FRAME RELAY

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FRAME RELAY

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REFERENCE

1 Frame Relay

In this chapter we will give you an overview of Frame Relay technology.

Secondly, we will describe the protocol structures of Frame Relay.

After that some Frame Relay services will be introduced.

Following that, the Frame Relay subsystems will be described.

Concluding, we will describe some example configurations using Setup Tool.

Frame Relay on BinTec Routers

Frame Relay is officially supported on the BIANCA/BRICK-XL2, BIANCA/BRICK-XMP, BIANCA/BRICK-XM with 2MB flash, BIANCA/BRICK-XS with 2MB flash, and on the BinGO! Plus/Professional. The BinTec router (the expression BinTec router in the further text of this Chapter also includes the BinGO! Plus/Professional) can be used as a Frame Relay Switch or a Frame Relay Router and supports the following official and defacto standards:

- RFC 1490 Multiprotocol Interconnect over Frame Relay
- RFC 1293 Inverse Address Resolution Protocol
- ITU-T Q933a, Appendix II, X6 Line Management Extensions
- FRF 1.1 Congestion Management

Frame Relay requires a separate license to be installed on the BinTec router and may be purchased directly from BinTec Communications AG or your local distributor.

Frame relay is a connection-oriented technology that provides a fast packet-switching service for access to Wide Area Networks. It makes optimum use of available bandwidth using a complex statistical multiplexing algorithm. Due to the omission of some layer three network functions, Frame Relay is often thought of as a “streamlined version for X.25”.

Frame Relay is a flexible and cost-effective alternative to existing WAN technologies best suited for network installations exemplifying any of the following characteristics:

- Applications generate significant amounts of bursty traffic.
- Network traffic is delay-sensitive.
- High network availability is a major priority.
- Dispersed enterprise (locations separated by long distances).
- Integration with existing public and/or private, packet-switched networks is required.

1.1 An Overview of Frame Relay Technology

As the name suggests, it works by breaking data streams into variable length frames and forwards (relays) these frames into the network via predetermined logical connections called Permanent Virtual Circuits, or PVCs.

Some of the key concepts of Frame Relay are listed below:

- Small, variable length frames are used to transport user data;
  this makes frame relay well suited for data applications (particularly those generating bursty-traffic) - video and voice transmissions are generally not appropriate.
- Improved overall performance (compared to X.25 - a result of limited error correction and acknowledgment routines.
- Users are guaranteed a minimum amount of bandwidth which is always available (the Committed Information Rate section A, chapter 1.3.1, page 13, or CIR).
- High network availability is achieved through statistically multiplexing virtual connections (data streams) onto logical connections, or Permanent Virtual Circuits (PVCs).

- Integrated bandwidth allocation (true bandwidth on demand) allows users to take up additional bandwidth, when available, at no extra charge - based on the user's Committed Burst Rate section A, chapter 1.3.2, page 13 (CBR) and Excess Burst Rate section A, chapter 1.3.3, page 13 (EBR).

There are different types of equipment found in a typical Frame Relay Network based on the various tasks they perform.

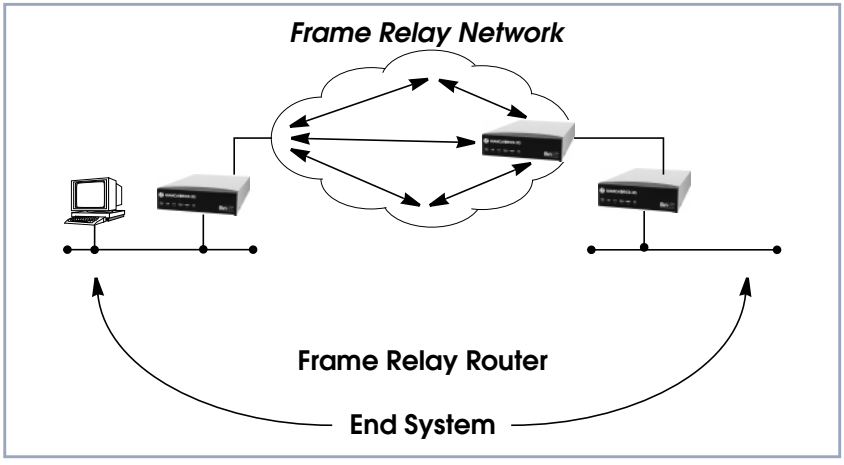

Figure A-1: Frame Relay Network

- End Systems
  End systems are typically end-user devices that take advantage (make use of) the underlying Frame Relay network. Depending on the application running on the end stations bandwidth requirements of end systems on the LAN can be different. Some applications generate large amounts of intermittent bursty traffic (typical of data applications, telnet, ftp, www) while others (like voice or video) require a constant bitrate.

- Frame Relay Routers
  Frame Relay Routers are used to connect point–to–multipoint networks (LANs) to a public (or private) Frame Relay network. It is the router's job to encapsulate data into Frame Relay frames for transport over the network link. A Frame Relay Router encapsulates LAN frames in frame relay frames and feeds those frames to a Frame Relay Switch for transmission across the network. A Frame Relay Router also receives frame relay frames from the network, strips the frame relay frame off each frame to product the orig-

inal LAN frame, and passes the LAN frame on to the end device. A Frame Relay Router communicates directly with one or more Frame Relay Switches to negotiate the opening/closing of virtual circuits and to control network congestion.

- Frame Relay Switches
  Switches are typically owned by public network providers but may be owned by private sites implementing private Frame Relay Networks. Aside from the FECN, BECN, and DE frame fields (used for congestion management) the content and final destination of individual frame is of no interest to the switch. Using a simple mapping scheme frames are passed from one interface (DLCI) to another.

1.2 Protocol Structure

1.2.1 Frame Relay Protocol Stack

Although similar in concept to X.25, frame relay operates at layer 2 of the OSI reference model. This is where the main differences between the two lie. Frame relay simply leaves out the extensive error detection/correction and end–to–end flow control found in X.25. This greatly simplifies the tasks a frame relay switch must perform.

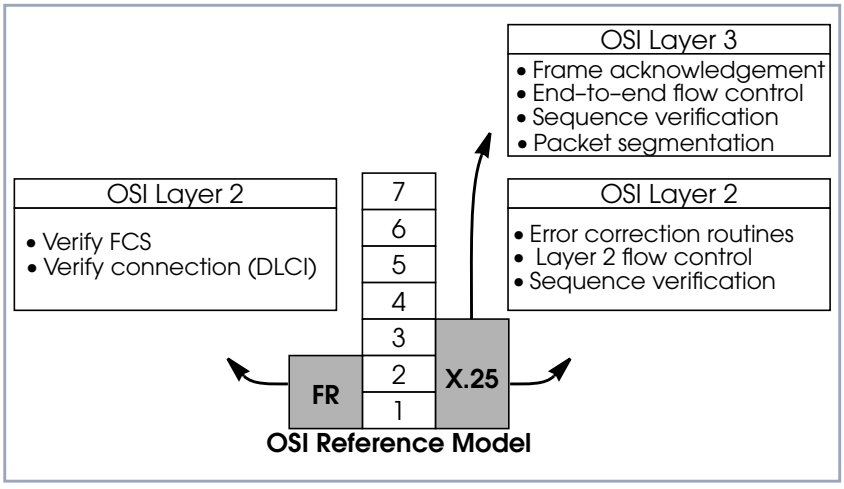

Figure A-2: Frame Relay in OSI Reference Model

1.2.2 Frame Relay Frame Format

As shown below frame relay is a streamlined protocol that uses HDLC framing. Virtual frame relay connections are routed based on the DLCI field of incoming frames.

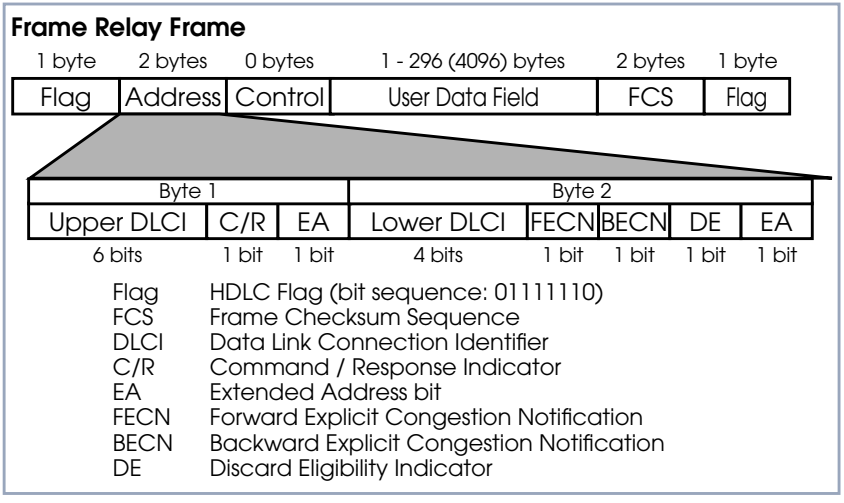

Figure A-3: Frame Relay Frame

1.2.3 Frame Relay Addressing

The basic (unextended) Frame Relay specification only supports locally significant addressing. These addresses are up to 2 bytes long. Using the EA fields extended addresses can be used which may be up to 4 bytes long.

When a frame is read the first EA bit that is set (i.e., it's value = *1*) determines the address.

1.2.4 Congestion Notification

The FECN and BECN bits (see above) are used to notify neighboring frame relay devices of possible congestion.

1.2.5 Virtual Circuits

In Frame Relay multiple connections are mapped to a single physical network connection.

1.2.6 Data Link Connection Identifier

The DLCI field is used to route virtual frame relay connections. A standard DLCI (2 byte address field) consists of 10 bits and is based on the frame's Upper and Lower DLCI fields. These 10 bits establish an upper limit of 1024, 210, possible simultaneous virtual channels that can be multiplexed on to a PVC.

The DLCI field is used to route virtual frame relay connections. A standard DLCI (2 byte address field) consists of 10 bits and is based on the frame's Upper and Lower DLCI fields. These 10 bits establish an upper limit of 1024, 210, possible simultaneous virtual channels that can be multiplexed on to a PVC.

DLCI	Use (Q.922)	Use (LMI)
0	Signalling	Reserved
1 - 15	Reserved	Reserved
16 - 511	Available (except when the D-channel is used)	Available
512 - 991	Available	Available
992 - 1007	Layer 2 management	Available
1008 - 1018	Reserved	Reserved
1019 - 1022	Reserved	Multicasting
1023	Consolidated Link Layer Management	Signalling

A DLCI is only significant to the local station. Though it is used locally to identify both directions of a virtual circuit it has no meaning to the next station (or the destination) in the frame relay network.

1.3 Frame Relay Services

Frame relay access can be purchased in a variety of configurations depending of your site's needs. Characteristics of the service you will receive include:

1. The type of physical connection you have to the frame relay network, ISDN or X.21.
2. The amount (from 56Kbps up to 2Mbps) and type of bandwidth available via this connection; this will include your guaranteed and excess rates. See CIR, CBR, and EBR earlier.
3. The number of PVCs you are receiving.

1.3.1 Committed Information Rate

When purchasing frame relay services from your provider, you will be assigned a Committed Information Rate. This defines the minimum amount of bandwidth that your provider guarantees to be available to your site at all times.

1.3.2 Committed Burst Rate

You will also receive a Committed Burst Rate with your service package. This is an additional amount of bandwidth (in excess of your CIR) you may use when network resources are available. The CBR is free of charge, but be aware that all frames that are in excess of your CIR will be DE (Discard Eligible) flagged and may be discarded by intermediate switches if the network becomes congested.

1.3.3 Excess Burst Rate

As Excess Burst Rate is also available; it defines the maximum data rate the service provider's network will attempt to sustain. Also note that all EBR traffic is flagged Discard Eligible.

1.4 The Frame Relay Subsystem

Frame Relay on the BinTec router consists of 5 SNMP system tables contained in the BinTec router's **fr** group. An overview of these tables is shown below. The full description of each SNMP object is contained on the following pages.

1.4.1 Overview: Frame Relay System Tables

Variable	Meaning
frGlobals	Global settings for Frame Relay on the BinTec router. Currently only contains the **frTrapState** object which is used to enable/disable **frDLCIStatusChange** traps on the BinTec router. (This trap indicates that the state of a particular Virtual Circuit has changed.)
frDlcmiTable	Contains parameters for each DLCM (Data Link Connection Management) interface for each instance of frame relay service on the BinTec router.
frCircuitTable	Contains information for each Data Link Connection Identifiers and corresponding virtual circuits.
frErrTable	Used to store important status messages reported for interfaces configured with Local Management Interface.
frMprTable	Contains Multiprotocol Routing over Frame Relay interfaces (MPFR) on the BinTec router. These interfaces are Virtual interfaces since they do not necessarily map to a single hardware interface. MPFR interfaces may be used by higher level protocols.

Table A-1: **Frame Relay System Tables**

biboAdmSyslogMessage	-Level
Attach link <ifindex> failed	debug
Attach link <ifindex>	debug
Bind link <ifindex> failed	debug
Link <ifindex> bound; starting LMI	debug
Be exceeded - packet discarded	debug
Want open ifc <ifindex>	debug
Unknown ARP protocol <proto>	debug
No license	info
DLCI out of range: <dlci>	notice
No more than 256 interfaces allowed	error
Create: illegal index <ifindex>	error
Create: index <ifindex> already exists	error

Table A-2: **biboAdmSyslogMessage**

1.4.2 Frame Relay Setup Tool Menus

Several menus have been added to Setup Tool to allow for easy configuration of Frame Relay on the BinTec router. An overview of the menu structure is shown below. Individual submenus are described in detail on the following pages.

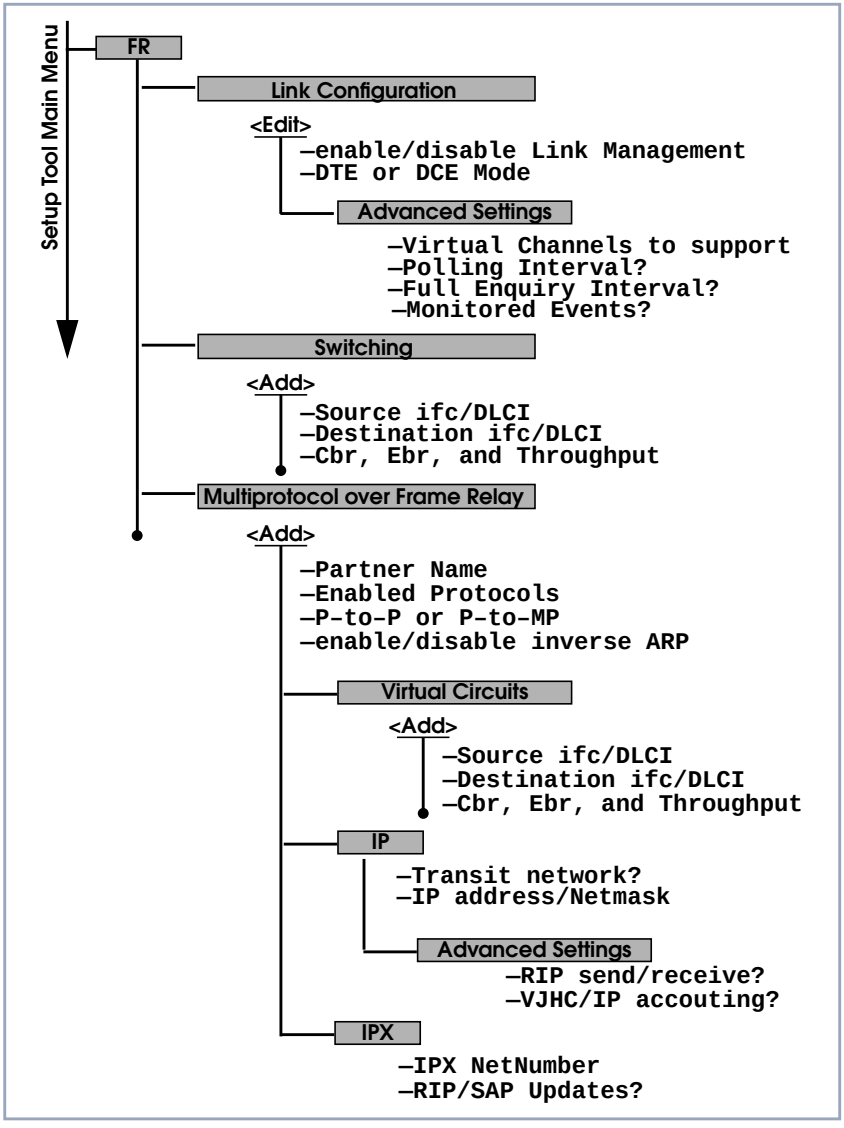

Figure A-4: Setup Tool Menu Structure

1.4.3 Setup Tool Menus

Frame Relay on the BinTec router can be configured from Setup Tool using the three menus available here.

```
BinTec router Setup Tool                        BinTec Communications AG
[FRAME RELAY]: Frame Relay Configuration                        MyRouter


                    Link Configuration
                    Switching
                    Multiprotocol over Frame Relay

                    EXIT


Press <Ctrl-n>, <Ctrl-p> to scroll through menu items, <Return> to
enter
```

Field	Meaning
Link Configuration	contains the settings relative to the layer 2 of Frame Relay interface.
Switching	lists settings for each Frame Relay Virtual Circuit.
Multiprotocol over Frame Relay	lists all existing MPFR interfaces configured on the BinTec router.

Table A-3: ***FR*** ➧ ***FRAME RELAY CONFIGURATION***

➤ Go to ***FR*** ➧ ***LINK CONFIGURATION.***
This menu lists the available links that may be configured as the transport layer of a Frame Relay interface. Use the menu shown below (First select the link and press **Enter**) to edit link's settings.

```
BinTec router Setup Tool                        BinTec Communications AG
[FRAME RELAY][LINK][EDIT]: Frame Relay Link Configuration     MyRouter


    Link
    Line Management
    Mode

    Advanced Settings


                  SAVE                  CANCEL

Press <Ctrl-n>, <Ctrl-p> to scroll, <Return> to edit/select
```

Field	Meaning
Link	Shows the link that is currently being edited.
Line Management	Determines whether or not link management is being performed on this link. Currently, the method described in Q.933 is supported.
Mode	Defines the mode (DTE or DCE) the BinTec router operates at for this connection. Note that one side of the link must operate as DTE and one as DCE.

Table A-4: ***FR*** ➧ ***LINK CONFIGURATION***

➤ Go to ***ADVANCED SETTINGS.***
This menu can be used to configure special settings relating to line management for Frame Relay interfaces on the BinTec router. Some options only apply to BinTec router operating in DTE or DCE mode.

```
BinTec router Setup Tool                        BinTec Communications AG
[FRAME RELAY][LINK][EDIT][ADVANCED]: Advanced Link Configuration
                                                                MyRouter


    Supported Virtual Channels       250

    Polling Interval                 10
    Full Enquiry Interval            6
    Idle Interval                    15
    Error Threshold                  3
    Monitored Events                 4


                OK                   CANCEL

Enter integer range 1...250
```

Field	Meaning
Supported Virtual Channels	This field can be used to control how many Virtual Channels this Link supports; a maximum of 250 (default) VCs are possible.
Polling Interval	When set for DTE mode (client) and q933a line management is enabled this field determines the number of seconds between successive status enquiry messages sent out by the BinTec router. (Default 10 seconds).
Full Enquiry Interval	When set for DTE mode (client) and q933a line management is enabled this field determines the number of status enquiry intervals that pass before issuing a full status enquiry message (default 6 intervals).
Idle Interval	When set for DCE mode (server) and line management is enabled this field defines the number of seconds within a status enquiry messages should be received (default 15 seconds).
Error Threshold	When line management is enabled, this field defines the maximum number of unanswered Status Enquiries the BinTec router accepts before declaring the interface down (default 3 messages).
Monitored Events	When line management is enabled this field defines the number of status polling intervals over which the error threshold (previous field) is counted. For example, if within **MonitoredEvents** number of events the station receives **ErrorThreshold** number of errors, the interface is marked as down (default 4 intervals).

Table A-5: ***FR*** ➧ ***LINK CONFIGURATION*** ➧ ***ADVANCED SETTINGS***

- Go to ***SWITCHING.***
  This menu is used to configure frame relay switching functionality on the BinTec router. When used as a Frame Relay switch this menu can be used to configure routes, or mappings (i.e., from incoming interface/DLCI to outgoing interface DLCI).
  Frame Relay routes can be added, removed, or changed here.

```
BinTec router Setup Tool                    BinTec Communications AG
[FRAME RELAY][SWITCHING]: Frame Relay Switching              MyRouter


    Source                Destination
Interface    DLCI     Interface    DLCI     Bc       Be       Throughput


             ADD              DELETE               EXIT
```

- Select ***ADD*** to create a new Frame Relay route.
- Select ***DELETE*** to remove a Frame Relay route entry that has been tagged (using the spacebar) for deletion.
- Select ***EXIT*** to accept the list of Frame Relay routes and return to the previous menu.
  To edit a Frame Relay route, highlight the entry and then enter **Return**. When adding or changing an entry the following information must be provided.

Field	Meaning
Source Interface	Use the spacebar and scroll through the list of Frame Relay interfaces to select the source interface for this route.
Source DLCI	Defines the DLCI of the source interface for this route.
Destination Interface	Use the spacebar to scroll through the list of Frame Relay interfaces and select the destination interface.
Destination DLCI	Use the spacebar to scroll through the list of Frame Relay interfaces and select the destination interface.
Committed Burst Rate (Abbreviated **Bc**)	This field defines the maximum amount of data (in bits) to transfer under normal conditions.
Excess Burst Rate (Abbreviated **Be**)	This field defines the maximum amount of uncommitted data (in bits) to attempt deliver.
Throughput	This field defines the physical throughput for this interface (and defaults to **ifSpeed**).

Table A-6: ***FR*** ➧ ***SWITCHING***

➤ Go to ***MULTIPROTOCOL OVER FRAME RELAY.***
This menu lists Multiprotocol Routing over Frame Relay interfaces on the BinTec router. MPFR interfaces can be added, removed, or changed here.

```
BinTec router Setup Tool                    BinTec Communications AG
FRAME RELAY][MPR]: Frame Relay Multiprotocol Routing          MyRouter


   Interface Name       Type


       ADD              DELETE          EXIT
```

Field	Meaning
Interface Name	Identifies the interface name (taken from the **ifDescr** object from the **ifTable**).
Type	Specifies whether the interface is a point–to–point, or point–to–multipoint interface.

Table A-7: ***FR*** ➧ ***MULTIPROTOCOL OVER FRAME RELAY***

ADD ➤ Go to ***ADD.***
This menu is used to create (or change) MPFR (Multi-Protocol routing over Frame Relay) interfaces on the BinTec router.

```
BinTec router Setup Tool                        BinTec Communications AG
[FRAME RELAY][MPR][ADD]: Configure Frame Relay MPR Partner    MyRouter


Partner Name

Interface Type                multipoint
Inverse ARP                   enabled



Virtual Circuits>
IP>
IPX>

                  SAVE                        CANCEL

Enter string, max length = 25 chars
```

Field	Meaning
Partner Name	Define a unique name to identify this MPFR partner.
Interface Type	Determines the interface type as being either “multipoint” or “point to point”.
Inverse Arp	Enables/disables inverse ARP over this interface.

Table A-8: ***FR*** ➧ ***MULTIPROTOCOL OVER FRAME RELAY*** ➧ ***MULTIPROTOCOL ROUTING***

➤ Go to ***VIRTUAL CIRCUITS.***
This menu should only be used by sites receiving multiple DLCIs from their Frame Relay service provider. Depending on the number of DLCIs and type of service being received use this menu to define the appropriate data rates.

```
BinTec router Setup Tool                          BinTec Communications AG
[FRAME RELAY][MPR][VC]: Configure Frame Relay Virtual Circuits
                                                                  MyRouter


        Source                  Destination
    Interface    DLCI     Interface    DLCI     BC   Be   Throughput


              ADD               DELETE            EXIT
```

Field	Meaning
Source Interface	Using the spacebar, scroll through the list of Frame Relay interfaces.
Source DLCI	Defines the DLCI used on this interface.
Committed Burst Rate	The maximum amount of data that is guaranteed to be transferred by the service provider.
Excess Burst Rate	The amount of additional data that is uncommitted by the service provider.
Throughput	The physical throughput of this interface.

Table A-9: ***FR*** ➧ ***MULTIPROTOCOL OVER FRAME RELAY*** ➧ ***VIRTUAL CIRCUITS***

IP ➤ Go to ***IP.***
This is where you configure the IP settings for this remote MPFR partner.

The settings used in this menu are the same as those used in the ***WAN PARTNER*** ➧ ***ADD*** ➧ ***IP*** menu described in the User's Guide but only apply to this MPFR partner.

IPX ➤ Go to ***IPX.***
This is where you configure the IP settings for this remote MPFR partner.

The settings used in this menu are the same as those used in the ***WAN PARTNER*** ➧ ***ADD*** ➧ ***IPX*** menu described in the User's Guide but only apply to this MPFR partner.

1.5 Example Configuration using Setup Tool

1.5.1 Frame Relay over ISDN Lines

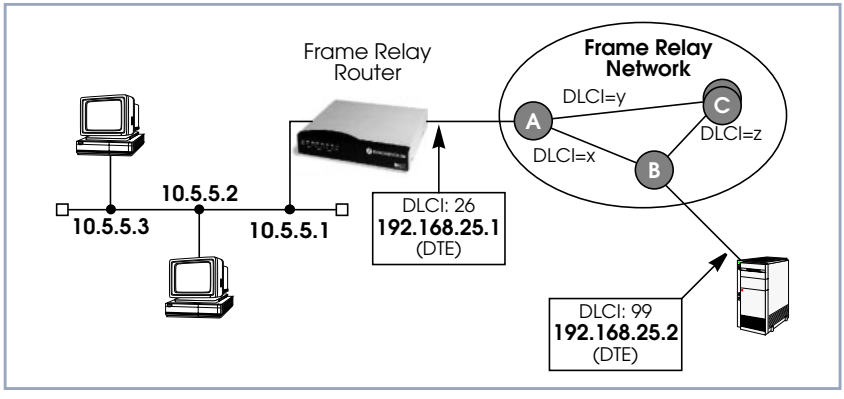

Figure A-5: Scenario: Frame Relay over ISDN Lines

Requirements Frame Relay requires a separate license to be installed on the BinTec router.

➤ After installing your license verify the Frame Relay is listed as “valid” in Setup Tool’s License menu (or the Status field for the frame_relay entry in the **biboAdmLicInfoTable** shows valid_license).

Step 1

Define the physical interface

➤ In Setup Tool’s main menu select the ISDN interface where the Frame Relay service is being received.

```
BinTec router Setup Tool                        BinTec Communications AG
[WAN][ADD]: WAN Interface                                       MyRouter

Result of autoconfiguration:          Euro ISDN, point to multipoint

ISDN Switch Type                      autodetect on bootup

D-channel                             dialup
B-channel                             dialup
B-channel                             dialup


Incoming Call Answering>
Advanced Settings>

                 SAVE                 CANCEL

Use <Space> to select
```

➤ You should verify the **Result of autoconfiguration** field is correct. If this interface is a leased line or it was not properly detected set the Switch Type and D/B channel fields appropriately here and **SAVE** the settings.

Step 2

Configure a new WAN Partner

➤ Create a new interface in the ***WAN Partner*** ➧ ***ADD*** menu.
This step defines the (physical) link to the next switch in the Frame Relay network (host A shown above).

```
BinTec router Setup Tool                        BinTec Communications AG
[WAN][ADD]: Configure WAN Partner ()                              MyRouter

Partner Name                        FRprovider

Encapsulation                       Frame Relay
Encryption                          none
Calling Line Identification         no


WAN Numbers>
PPP>
Advanced Settings>


IP>
IPX>
BRIDGE>

Use <Space> to select
```

➤ After defining a partner name select the **Encapsulation** *Frame Relay* and configure no other protocol. Under **WAN Numbers** select the ISDN port (from step 1) to use and **SAVE** the settings.

Step 3

Configure the Frame Relay Link Settings

➤ Go to the ***FR*** ➧ ***LINK CONFIGURATION*** menu and select the physical link (partner name) you configured in the previous step and press enter to set the desired parameters. It is very important that you set the **Mode** field to *dte* here if the BinTec router is operating as a Frame Relay router.

```
BinTec router Setup Tool                        BinTec Communications AG
[FRAME RELAY][LINK][EDIT]: Frame Relay Link Configuration         MyRouter



Link                        FRprovider
Line Management             none
Mode                        dte


Advanced Settings>


                  SAVE                  CANCEL

Use <Space> to select
```

➤ Optionally, you can define whether Link Management should be performed for this link. If Link management is to be performed on this link, several options are available via the Advanced Settings sub-menu that control how often various LMI packets to send to the server (DCE) and the intervals at which these enquiries are sent.

Step 4

Configure the Multi-Protocol Routing Interface

➤ Go to the ***MULTIPROTOCOL OVER FRAME RELAY*** menu and select **ADD** to create a new MPFR (Multi-Protocol routing over Frame Relay) partner interface. This step will define the virtual interface to the end-system (host at IP address 192.168.25.2 in the diagram above) IP packets will be routed to/from.

When enabling protocols to route over Frame Relay please note that at current, only IP over Frame Relay has been tested on the BinTec router.

```
BinTec router Setup Tool                        BinTec Communications AG
[FRAME RELAY][MPR][ADD]: Configure Frame Relay MPR Partner    MyRouter

Partner Name                  FRpartner

Interface Type                point to point
Inverse Arp                   disabled


Virtual Circuits>
IP>
IPX>

                  SAVE                  CANCEL

Enter string, max length = 25 chars
```

Step 5

Select Frame Relay Interface

➤ Go to ***VIRTUAL CIRCUITS*** ➧ ***ADD*** to select the interface to use for the Frame Relay partner.

```
BinTec router Setup Tool                        BinTec Communications AG
[FRAME RELAY][MPR][ADD][Switching][ADD]: Configure Frame Relay Virtual
Circuits                                                        MyRouter


        Source Interface              xi2
        Source DLCI                   16


        Committed Burst Rate          64000
        Excess Burst Rate             0
        Throughput                    64000


                OK                    CANCEL

Use <Space> to select
```

The most important setting, however, is the following (see table A-9, page 24 for the description of the Virtual Circuit parameters):

Field	Meaning
Source Interface	In this field one of the WAN Partners with Frame Relay encapsulation can be selected.

Table A-10: ***FR*** ➧ ***MULTIPROTOCOL OVER FRAME RELAY*** ➧ ***ADD*** ➧ ***VIRTUAL CIRCUITS*** ➧ ***ADD***

Step 6

Configure IP settings for MPFR Interface

➤ In the ***IP*** submenu configure the IP settings for the remote Frame Relay end station (192.168.25.2 in our example diagram). A transit network is optional. Select **SAVE** to ensure your Frame Relay setup is saved to a configuration file.

```
BinTec router Setup Tool                       BinTec Communications AG
[FRAME RELAY][MPR][IP]: IP Configuration (FRpartner)           MyRouter


IP Transit Network                     no



Partner’s LAN IP Address>              192.168.25.2
Partner’s LAN IP Netmask>              255.255.255.0


Advanced Settings>

                SAVE                   CANCEL

Enter string, max length = 25 chars
```