame Relay LMI Configuration


   Back Up like BIR     =   No               Dial FR             =   No
   Point to point line  =   No               Point to point DLCI =    0

   LMI enabled          =  Yes               LMI DLCI            =    0
   LMI type             =  CCITT             LMI Orphans OK      =  Yes

   Protocol broadcast   =  Yes        Congestion monitoring   =  Yes
   Emulate multicast    =  Yes        CIR monitoring          =  Yes

   PVCs P1 allowed         =   64     CIR monitor adjustment   =    1
   Timer T1 seconds        =   10     Counter N1 increments    =    6
   LMI N2 error threshold  =    3     LMI N3 error window      =    4
   IR % Increment          =   12     IR % Decrement           =   25
   MIR % of CIR            =    5

  Maximum PVCs allowed  =   64
  Total PVCs configured =    2

         Circuit           Circuit  Circuit    CIR     Burst   Excess
         Name              Number    Type     in bps   Size    Burst  Encrypt
  ------------------------ -------- ---------- ------- ------- ------- -------
```

```
  Unassigned                   16   Permanent     1200    1200   56000    No
Inverse ARP: default                Encapsulation: IETF
  Unassigned                   17   Permanent     1200    1200   56000    No
Inverse ARP: off                    Encapsulation: IETF

               Frame Relay Protocol Address Translations

Protocol Type           Protocol Address             Circuit Number
 -------------           ----------------             --------------
       IP                     172.16.4.1                   16

   Circuit = 8                            Output =    5


  Maximum PVCs allowed  =   64
  Total PVCs configured =    2

       Name                Circuit   Circ.   Circ.    Back-ISDN Encrypt
      Circuit               Main    Back-FR Back-ISDN  always   Back-ISDN
  ------------------------ --------- ------- --------- --------- ---------
  Unassigned                   16       17        20     Yes        No
  Unassigned                   17        0         0      No        No
PVC Back-Up return time not set


DLCI COMPRESSION    MEMORY         CONTROL
---- -----------    -------        -------
16   adaptive       pkt-by-pkt     owner
16   CRTP           with-udp-checksum
17   NOT_COMPRESSION ****           ****

Encrypt Card not available

DLCI   FRAGMENTATION   SIZE
  16      enabled       256
  17     disabled

Inverse ARP: default
Inverse ARP Default Value: on
serialX/X FR config>
```

Command history:

Release	Modification
11.00.02, 11.00.01.01.01	The command output has been changed to delete encryption information.

2.6.7.2 LIST BACKUP

This command displays information about the Frame Relay interface's configured PVCs and associated backup circuits.

Example:

```
<interface_name> FR config>list back-up

  Maximum PVCs allowed  =   64
  Total PVCs configured =    2

       Name                Circuit   Circ.   Circ.    Back-ISDN Encrypt
      Circuit               Main    Back-FR Back-ISDN  always   Back-ISDN
  ------------------------ --------- ------- --------- --------- ---------
  c16                          16       17        20     Yes       Yes
  c17                          17        0         0      No        No
<interface_name> FR config>
```

Maximum PVCs allowed	This is the maximum number of PVCs that can be added to the interface. This number includes PVCs added with the **PVC** command and those learned dynamically through the management interface.

Total PVCs configured	This is the actual number of PVCs configured on the interface.
Name Circuit	Indicates the ASCII name of the configured PVC.
Circuit Main	Indicates the identifier of a main PVC.
Circ. Back-FR	Indicates the identifier of the main circuit's backup PVC. If this value is zero, it means that the main circuit doesn't have a backup PVC configured.
Circ. Back-ISDN	Indicates the identifier of the main circuit's ISDN backup interface. If this value is zero, it means that the main circuit does not have an associated ISDN backup circuit.
Back-ISDN always	If this option is configured, it means that whenever the two Frame Relay circuits (main and secondary) are inactive, transmitting is switched to the ISDN backup circuit. If this option is not configured, data is only transmitted across the ISDN circuit if the interface drops.
Encrypt Back-ISDN	This is the data transmission mode being applied to the ISDN backup circuit: clear (*No*) or encrypted (*Yes*).

2.6.7.3 LIST BIT-DISCARD-PROTOCOL

This command shows whether the protocol discard bit is enabled or disabled in each protocol. If it is enabled for a particular protocol, it means that that protocol's frames are transmitted with the discard bit set to one. The network can reject data that exceeds a PVC's CIR. Configuring the discard bit tells the network which protocols carry lower-priority traffic so that the traffic from those protocols can be discarded if necessary.

Example:

```
<interface_name> FR config>list bit-discard-protocol

                Protocol Name              Discard Eligib. Bit
          -------------------------       ----------------------
                  IP                                  No
                  IP6                                 No
                  ARP                                 No
                  H323                                No
                  DHCP                                No
                  MGCP                                No
                  BGP                                 No
                  SNMP                               Yes
                  OSPF                                No
                  RIP                                 No
                  SIP                                 No
                  ASRT                                No
                  NHRP                                No
                  DLS                                 No
                  PPPoE                               No
                  L2TP                                No
                  dot1X                               No
                  Preauth                             No
                  NOE                                 No
                  BFD                                 No
                  SCCP                                No
                  GW104                               No
                  RPNG                                No
                  PIM                                 No
                  IGMP                                No
                  OSPFv3                              No
                  MSDP                                No
     DHCPv6                             No

<interface_name> FR config>
```

Command history:

Release	Modification
10.08.38, 10.09.04, 11.00.00	The command output has been changed to display IGMP and PIM protocol information.
11.00.00	The command output has been changed to display IPv6 protocol information.
10.08.40, 10.08.38.01.05, 10.09.08, 10.09.05.01.03	The command output has been changed to display MSDP protocol information.
11.00.01	The command output has been changed to display MSDP, RIPng and OPSFv3 protocol information.
11.00.03, 11.00.01.01.02	The command output has been changed to display DHCPv6 protocol information.

2.6.7.4 LIST CIRCUITS

This command displays information about all PVCs configured on the Frame Relay interface.

Example:

```
<interface_name> FR config>list circuits

  Maximum PVCs allowed  =   64
  Total PVCs configured =    2

         Circuit           Circuit  Circuit    CIR     Burst   Excess
         Name              Number    Type     in bps   Size    Burst  Encrypt
  ------------------------ -------- ---------- ------- ------- ------- -------
  Unassigned                   16   Permanent     1200    1200   56000    No
Inverse ARP: default                Encapsulation: IETF
  Unassigned                   17   Permanent     1200    1200   56000    No
Inverse ARP: off                    Encapsulation: IETF
<interface_name> FR config>
```

Maximum PVCs allowed	This is the maximum number of PVCs that can be added to the interface. This number includes PVCs added with the **PVC** command and those dynamically learned through the management interface.
Total PVCs configured	This is the actual number of PVCs configured on the interface.
Circuit name	Indicates the ASCII name of the configured PVC.
Circuit number	Indicates the identifier of a configured PVC.
Circuit type	This is the type of virtual circuit currently configured. This version of Frame Relay only supports permanent virtual circuits (PVC).
CIR in bps	Indicates the information rate that the network commits to deliver data under normal conditions.
Committed Burst Size (Burst Size)	Indicates the maximum amount of data (in bits) that the network commits to transmit during a time period equal to (Committed Burst Size/CIR) seconds.
Excess Burst Size (Excess Burst)	Indicates the maximum amount of uncommitted data (in bits) in excess of the Committed Burst Size that the network attempts to deliver during a time period equal to (Committed Burst Size/CIR) seconds.
Encrypt	Indicates whether the Frame Relay frame data field is clear or encrypted.
Inverse ARP	Allows you to define whether you want to enable or disable the Inverse ARP protocol in each circuit. If not specified, the *default* value is taken (i.e., the *Inverse ARP Default Value* is adopted). Orphan circuits always take the configured Inverse *ARP Default Value*.
Encapsulation	Displays the type of encapsulation: IETF or compatible.

2.6.7.5 LIST COMPRESSION

Displays the compression options enabled for each circuit:

- Data compression: **ADAPTATIVE (LZS)** or **PREDICTOR**, **CONTINUOUS** or **PKT-BY-PKT** and **OWNER** or **COMPATIBLE**.

ADAPTIVE (LZS)	CONTINUOUS	OWNER
		COMPATIBLE
	PKT-BY-PKT	OWNER
		COMPATIBLE
PREDICTOR	CONTINUOUS	

- Voice over IP compression: **CRTP**, **WITH-UDP-CHECKSUM** or **WITHOUT-UDP-CHECKSUM**.

Example:

```
<interface_name> FR config>list compression

DLCI COMPRESSION    MEMORY         CONTROL
---- -----------    -------        -------
16   adaptive       pkt-by-pkt     owner
16   CRTP           with-udp-checksum
17   NOT_COMPRESSION ****           ****
<interface_name> FR config>
```

DLCI	Indicates the DLCI corresponding to the PVC in which data compression is applied.
COMPRESSION	Indicates the type of compression algorithm to be applied. This can be ADAPTIVE or PREDICTOR.
MEMORY	This allows you to choose the data set used in calculating the necessary dictionary symbols for compression. If the compression is CONTINUOUS, the algorithm takes into account all data from previously received frames from the point where the connection was started. With PKT-BY-PKT compression, the dictionary is recalculated with every packet - making for a less efficient but faster compression.
CONTROL	This allows you to choose between Cisco COMPATIBLE or PROPRIETOR compression.

2.6.7.6 LIST ENCRYPTION

Displays cyphering information.

Command history:

Release	Modification
11.00.02, 11.00.01.01.01	This command is obsolete. Encryption is no longer supported.

2.6.7.7 LIST FLOW-CONFIGURATION

Displays flow control parameters. These parameters must only be modified by Teldat technical personnel. Inappropriate use can seriously impact device performance.

```
<interface_name> FR config>list flow-configuration

   Circuit = 8                          Output =    5


<interface_name> FR config>
```

2.6.7.8 LIST FRAGMENTATION FRF12

Shows whether FRF.12 fragmentation is enabled for each circuit.

Example:

```
<interface_name> FR config>list fragmentation-frf12

DLCI   FRAGMENTATION   SIZE
  16      enabled       256
  17     disabled

<interface_name> FR config>
```

2.6.7.9 LIST HDLC

Displays Frame Relay High-level Data Link Control (HDLC) configuration. In the case of *Generic FR* interfaces, many of these parameters are irrelevant and consequently do not appear in the list.

Example 1:

```
serialX/X FR config>list hdlc

                   Frame Relay HDLC Configuration


   Encoding               =     NRZ   IDLE                    = Flag
   Clocking               = External
   Interface Direction    =     DTE
   Line access rate bps   = 2048000   Interface MTU in bytes   = 2048
   Transmit delay         =       0
   Invert TxClock         = Yes

serialX/X FR config>
```

Example 2:

```
frX FR config>list hdlc

                   Frame Relay HDLC Configuration


   Line access rate bps   =   64000   Interface MTU in bytes   = 2048

frX FR config>
```

Encoding	Indicates the encoding type: NRZ or NRZI.
IDLE	This is the idle type configured: flag or mark.
Clocking	Indicates the clocking type used: external or internal.
Interface Direction	Shows the device working mode: DCE or DTE.
Line access rate bps	Indicates the physical rate for the Frame Relay interface.
Interface MTU in bytes	This is the maximum transmission unit (amount of user data per frame) that can be transmitted or received over the network at any given time.
Transmit delay	This is the delay configured between transmitted packets.
Invert TxClock	Indicates if the transmission clock is inverted or not.

2.6.7.10 LIST INVERSE-ARP

Displays the Inverse ARP protocol configuration by interface. If you want to, you also have the option of choosing your own Inverse ARP protocol configuration in each circuit.

Example:

```
<interface_name> FR config>list inverse-arp
Inverse ARP: default
Inverse ARP Default Value: on
```

```
<interface_name> FR config>
```

2.6.7.11 LIST LMI

Displays Frame Relay interface management information.

Example:

```
<interface_name> FR config>list lmi

                  Frame Relay LMI Configuration


   Back Up like BIR     =   No               Dial FR             =   No
   Point to point line  =   No               Point to point DLCI =    0

   LMI enabled          =  Yes               LMI DLCI            =    0
   LMI type             =  CCITT             LMI Orphans OK      =  Yes

   Protocol broadcast   =  Yes        Congestion monitoring   =  Yes
   Emulate multicast    =  Yes        CIR monitoring          =  Yes

   PVCs P1 allowed         =   64     CIR monitor adjustment   =    1
   Timer T1 seconds        =   10     Counter N1 increments    =    6
   LMI N2 error threshold  =    3     LMI N3 error window      =    4
   IR % Increment          =   12     IR % Decrement           =   25
   MIR % of CIR            =    5
<interface_name> FR config>
```

Back Up like BIR	Indicates whether the option for the device to act as BIR is enabled.
Dial FR	Indicates whether the interface behaves as a switched Frame Relay line (e.g., Frame Relay over an ISDN basic access).
Point to point line	Indicates whether the option for the interface to act as a point-to-point line is enabled (routing all traffic via the configured DLCI).
Point to point DLCI	All traffic output is via the DLCI when the option for the interface to act as a point-to-point line is enabled.
LMI enabled	Indicates whether the Frame Relay interface management option is enabled.
LMI DLCI	This is the management circuit number. This number reflects the LMI type, 0 for ANSI and UIT (CCITT) or 1023 for Rev. 1.
LMI type	This is the LMI type, either Rev. 1, ANSI or UIT (CCITT).
LMI Orphans OK	Indicates whether non-configured circuits are available for use.
Protocol broadcast	Indicates whether protocols such as RIP can function over the Frame Relay interface, because the transmit broadcast packets capability has been enabled on the interface. Please remember to enable the *Emulate multicast* option to allow the transmission to take place.
Emulate multicast	Indicates whether multicast emulation is enabled.
Congestion monitoring	Indicates whether the congestion monitoring feature is enabled, thereby allowing the circuit information rate to vary in response to network congestion.
CIR monitoring	Indicates whether the circuit monitoring feature, which imposes a particular transmission rate, is enabled.
PVCs P1 allowed	This is the maximum number of PVCs that can be used with this Frame Relay interface.
CIR monitor adjustment	This is the maximum burst transmission speed allowed over a PVC when CIR monitoring is enabled. The range is 1 to 100. The maximum burst transmission

	speed is the configured CIR value times the CIR monitor adjustment value. PVCs with a specified Committed Burst Size ignore this value.
Timer T1 seconds	Indicates the frequency with which the Frame Relay interface performs a sequence number exchange with the management entity.
Counter N1 increments	Indicates the time (in seconds) that must expire before the Frame Relay interface requests a complete PVC status report from management.
LMI N2 error threshold	This is the number of management event errors occurring in an N3 window that will cause a reset of the Frame Relay interface.
LMI N3 error window	Indicates the number of monitored events used to measure the N2 error threshold.
IR% Increment	When congestion monitoring is enabled, this indicates the percentage of the CIR by which the Variable Information Rate (VIR) should increase when congestion ends.
IR% Decrement	When congestion monitoring is enabled, this indicates the percentage of the CIR by which the VIR should be decreased when congestion is encountered.
MIR% of CIR	Indicates the minimum VIR when congestion levels remain high for a long time.

2.6.7.12 LIST PROTOCOL-ADDRESSES

Displays information relating to the configured protocol addresses.

Example:

```
<interface_name> FR config>list protocol-addresses

               Frame Relay Protocol Address Translations

 Protocol Type           Protocol Address            Circuit Number
 -------------           ----------------            --------------
       IP                    172.16.4.1                   16
       IPv6                  2001:db8::1                  16


<interface_name> FR config>
```

Protocol Type	Indicates the name of the protocol running over the interface.
Protocol Address	Indicates the protocol remote address associated with a particular circuit.
Circuit Number	This is the identifier of the PVC that is handling the protocol and through which the given protocol address is reached.

Command history:

Release	Modification
11.00.03, 11.00.01.01.02	The command output has been changed to display IPv6 protocol address information.

2.6.7.13 LIST RETURN-TIME-BACK-UP

Displays information about the configured time interval that must expire before routing reverts to the main PVC from the backup PVC.

Example:

```
<interface_name> FR config>list return-time-back-up

PVC Back-Up return time:
        Hour: 17
        Minute: 53
PVC BACK UP return:            ENABLED
```

```
<interface_name> FR config>
```

Hour	Indicates the hour at which routing will revert from the backup PVC.
Minute	Indicates the minute at which routing will revert from the backup PVC.
PVC BACK UP return	Indicates whether the option to revert from the backup PVC at a specified time is enabled.

2.6.8 LMI

Enables management activity. All circuits that were statically added are marked as present and active from the network perspective. After issuing the **LMI** command, use the **SET** command to select the management mode for your Frame Relay interface. Refer to section 4 “Frame Relay Network Management” found in Chapter 1 or the **SET** command section for more information. The system defaults to CCITT.

Use the **LMI** command to enable the management if you have previously disabled it.

Example:

```
<interface_name> FR config>lmi
<interface_name> FR config>
```

2.6.9 MTU <value>

Sets the size of the network frames received and transmitted over the link. Data link and MAC layer headers are not included. The default value for all interfaces is 2048.

Example:

```
<interface_name> FR config>mtu ?
  <5..8189>    Parameter Circuit
<interface_name> FR config>mtu 2000
<interface_name> FR config>
```

2.6.10 MULTICAST-EMULATION

This enables the multicast emulation option in this interface. All broadcast or multicast packets that reach this interface are transmitted via all active circuits. This option is enabled by default.

Example:

```
<interface_name> FR config>multicast-emulation
<interface_name> FR config>
```

2.6.11 NO

Deletes any PVC or protocol address previously added using the **PVC** or **PROTOCOL-ADDRESS** commands; or disables the sending of the protocol discard bit (DE), *broadcast* transmission, *multicast* emulation, local management (LMI), CIR monitoring, overflow monitoring, behavior as BIR, use of orphan circuits or behavior of the interface as point-to-point. In the case of FR over serial line interfaces (not *Generic FR*), you can also disable transmission clock inversion.

Syntax:

```
serialX/X FR config>no ?
  bfd                     Interface Bidirectional Forwarding Detection config
                          commands
  bit-discard-protocol    Frames in the enabled prot are marked with DE bit
  broadcast               Interface capable of transmitting broadcast packets
  cir-monitor             Enable the circuit monitor feature
  congestion-monitor      Circuit's CIR rate vary in response to congestion
  description             Enter interface description
  invert-txc              Invert transmit clock
  ip                      Interface Internet Protocol config commands
  ipv6                    Interface Internet Protocol version 6 config commands
```

```
  lmi                    Enable management activity
  mtu                    Sets the interface maximum transmit unit
  multicast-emulation    Multicast emulation option in this interface
  nucleox-like-bir       Router acting as BIR option is enabled
  orphan-circuits        Use of all non configured orphan circuits
  point-to-point-line    Interface acting as a point-to-point line
  protocol-address       Static configured destination protocol addresses
  pvc                    PVC to the Frame Relay interface
  service-policy         Configure QoS Service Policy
  shutdown               Change state to administratively down
  update                 Update a level indicator
```

Command history:

Release	Modification
11.00.03, 11.00.01.01.02	This command has been changed to include the *ipv6* option. The IPv6 protocol is supported on Frame Relay.

2.6.11.1 NO BIT-DISCARD-PROTOCOL

When this option is disabled for a specific protocol, all frames corresponding to that protocol are transmitted with the DE bit set to zero. This option is disabled by default in all protocols.

Example:

```
<interface_name> FR config>no bit-discard-protocol ?
  arp     Access ARP protocol
  asrt    Access ASRT protocol
  bfd     Access BDF protocol
  bgp     Access BGP protocol
  dep     Access DEP protocol
  dhcp    Access DHCP protocol
  dhcpv6  Access DHCPv6 protocol
  dls     Access DLS protocol
  dot1x   Access 802.1X protocol
  gw104   Access GW-104 protocol
  nhrp    Access NHRP protocol
  h323    Access H323 protocol
  igmp    Access IGMP protocol
  ip      Access IP protocol
  ipv6    Access IPv6 protocol
  l2tp    Access L2TP protocol
  mgcp    Access MGCP protocol
  msdp    Access MSDP protocol
  noe     Access NOE protocol
  ospf    Access OSPF protocol
  ospfv3  Access OSPFv3 protocol
  pim     Access PIM protocol
  rip     Access RIP protocol
  ripng   Access RIPNG protocol
  sccp    Access SCCP protocol
  sip     Access SIP protocol
  snmp    Access SNMP protocol
<interface_name> FR config>no bit-discard-protocol ip
<interface_name> FR config>
```

Command history:

Release	Modification
10.08.38, 10.09.04, 11.00.00	This command has been changed to include the *igmp* and *pim* options.
10.08.40, 10.08.38.01.05, 10.09.08, 10.09.05.01.03	This command has been changed to include the *msdp* option.
11.00.01	This command has been changed to include the *msdp*, *ripng* and *ospfv3* options.
11.00.02, 11.00.01.01.01	This command has been changed to obsolete the *dep* option. The DEP protocol is no longer supported.

Release	Modification
11.00.03, 11.00.01.01.02	This command has been changed to include the *dhcpv6* option.

2.6.11.2 NO BROADCAST

Prevents broadcast or multicast packets arriving at this interface. This option is enabled by default.

Example:

```
<interface_name> FR config>no broadcast
<interface_name> FR config>
```

2.6.11.3 NO CIR-MONITOR

Disables the circuit monitoring option imposed by the transmission rate previously configured through the **PVC** command. This option is disabled by default.

Example:

```
<interface_name> FR config>no cir-monitor
<interface_name> FR config>
```

2.6.11.4 NO CONGESTION-MONITOR

Disables the congestion monitoring feature. It prevents the information rate from varying between 0.25 times CIR and the line speed in response to network congestion. The default is disabled.

Example:

```
<interface_name> FR config>no congestion-monitor
<interface_name> FR config>
```

2.6.11.5 NO INVERT-TXC

Prevents the transmission clock from being inverted. This command is only valid (within the FR menu itself) for Frame Relay over serial line interfaces directly created over one of the device's serial lines through the **SET DATA-LINK FRAME-RELAY <interface_name>** command: It does not apply to *Generic FR* interfaces or FR subinterfaces, as these types of line parameters are generally configured in the base interface (if required). By default the invert transmission clock option is disabled.

Example:

```
serialX/X FR config>no invert-txc
serialX/X FR config>
```

2.6.11.6 NO LMI

Disables all management activity. The system sets LMI CCITT to enable as the default.

Note

Disabling this parameter allows normal operation in end-to-end Frame Relay testing in the absence of a real network or management interface. With end-to-end Frame Relay testing, PVCs with the same identifier (e.g., 17 and 17), must be added to both ends of the link.

Example:

```
<interface_name> FR config>no lmi
<interface_name> FR config>
```

2.6.11.7 NO MTU

Sets the mtu to its default value; 2048 bytes.

Example:

```
<interface_name> FR config>no mtu
<interface_name> FR config>
```

2.6.11.8 NO MULTICAST-EMULATION

This disables the multicast emulation option in this interface. All broadcast or multicast packets that reach this interface are discarded. This option is enabled by default.

Example:

```
<interface_name> FR config>no multicast-emulation
<interface_name> FR config>
```

2.6.11.9 NO ORPHAN-CIRCUITS

Prohibits the use of all non-configured orphan circuits at the interface. The default setting for orphan circuits is enabled. If this feature remains disabled, you are required to add PVCs through configuration.

Example:

```
<interface_name> FR config>no orphan-circuits
<interface_name> FR config>
```

2.6.11.10 NO POINT-TO-POINT-LINE

The interface acting as a point-to-point line option is disabled. This option is disabled by default.

Example:

```
<interface_name> FR config>no point-to-point-line
<interface_name> FR config>
```

2.6.11.11 NO PROTOCOL-ADDRESS

Deletes any protocol address previously associated with a particular PVC (static ARP entries or Neighbors in the case of IPv6).

Syntax:

```
<interface_name> FR config>no protocol-address {<ip_address> | <ipv6_address>}; <dlci>
```

The parameters that must be entered when executing this command are as follows:

ip_address	Indicates the IP address associated with a particular PVC.
ipv6_address	Indicates the IPv6 address associated with a particular PVC.
dlci	This is the identifier (from between 16 and 1007) of the PVC that the specified IP/IPv6 address was associated with.

Example:

```
<interface_name> FR config>no protocol-address ?
  <a.b.c.d>    Ipv4 format
<a::b>       Ipv6 address;<interface_name> FR config>no protocol-address 172.16.4.1 ?
  <16..1007>    Value in the specified range
<interface_name> FR config>no protocol-address 172.16.4.1 16
<interface_name> FR config>
```

Command history:

Release	Modification
11.00.03, 11.00.01.01.02	This command has been as changed to include the possibility of configuring an *IPv6_address*s.

2.6.11.12 NO PVC

Clears any previously configured permanent virtual circuit (PVC).

Syntax:

```
<interface_name> FR config>no pvc <dlci>
```

Example:

```
<interface_name> FR config>no pvc 16
<interface_name> FR config>
```

2.6.12 ORPHAN-CIRCUITS

Allows you to use all the management-learned non-configured circuits (orphan circuits) in the interface. The default for this feature is enabled. The CIR defaults to 64 Kbps, the Committed Burst Size to 64 Kbits and the Excess Burst Size to 0.

Example:

```
<interface_name> FR config>orphan-circuits
<interface_name> FR config>
```

2.6.13 POINT-TO-POINT-LINE

Enables point-to-point line interface behavior. When enabled, all IP packets going to this interface are transmitted using the DLCI that was configured when the option was enabled. This saves you from having to configure static destination addresses (entries that associate a DLCI with a protocol address). This option is only applicable for IP and is disabled by default.

Syntax:

```
<interface_name> FR config>point-to-point-line <dlci>
```

dlci	This is the DLCI used to send all packets that arrive at this interface. It has to correspond to a previously configured PVC.

Example:

```
<interface_name> FR config>point-to-point-line 16
<interface_name> FR config>
```

2.6.14 PROTOCOL-ADDRESS

Adds static protocol destination addresses to the Frame Relay interface. Adding these addresses avoids having to use ARP during the forwarding process. This feature may be necessary when connecting to Frame Relay equipment that does not support ARP (or ND in the case of IPv6). What it does is associate a protocol address with a specific PVC (identified through its DLCI) which, being a permanent circuit, already has a fixed DLCI assigned to it. Consequently, any packet from said protocol whose destination address is the one indicated is transmitted by that PVC.

Syntax:

```
<interface_name> FR config>protocol-address {<ip_address> | <ipv6_address>}; <dlci>
```

The parameters that must be entered when executing this command are as follows:

ip_address	IP address associated with a particular PVC.
ipv6_address	IPv6 address associated with a particular PVC.
dlci	PVC identifier (from between 16 and 1007) with which the indicated IP/IPv6 address is associated.

Example 1:

```
<interface_name> FR config>protocol-address 172.16.4.1 16
<interface_name> FR config>
```

Example 2:

```
<interface_name> FR config>protocol-address 2001:db8::1 16
<interface_name> FR config>
```

Command history:

Release	Modification
11.00.03,	This command has been changed to include the possibility of configuring an

Release	Modification
11.00.01.01.02	s.

2.6.15 PVC

Adds a PVC to the Frame Relay interface beyond the default range of 15. The maximum number of PVCs that can be added is approximately 992, but the actual number of PVCs the interface can support is affected by the number of receive buffers configured on the interface.

Syntax:

```
<interface_name> FR config>PVC <dlci>
  backup                Configure several backup parameters
       dlci                   Set a frame-relay dlci to backup
       isdn-dlci              Set an isdn frame-relay dlci to backup
       always                 Always backup to the isdn dlci
       encrypt                Encrypt data through the isdn backup

  Bc                    Outgoing Committed Burst Size

  Be                    Outgoing Excess Burst Size

  CIR                   Outgoing Committed Information Rate

  compression           Enable/disable compression for this circuit
        crtp                   Compress IP/UDP/RTP headers
        adaptive               Use LZS compression
        predictor              Use predictor compression

  default               Create the virtual circuit

  encapsulation         Encapsulation type
        ietf                   IETF standard encapsulation
        compatible             Ethertype encapsulation

  encrypt               Enable/disable encryption

  fragmentation-size    Forced fragmentation size

  inverse-arp           Inverse ARP configuration for this dlci
        default                Default Inverse ARP
        off                    Inverse ARP disabled
        on                     Inverse ARP enabled

  name                  Set the virtual circuit name

  no                    Negate a command or set its defaults
        backup                 Configure several backup parameters
        Bc                     Outgoing Committed Burst Size
        Be                     Outgoing Excess Burst Size
        CIR                    Outgoing Committed Information Rate
        compression            Enable/disable compression for this circuit
        encapsulation          Encapsulation type
        encrypt                Enable/disable encryption
        fragmentation-size     Forced fragmentation size
        name                   Set the virtual circuit name
        route                  Set static route for PVC switching

  route                 Set static route for PVC switching
```

Example:

```
<interface_name> FR config>pvc 16 default
<interface_name> FR config>
```

dlci	Indicates the circuit number. This must be between 16 and 1007.

backup dlci This is the identifier of a main PVC's backup PVC. If this value is zero, then the main circuit does not have a backup PVC configured.

backup isdn-dlci This is the identifier of the main circuit's ISDN backup circuit. If this value is zero, it means that the main circuit does not have an associated ISDN backup circuit.

backup always If this option is configured, it means that whenever the two Frame Relay circuits (main and secondary) are inactive, transmitting is switched to the ISDN backup circuit. If this option is not configured, data is only transmitted across the ISDN circuit if the interface drops.

backup encrypt This is the data transmission mode being applied over the ISDN back-up circuit: clear or encrypted.

Bc Indicates the maximum amount of data in bits that the network commits to deliver during a time period equal to (Committed Burst Size/CIR) seconds. The range is 300 to 52428800 bits. The default is 16 Kbits.

Be Indicates the maximum amount of uncommitted data in bits in excess of Committed Burst Size that the network attempts to deliver during a time period equal to (Committed Burst Size/CIR) seconds. The range is 0 to 52428800 bits. The default is 0.

CIR Indicates the committed information rate (CIR) in a range of 300 to 52428800 bps 2.048 Mbps. The default is 16 Kbps.

compression Enables data compression for a specific DLCI.

You can choose between the following:

- Data Compression: **ADAPTIVE** or **PREDICTOR**, **CONTINUOUS** or **PKT-BY-PKT** and **OWNER** or **COMPATIBLE** . Available options:

ADAPTIVE (LZS)	CONTINUOUS	OWNER
		COMPATIBLE
	PKT-BY-PKT	OWNER
		COMPATIBLE
PREDICTOR	CONTINUOUS	

- Compression for Voice over IP: At the same time as compressing data, you can enable CRTP compression (RFC-2508) for Voice over IP. This allows you to configure the **WITH-UDP-CHECKSUM** or **WITHOUT-UDP-CHECKSUM** options. You can also control which RTP traffic you want to apply CRTP compression to by configuring an access list and associating it with the CRTP compression. The number of slots used for CRTP compression is 16 although this number can be configured through the **MAX-CONNECTIONS** option.

default Sets the PVC configuration to its default value.

encapsulation Allows you to select the type of encapsulation to use in the Frame Relay frames: IETF or compatible.

encrypt Allows you to decide whether the Frame Relay data field will be sent encrypted or in clear.

fragmentation-size Allows you to Enable FRF.12 Fragmentation specifying the fragmentation size in bytes.

inverse-arp Allows you to define whether you want to have the Inverse ARP protocol enabled or disabled for each circuit. The default value is the value set in the *Inverse ARP Default Value* parameter. Orphan circuits always take the value configured in the *Inverse ARP Default Value* .

name Indicates the ASCII string that is assigned to describe the circuit. This parameter is optional, but you must assign a circuit name to do bridging over the Frame Relay interface. We recommend that you use a name that describes the characteristics of the circuit. The default is *Unassigned*. The maximum length is 23 characters.

no

Using this command you can disable automatically switching to the ISDN backup whenever the main and backup circuits are no longer available (even though the Frame Relay interface hasn't dropped completely), encryption of data in the main circuit and the ISDN backup circuit, and forced compression or fragmentation (FRF.12). You can also delete the DLCI established as backup to that main circuit, the backup DLCI over ISDN, the name assigned to the circuit being configured or the static route for Frame Relay *Switching*, or establish the default values for the *Be*, *Bc*, *CIR* or *encapsulation* parameters.

route

Allows you to configure and associate a route with this DLCI for Frame Relay *Switching*. The command syntax is as follows:

```
pvc <dlci> route <out_interface> <out_dlci>
```

where

dlci is the circuit number (PVC) that you are configuring.

out_interface is the output interface where the packets are transmitted.

out_dlci is the DLCI of the output interface configured to transmit the packets.

To globally enable Frame Relay *Switching*, you must do it from the **FEATURE FRAME-RELAY-SWITCH** menu.

Command history:

Release	Modification
11.00.02, 11.00.01.01.01	This command has been changed to obsolete *encryption* options. Encryption is no longer supported.

2.6.16 SET

Configures the interface to run the Frame Relay protocol.

CONSIDERATIONES FOR THE SET COMMAND

The N2 and N3 parameters need further explanation before you configure them. The N2 parameter sets the error threshold for management events, and the N3 parameter sets the number of events that are monitored in the events window. If the number of management errors in the events window equals N2, the Frame Relay interface resets.

Example:

```
<interface_name> FR config>set n3-parameter 4
<interface_name> FR config>set n2-parameter 3
<interface_name> FR config>
```

The window size in this example is 4 (N3 = 4) and the error threshold is 3 (N2 = 3). This means that the system is monitoring 4 management events to see if any of them are in error. If the number of events in error equals 3 (the N2 parameter), the Frame Relay interface is reset and the network is considered “network down”.

For the status of the network to be considered “network up”, the number of events in error within the window must be less than N2.

Syntax:

```
serialX/X FR config>set ?
  backup-key              Encrypt card backup key configuration
  encoding                Encoding type to be used for HDLC transmission
  encryption              Encrypt card configuration
  flow-parameter          Flow control parameters
  idle                    Set the transmit idle state for HDLC framing
  inverse-arp             Configuration of the inverse-arp protocol
  ir-adjustment           Downward and upward movement of the variable CIR
  key-single              Encrypt card key configuration
  line-speed              Set the line speed in bits per second used
  lmi-type                Set the management type for the interface
  n1-parameter            T1 intervals before a complete PVC status inquiry
  n2-parameter            Number of errors monitored before interface resets
  n3-parameter            Number of monitored management events for measuring
```

```
  p1-parameter           Maximum number of PVCs supported by the interface
  return-time-back-up    Time after the backup circuits stop doing backup
  t1-parameter           Interval to wait between sequence number exchanges
  transmit-delay         Insertion of a delay between transmitted packets
```

Note

The ENCRYPTION, KEY-SINGLE and BACKUP-KEY features are used to modify the circuit's encryption configuration (if any) in the Frame Relay interface.

2.6.16.1 SET ENCODING

Sets the encoding type to be used for HDLC transmission. The available options are NRZ – Non Return to Zero and NRZI – Non Return to Zero Inverted. Most configurations use NRZ, which is the default value.

This command does not apply to *Generic FR* interfaces or FR subinterfaces, as these types of line parameters are usually configured in the base interface (if applicable).

Syntax:

```
serialX/X FR config>set encoding ?
  nrz     Non return to zero enconding
  nrzi    Non return to zero inverted enconding
```

SET ENCODING NRZ

Example:

```
serialX/X FR config>set encoding nrz
serialX/X FR config>
```

SET ENCODING NRZI

Example:

```
serialX/X FR config>set encoding nrzi
serialX/X FR config>
```

2.6.16.2 SET FLOW-PARAMETER

This command must only be used by Teldat technical personnel. Inappropriate use can seriously impact device performance.

2.6.16.3 SET IDLE

Sets the transmit idle state for HDLC framing. The default value is FLAG, which provides continuous flags (7E hex) between frames. The MARK option puts the line in a marking state (OFF, 1) between frames.

This command does not apply to *Generic FR* interfaces or FR subinterfaces, as these types of line parameters are usually configured in the base interface (if applicable).

Syntax:

```
serialX/X FR config>set idle ?
  flag    Continuous flags (7E hex) between frames
  mark    Marking state (OFF, 1) between frames SET IDLE FLAG
```

SET IDLE FLAG

Example:

```
serialX/X FR config>set idle flag
serialX/X FR config>
```

SET IDLE MARK

Example:

```
serialX/X FR config>set idle mark
serialX/X FR config>
```

2.6.16.4 SET INVERSE-ARP

The configuration of these parameters only makes sense if the Inverse ARP protocol is globally enabled (for more information, please see the following manual: Teldat-Dm 701-I "ARP & InARP Protocol"). Changes made with this command only affect this interface.

Syntax:

```
<interface_name> FR config>set inverse-arp ?
  default-value    Modify the value taken by the default-value
  global-value     Enable or disable the Inverse ARP protocol by interface
```

SET INVERSE-ARP DEFAULT-VALUE

This command lets you change the DEFAULT Inverse ARP configuration value per interface. The possible values are OFF (disabled) and ON (enabled). The default is ON. Orphan circuits always take the DEFAULT value.

Syntax:

```
<interface_name> FR config>set inverse-arp default-value ?
  off    Set the default-value to no inverse-arp
  on     Set the default-value to inverse-arp
```

Example:

```
<interface_name> FR config>set inverse-arp default-value on
<interface_name> FR config>
```

SET INVERSE-ARP GLOBAL-VALUE

This command lets you enable or disable the Inverse ARP protocol per interface. By default, GLOBAL-VALUE is set to "DEFAULT", that is, it takes the DEFAULT Inverse ARP configuration value.

Syntax:

```
<interface_name> FR config>set inverse-arp global-value ?
  default    Take the default inverse-arp configuration value
  off        Disable Inverse ARP
  on         Enable Inverse ARP
```

Example:

```
<interface_name> FR config>set inverse-arp global-value default
<interface_name> FR config>
```

2.6.16.5 SET IR-ADJUSTMENT

This parameter is only applicable when congestion monitoring is enabled. It allows you to define the percentage by which the variable information rate (VIR) should be decreased (when congestion is encountered) or increased (when congestion ends). It also allows you to set the minimum VIR value when congestion levels remain high for a long time. These values are given as a percentage of the configured CIR.

Example:

```
<interface_name> FR config>set ir-adjustment ?
  <1..100>    IR adjustment % increment
<interface_name> FR config>set ir-adjustment 12 ?
  <1..100>    IR adjustment % decrement
<interface_name> FR config>set ir-adjustment 12 25 ?
  <1..100>    Minimum IR as % of CIR
<interface_name> FR config>set ir-adjustment 12 25 25 ?
  <cr>
<interface_name> FR config>set ir-adjustment 12 25 25
<interface_name> FR config>
```

2.6.16.6 SET LINE-SPEED

Sets the line speed (in bits per second) for the interface. The CIR monitor uses this rate to regulate the transmitted traffic and for calculating transmit and receive statistics.

The selected rate is a value from 1200 to 2.048 Mbps. The default is 64 Kbps.

This command does not apply to *Generic FR* interfaces or FR subinterfaces, as these types of line parameters are usually configured in the base interface (if applicable).

Example:

```
serialX/X FR config>set line-speed ?
  <1200..2048000>    Access rate in bps
serialX/X FR config>set line-speed 64000
serialX/X FR config>
```

2.6.16.7 SET LMI TYPE

Sets the management type for the interface. See section 5 “Enabling Frame Relay Management” of this chapter for additional information on configuring the Frame Relay management type. The default is CCITT.

Command	Options	Description	Default
SET	LMI-TYPE REV1	Conforms to LMI Revision 1, (Stratacom’s Frame Relay Interface Specification)	N/A
	LMI-TYPE ANSI	Conforms to ANSI T1.617USDN-DSS1-Signaling Specification for Frame Relay Bearer Service (known as Annex D)	N/A
	LMI-TYPE CCITT	Conforms to Annex A of the ITU (former CCITT) Recommendation Q.933 - DSS1 (Signaling Specification for Frame Mode Basic Call Control)	Enabled

Example:

```
<interface_name> FR config>set lmi-type ?
  ansi     ANSI T1.617USDN-DSS1-Signalling specification
  ccitt    Annex A of ITU (former CCITT)  Recommendation Q.933 - DSS1
  rev1     LMI revision 1
<interface_name> FR config>set lmi-type ansi
<interface_name> FR config>
```

2.6.16.8 SET N1- PARAMETER

Configures the number of T1 timer intervals that must expire before a complete PVC status inquiry is requested. This parameter takes values from 1 to 255. The default is 6.

Example:

```
<interface_name> FR config>set n1-parameter 6
<interface_name> FR config>
```

2.6.16.9 SET N2- PARAMETER

Configures the number of errors that must occur in the management events screen monitored by the N3 parameter before the Frame Relay interface resets. This parameter takes values from 1 to 10. The default is 3. The assigned value must be less than or equal to the N3 parameter. If the value configured for N2 is higher than the N3 value, this latter value will adjust and take the same value as N2.

Example:

```
<interface_name> FR config>set n2-parameter ?
  <1..10>
<interface_name> FR config>set n2-parameter 3
<interface_name> FR config>
```

2.6.16.10 SET N3- PARAMETER

Configures the number of monitored management events for measuring the N2 parameter. This parameter takes values from 1 to 10. The default is 4. The value that you configure for N3 must always be higher than the N2 value; if you attempt to set a lower value for N3 than N2, then N3 will maintain its previous value.

Example:

```
<interface_name> FR config>set n3-parameter ?
  <1..10>
<interface_name> FR config>set n3-parameter 4
<interface_name> FR config>
```

2.6.16.11 SET P1- PARAMETER

Configures the maximum number of PVCs supported by the Frame Relay interface. This parameter takes values from 0 to 992. The default is 64. A 0 (zero) value implies that the interface does not support PVCs.

Example:

```
<interface_name> FR config>set p1-parameter ?
  <0..992>
<interface_name> FR config>set p1-parameter 64
<interface_name> FR config>
```

2.6.16.12 SET RETURN-TIME-BACK-UP

This lets you specify a time (in hours and minutes) to return traffic from the backup PVCs to their corresponding main circuits.

Example:

```
<interface_name> FR config>set return-time-back-up ?
  yes    Enable backup return time
  no     Disable backup return time
<interface_name> FR config>set return-time-back-up yes ?
  <0..23>
<interface_name> FR config>set return-time-back-up yes 17 ?
  <0..59>
<interface_name> FR config>set return-time-back-up yes 17 54 ?
  <cr>
<interface_name> FR config>set return-time-back-up yes 17 54
<interface_name> FR config>
```

2.6.16.13 SET T1-PARAMETER

Configures the interval (in seconds) that the Frame Relay interface waits between sequence number exchanges with Frame Relay management. This is a number from 5 to 30. The default is 10.

Example:

```
<interface_name> FR config>set t1-parameter ?
  <5..30>
<interface_name> FR config>set t1-parameter 10
<interface_name> FR config>
```

2.6.16.14 SET TRANSMIT DELAY

This command lets you introduce a delay between transmitted packets. The purpose of the command is to slow down the serial line so that it is compatible with older, slower serial devices at the other end of the line. It also prevents the loss of hello packets between different lines. The delay default value is 0.

This command does not apply to *Generic FR* interfaces or FR subinterfaces, as these types of line parameters are usually configured in the base interface (if applicable).

Example:

```
serialX/X FR config>set transmit-delay ?
  <0..15>
serialX/X FR config>set transmit-delay 0
```

```
serialX/X FR config>
```

2.6.17 EXIT

This command allows you to exit the Frame Relay configuration menu. If the interface is a *Generic FR* interface, you are returned to the interface's main configuration menu. In the case of a Frame Relay interface configured over a serial line created directly on one of the device's serial lines through the **SET DATA-LINK FRAME-RELAY <interface_name>** command, you are returned to the *Config*> prompt.

Syntax:

```
<interface_name> FR config>exit
```

Example 1:

```
frX FR config>exit
frX config>
```

Example 2:

```
serialX/X FR config>exit
Config>
```

2.7 Frame Relay Switching

This consists of switching packets between PVCs from different interfaces based on the DLCI. Frame Relay considers the DLCI to be the equivalent of a MAC address.

When configuring packet switching between DLCIs, the following applies:

- Switching cannot be configured between DLCIs that are on the same interface.
- Switching cannot be configured on point-to-point interfaces.
- Switching cannot be configured on a DLCI if it has a route assigned to it.

To enable Frame Relay *Switching* in a particular PVC, you must indicate the outbound path of the switched packets – that is, the FR interface and DLCI through which the packets will be transmitted. To do this, use the following command in the corresponding PVC's configuration:

```
pvc <dlci> route <out_interface> <out_dlci>
```

where

dlci is the circuit number (PVC) you are configuring.

out_interface is the output interface through which the packets are transmitted.

out_dlci is the DLCI of the output interface configured to transmit the packets.

After configuring the PVC where you want to perform Frame Relay *Switching* in the manner specified, you need to globally enable the Frame Relay *Switching* functionality. You do this from the **FEATURE FRAME-RELAY-SWITCH** menu:

```
*config


Config>feature frame-relay-switch

-- Frame Relay Switch configuration --
Frame Relay Switch>
```

The commands available within this menu are described below:

```
Frame Relay Switch>?
  enable    Enable Frame Relay Switch feature
  list      Display Frame Relay Switch configuration
  no        Negate a command or set its defaults
  exit
```

2.7.1 ENABLE

Globally enables Frame Relay *Switching*.

Syntax:

```
Frame Relay Switch>enable
```

Example:

```
Frame Relay Switch>enable
Frame Relay Switch>
```

2.7.2 LIST

Displays the current Frame Relay *Switching* configuration.

Syntax:

```
Frame Relay Switch>list
```

Example:

```
Frame Relay Switch>list
Frame Relay Switch Feature : Enabled

Frame Relay Switch>
```

2.7.3 NO

This command allows you to globally disable Frame Relay *Switching*.

Syntax:

```
Frame Relay Switch>no ?
  enable    Enable Frame Relay Switch feature
Frame Relay Switch>no enable ?
  <cr>
```

2.7.3.1 NO ENABLE

Globally disables Frame Relay *Switching*.

Example:

```
Frame Relay Switch>no enable
Frame Relay Switch>
```

2.7.4 EXIT

Returns to the general configuration menu.

Syntax:

```
Frame Relay Switch>exit
```

Example:

```
Frame Relay Switch>exit
Config>
```

Chapter 3 Monitoring Frame Relay

3.1 Introduction

This chapter describes the Frame Relay monitoring commands and includes the following sections:

- Displaying the Frame Relay monitoring prompt.
- Frame Relay monitoring commands.
- Frame Relay interfaces and the **MONITOR** process **DEVICE** command.

For additional information on Frame Relay, please see Chapter 1 “The Frame Relay Interface”.

3.2 Displaying the Frame Relay monitoring prompt

The first thing you need to do to perform Frame Relay monitoring is access the corresponding monitoring commands. You do this as follows:

(1) At the GESTCON prompt (*), type **PROCESS 3** (or **P 3**) or **MONITOR**.

(2) At the MONITOR prompt (+), enter **NETWORK <interface_name>**, where **interface_name,** is the name of the interface used by Frame Relay.

(3) If the interface is a a *Generic FR* interface, enter the **FR** command to access the FR monitoring menu. If it is a Frame Relay interface directly configured on one of the device's serial lines (through the **SET DATA-LINK FRAME-RELAY <interface_name>** command), you are already in the Frame Relay monitoring menu and have access to the different commands.

Example 1 (Frame Relay directly configured on one of the device's serial lines):

```
*MONITOR
Console Operator
+NETWORK serialX/X



-- Frame Relay Console --
serialX/X FR+
```

Example 2 (*Generic FR*):

```
*MONITOR
Console Operator
+NETWORK frX

Generic FR Console
frX+?
BASE-INTERFACE
FR
EXIT
frX+FR

-- Frame Relay Console --
frX FR+
```

(4) At the Frame Relay monitoring prompt (<interface_name> FR+), you can enter the desired monitoring commands from among those available. These commands are explained in the next section:

(5) Please see the next section for an explanation of the commands.

3.3 Frame Relay monitoring commands

Below is a list of the Frame Relay monitoring commands, followed by an explanation of each one. Use these commands to gather information from the Frame Relay interface.

Command	Function
? (HELP)	Lists the available commands or options.
ACTIVE	Activates a PVC.

CLEAR	Clears statistics from the Frame Relay interface.
COMPRESSION	Allows you to view compression statistics and the software version. You can also restart these statistics.
CRTP	Allows you to view CRTP compression statistics for PVC's enabled with this type of compression. You can also restart these statistics.
DISABLE	Disables CIR monitoring and overload monitoring.
ENABLE	Enables CIR monitoring and congestion monitoring for a Frame Relay interface. It also lets you set an immediate return from backup, so that traffic is transferred across the main circuits rather than across the backup ones.
INACTIVE	Deactivates a PVC.
LIST	Displays statistics on the Frame Relay management entity and the different configured circuits, as well as information about the configured protocol addresses.
SET	Sets the values for *Committed Information Rate* (CIR), *Committed Burst Size* and *Excess Burst Size* for a Frame Relay PVC. It also sets the IR-ADJUSTMENT value: this allows you to define the size of decrements (when entering congestion) and increments (when recovering from a congestion situation) to the variable information rate (VIR), and the minimum value that said rate takes when congestion remains high for a long time.
EXIT	Returns to the monitoring menu immediately above.

Note

In this section, the terms “circuit number” and “PVC” are synonymous with the term “Data Link Circuit Identifier (DLCI)”.

3.3.1 ? (HELP)

This command lists the available commands or their options.

Syntax:

```
<interface_name> FR+?
```

Example:

```
<interface_name> FR+?
  active         Activate a PVC
  clear          Clear statistical information
  compression    Compression statistics and software version
  crtp           CRTP compression statistics
  disable        Disable specific features
  enable         Enable specific features
  inactive       Deactivate a PVC
  list           List status and statistics on Frame Relay
  set            Set specific parameters
  exit
<interface_name> FR+
```

3.3.2 ACTIVE

This command activates a Permanent Virtual Circuit (PVC).

Syntax:

```
<interface_name> FR+active <dlci>
```

Example:

```
<interface_name> FR+active 16
```

```
<interface_name> FR+
```

dlci This is the circuit number. It must be between 16 and 1007.

3.3.3 CLEAR

This command clears all statistics from the specified Frame Relay interface.

Syntax:

```
<interface_name> FR+clear
```

Example:

```
<interface_name> FR+clear
<interface_name> FR+
```

3.3.4 COMPRESSION

Syntax:

```
<interface_name> FR+compression ?
  restart-statistics    Restart compression statistics
  statistics            Display compression statistics
  version               Show compression software version
```

3.3.4.1 COMPRESSION RESTART-STATISTICS

This command restarts the compression statistics counters. It can be applied to a specific circuit or to all circuits.

Example:

```
<interface_name> FR+compression restart-statistics
<interface_name> FR+
```

3.3.4.2 COMPRESSION STATISTICS

This command prints compression and decompression statistics.

Example:

```
<interface_name> FR+compression statistics

FRAMES         COMPRESSION     (bytes          ) DECOMPRESSION   (bytes          )
-------------- ------------------------------- -------------------------------
MANAGED        127             (5735           ) 34              (3810           )
PROCESSED      127             (3245           ) 34              (2097           )
NOT PROCESSED  0               (0              ) 0               (0              )
ERROR          0                                 0
OUT OF SEQ.    0                                 0
CONTROL        0                                 0
DATA CONTROL   0                                 0
================================================================================
STATISTICS BEGINING 28/02/06 13:25:11
<interface_name> FR+
```

3.3.4.3 COMPRESSION VERSION

This command provides information about the compression software version that is running on the device.

Example:

```
<interface_name> FR+compression version

Revision: 1.1.1.4 $$---Name:  $

NoCard  Interrupt mode NOT ACTIVE
<interface_name> FR+
```

3.3.5 CRTP

Syntax:

```
<interface_name> FR+crtp <dlci> ?
  clear    Clear statistics
  list     Show statistics
```

3.3.5.1 CRTP <dlci>clear

This command starts the CRTP compression statistic counters for a particular circuit.

Example:

```
<interface_name> FR+crtp 16 clear
<interface_name> FR+
```

3.3.5.2 CRTP <dlci> list

This command displays a circuit's CRTP compression statistic counters.

Example:

```
<interface_name> FR+crtp 16 list
CRTP Compression Statistics
-----------------------------------
Outbound RTP packets.............:     837006
Outbound RTP compressed packets..:     769259
Searches for connection state....:    1223124
Times couldn't find conn. state..:      67740
Inbound RTP uncompressed packets.:        269
Inbound RTP compressed packets...:    1152843
Inbound RTP unknown type packets.:         67
Inbound   packets:         67
<interface_name> FR+
```

3.3.6 DISABLE

The **DISABLE** command allows you to disable Frame Relay CIR monitoring and congestion monitoring.

Syntax:

```
<interface_name> FR+disable ?
  cir-monitor           Disable CIR monitoring feature
  congestion-monitor    Disable congestion monitoring feature
```

3.3.6.1 DISABLE CIR-MONITOR

Example:

```
<interface_name> FR+disable cir-monitor
<interface_name> FR+
```

3.3.6.2 DISABLE CONGESTION-MONITOR

Example:

```
<interface_name> FR+disable congestion-monitor
<interface_name> FR+
```

3.3.7 ENABLE

The **ENABLE** command allows you to enable Frame Relay CIR monitoring and congestion monitoring. It can also be used to configure an immediate return from backup, so that the secondary circuits stop being used and traffic is rerouted to the primary circuits (this command produces an immediate return from backup).

Syntax:

```
<interface_name> FR+enable ?
  cir-monitor               Enable CIR monitoring feature
  congestion-monitor        Enable congestion monitoring feature
  pvc-back-up-return-time   Immediate return from backup
```

3.3.7.1 ENABLE CIR-MONITOR

Example:

```
<interface_name> FR+enable cir-monitor
<interface_name> FR+
```

3.3.7.2 ENABLE CONGESTION-MONITOR

Example:

```
<interface_name> FR+enable congestion-monitor
<interface_name> FR+
```

3.3.7.3 ENABLE PVC-BACK-UP-RETURN-TIME

Example:

```
<interface_name> FR+enable pvc-back-up-return-time
<interface_name> FR+
```

3.3.8 INACTIVE

This command deactivates a Permanent Virtual Circuit (PVC).

Syntax:

```
<interface_name> FR+inactive <dlci>
```

dlci	This is the circuit number (DLCI). It must be between 16 and 1007.

Example:

```
<interface_name> FR+inactive 16
<interface_name> FR+
```

3.3.9 LIST

The **LIST** command displays statistics about the specified Frame Relay interface, together with information on the configured protocol addresses.

Syntax:

```
<interface_name> FR+list ?
  all                   LMI and circuits information
  circuits              Circuits information
  info-circuit          Specific circuit information
  lmi                   LMI statistics
  protocol-addresses    Protocol addresses information
```

3.3.9.1 LIST ALL

This command displays PVC, management and circuit statistics for Frame Relay interfaces. The information displayed when this command is executed is a combination of the information given by the **LIST LMI** and **LIST CIRCUITS** commands.

3.3.9.2 LIST CIRCUITS

This command displays statistics on sent and received frames for all circuits configured and/or learned through management on the Frame Relay interface, including the type (permanent or *multicast*) and state (active, inactive, congested or deleted) of each circuit, together with an indication of whether it is an orphan circuit. It also shows the name configured for each circuit and whether the transmitted data are encrypted or unencrypted.

Example:

```
<interface_name> FR+list circuits

                                Orphan   Type/   Frames    Frames
 Circuit       Circuit Name     Circuit   State  Transmit  Received  Encrypt
 -------- ---------------------- -------- ------ --------- --------- -------
    16   Unassigned                 No     P/A       7782       1924  Yes
    17   Unassigned                Yes     P/A        589       4563   No

    A - Active     I - Inactive   R - Removed
    P - Permanent  M - Multicast  C - Congested
<interface_name> FR+
```

Circuit	Indicates the circuit number (DLCI).
Circuit Name	Indicates the name assigned to the circuit to be configured.
Orphan circuit	Indicates whether the circuit is a configured circuit or a circuit learned by management (in which case it is an orphan circuit).
Type	Indicates the circuit type: P (*Permanent*), M (*Multicast*).
State	Indicates the circuit status, A (Active), I (Inactive), R (Removed).C (Congested).
Frames Transmit	Indicates the number of frames transmitted by the circuit.
Frames Bytes received	Indicates the number of frames received by the circuit.
Encrypt	Indicates whether the data sent over this circuit is encrypted.

3.3.9.3 LIST INFO-CIRCUIT <dlci>

Displays detailed configuration and statistical information about the circuit with the specified DLCI.

Example:

```
<interface_name> FR+list info 16
Circuit number[16]?
    Circuit name         = Unassigned

    Circuit state        =      Idle  Circuit is orphan  =        No
    Frames transmitted   =         0  Bytes transmitted  =         0
    Frames received      =         0  Bytes received     =         0
    Total FECNs          =         0  Total BECNs        =         0
    Times congested      =         0  Times Inactive     =         0
    CIR in bits/second   =      1200  Current Info Rate  =      1200
    Committed Burst (Bc) =      1200  Excess Burst (Be)  =     56000

    Xmit frames dropped due to queue overflow        =         0
    Frames dropped due to input overrun              =         0
<interface_name> FR+
```

Circuit name	Name assigned to the circuit. If no name has been configured, the tag “Unassigned” will appear instead.
Circuit state	Indicates the circuit's status: *Active, Idle, Congested* or *Removed*. *Idle* means that it is waiting for management data; *Active*, that data is being transferred; *Congested*, that the data flow is being controlled; and *Removed* indicates that the circuit has been deleted by management.
Circuit is orphan	Indicates that the circuit wasn't configured by the user, rather it was learned during the management process.
Frames/Bytes transmitted	Indicates the number of frames and bytes the circuit has transmitted.
Frames/Bytes received	Indicates the number of frames and bytes the circuit has received.
Frames dropped	Indicates the number of transmitted frames the circuit has dropped.

Total FECNs	Indicates the number of times that the circuit has been notified of inbound congestion (notification of overload in the direction of transmission).
Total BECNs	Indicates the number of times that the circuit has been notified of outbound congestion (notification of overload in the opposite direction to transmission).
Times congested	Indicates the number of times that the circuit was overloaded.
Times Inactive	Indicates the number of times that the circuit was out of operation.
CIR in bits/second	Indicates the speed of data transmission in the circuit. This can range from 300 to 52428800 bps.
Current Info Rate	The rate in bits per second at which information is currently being transmitted.
Committed Burst (Bc)	The maximum amount of data (in bits) that the network agrees to deliver during a measurement interval equal to (Committed Burst Size/CIR) seconds.
Excess Burst (Be)	The maximum amount of uncommitted data (in bits) in excess of Committed Burst Size that the network attempts to deliver during a measurement interval equal to (Committed Burst Size/CIR) seconds.

3.3.9.4 LIST LMI

This command displays the most important statistics related to Frame Relay interface management.

Example:

```
<interface_name> FR+list lmi
Management Status:
--------------------

   Point to point line  =   No               Point to point DLCI =    0

   LMI enabled          =  Yes               LMI DLCI            =    0
   LMI type             =  CCITT             LMI Orphans OK      =  Yes
   LMI sequence interval (seconds) =   10

   Protocol broadcast   =  Yes        Congestion monitoring   =  Yes
   Emulate multicast    =  Yes        CIR monitoring          =  Yes

   Line access rate bps   =   64000   Interface MTU in bytes   = 2048
   PVCs P1 allowed         =   64     CIR monitor adjustment   =    1
   Timer T1 seconds        =   10     Counter N1 increments    =    6
   LMI N2 error threshold  =    3     LMI N3 error window      =    4
   IR % Increment          =   12     IR % Decrement           =   25
   MIR % of CIR            =    5

   Current receive sequence    = 0
   Current transmit sequence   = 0
   Total status enquiries      = 0         Total status responses   =       0
   Total sequence requests     = 0         Total sequence responses =       0

PVC Status:
---------------
   Total allowed    =      64        Total configured   =       2
   Total active     =       0        Total congested    =       0
   Total left net   =       0        Total join net     =       0
<interface_name> FR+
```

Point to point line	Shows whether the point-to-point line behavior option is enabled.
Point to point DLCI	Indicates the DLCI through which all traffic exits when point-to-point behavior is enabled.
LMI enabled	Shows whether Frame Relay management is enabled or disabled.

LMI DLCI	Indicates the management circuit number. This number is either 0 (ANSI and CCITT default) or 1023 (for LMI).
LMI type	Indicates the Frame Relay management type: ANSI, CCITT or LMI.
LMI Orphans OK	Shows whether or not the circuits learned by management are available for use.
LMI sequence interval (seconds)	Indicates the time interval used by management to exchange (*keep alive*) information with an end station.
Protocol broadcast	Shows whether protocols such as RIP are supported by the Frame Relay interface.
Congestion monitoring	Shows whether congestion monitoring is enabled or disabled.
Emulate multicast	Shows whether multicast emulation is enabled or disabled on each active PVC.
CIR monitoring	Shows whether circuit monitoring (which limits the router's transmission rate) is enabled or disabled.
Line access rate bps	Indicates the Frame Relay physical link's data transmission rate.
Interface MTU in byte	Indicates the size of user data in a Frame Relay frame.
PVCs P1 allowed	Indicates the number of PVCs the interface can use.
CIR monitor adjustment	Indicates the information rate value that is used to calculate the burst rate in excess of the configured CIR when CIR monitoring is enabled.
Timer T1 seconds	Indicates the frequency with which the Frame Relay interface exchanges numerical sequences with management.
Counter N1 increments	Indicates the time intervals that the Frame Relay interface waits before querying management about PVC status.
LMI N2 error threshold	Indicates the number of errors that must be registered in management events to reset the Frame Relay interface.
LMI N3 error window	Indicates the number of management events that are monitored by the management window.
IR % Increment	This is the percentage of the CIR by which the Variable Information Rate (VIR) increases when congestion ends.
IR % Decrement	This is the percentage of the CIR by which the Variable Information Rate (VIR) decreases when congestion is encountered.
MIR % of CIR	This is the minimum VIR when congestion levels remain high for a long time. This value is given as a percentage of the configured CIR.
Current receive sequence	Indicates the last sequence number that the Frame Relay interface received from management.
Current transmit sequence	Indicates the last sequence number that the Frame Relay interface sent to management.
Total status enquiries	Indicates the number of Frame Relay interface status inquiries made by management.
Total status responses	Indicates the number of Frame Relay interface responses to management status inquiries.
Total sequence requests	Indicates the number of sequence number exchanges between the Frame Relay interface and management.
Total sequence responses	Indicates the number of sequence number replies received in response to se-

	quence number exchanges with management.
Total PVC allowed	Indicates the number of PVCs (including orphans) that can be used by this interface.
Total PVC active	Indicates the number of active PVCs on this interface.
Total PVC configured	Indicates the number of PVCs configured for this interface.
Total PVC congested	Indicates the number of PVCs that are throttled down due to network congestion.
Total PVC left net	Indicates the number of PVCs that have left the network.
Total PVC join net	Indicates the number of PVCs that have joined the network.

3.3.9.5 LIST PROTOCOL-ADDRESSES

Displays information relating to the protocol addresses associated with PVCs on the interface. If the interface is down, then the configured protocol addresses do not appear.

Example:

```
<interface_name> FR+list protocol-addresses

               Frame Relay Protocol Address Translations

 Protocol Type           Protocol Address            Circuit Number
 -------------           ----------------            --------------
       IP                192.3.3.2                       16
       IPv6              2001:db8::1                     16


<interface_name> FR+
```

Protocol Type	Indicates the protocol type that the address in the following field belongs to.
Protocol Address	This is the protocol address. All packets destined for this address will be transmitted by the circuit number in the following field.
Circuit Number	Indicates the circuit number through which the packets will be sent to the corresponding protocol address.

Command history:

Release	Modification
11.00.03, 11.00.01.01.02	The command output was changed to display IPv6 protocol address information.

3.3.10 SET

Use the **SET** command to set the values for *Committed Information Rate* (CIR), *Committed Burst Rate,* and *Excess Burst Rate* for the specified PVC, or to dynamically modify the values by which the Variable Information Rate (VIR) increases and decreases when congestion is encountered.

Syntax:

```
<interface_name> FR+set ?
  info-circuit     Set CIR, Bc and Be
  ir-adjustment    change increase and decrease values of the VIR during
                   congestion periods
```

3.3.10.1 SET INFO circuit

Syntax::

```
<interface_name> FR+ set info-circuit <dlci> <CIR> <Bc> <Be>
```

dlci	Circuit number between 16 and 1007.
CIR	*Outgoing Committed Information Rate:* This is the value of the delivered information rate and can take values between 300 bps and 52428800 bps. The default is the current value.
Bc	*Outgoing Committed Burst Size:* This is the maximum amount of data in bits that the network commits to transmit in a time period equal to (*Committed Burst Size*/CIR) seconds. This can take values between 300 and 52428800 bps.
Be	*Outgoing Excess Burst Size:* This is the maximum amount of bits in excess of *Committed Burst Size* that the network attempts to transmit during a period equal to (*Committed Burst Size*/CIR) seconds. Admitted values are between 0 to 52428800 bps.

Example:

```
<interface_name> FR+ set info-circuit 16 1200 1200 56000
<interface_name> FR+
```

3.3.10.2 SET IR-ADJUSTMENT

This option allows you to dynamically change the values by which the variable information rate (VIR) increases and decreases during periods of congestion. The configuration of these parameters is therefore only significant when the congestion monitoring feature is enabled. It allows you to define the percentage by which the VIR increases (when congestion is encountered) and decreases (when congestion ends). It also allows you to set the minimum value that the VIR takes when congestion levels are maintained for a long time. These values are given as a percentage of the configured CIR.

Syntax:

```
<interface_name> FR+ set ir-adjustment <increment> <decrement> <minimum>
```

increment	This is the information rate increment percentage to apply
decrement	This is the information rate decrement percentage to apply
minimum	This is the minimum information rate as a percentage.

Example:

```
<interface_name> FR+set ir-adjustment 12 25 5
<interface_name> FR+
```

3.3.11 EXIT

The **EXIT** command allows you to return to the previous prompt level.

Syntax:

```
<interface_name> FR+exit
```

Example 1:

```
serialX/X FR+exit
+
```

Example 2:

```
frX FR+exit
frX+
```

3.4 Frame Relay Interfaces and the MONITOR procedure DEVICE command

The **DEVICE <interface_name>** command from the MONITOR procedure prompt (+) displays all Frame Relay interface statistics. If the interface is a *Generic FR* interface, these statistics cannot be viewed through this command, as they generally correspond to information related to the physical connection and therefore appear (if applicable) in the base interface associated with the Frame Relay interface. These statistics are therefore only available in FR interfaces over a serial line, which have been directly created over one of the device serial lines through the **SET DATA-LINK FRAME-RELAY** <**interface_name**> command.

3.4.1 DEVICE

Frame Relay interface statistics are displayed when you execute the **DEVICE <interface_name>** command from the prompt (+), provided you are dealing with a Frame Relay interface directly created over one of the device serial lines through the **SET DATA-LINK FRAME-RELAY <interface_name>** command.

Example:

```
+device serial0/0

                                    Auto-test   Auto-test     Maintenance
Interface            CSR    Vect      valids    failures        failures
serial0/0       FA200A20      5d           0           0               0

  Driver type:             DTE

  Circuit:           105  106  107  108  109
  Nicknames:         RTS  CTS  DSR  DTR  DCD
  State:             ON   ON   ON   ON   ON

  Line speed:               64000 Kbps
  Last port reset:          23 hours, 52 minutes, 22 seconds ago

  Input frame errors:
   CRC error              =          0   alignment (byte length)  =          0

   missed frame           =          0   too long (> 02062 bytes) =          0

   aborted frame          =          0   DMA/FIFO overrun         =          0

  Output frame counters:
   DMA/FIFO underrun errs =          0   Output aborts sent       =          0
+
```