Chapter 7

Routing with Frame Relay, X.25, and SNA

This chapter discusses Frame Relay, X.25, and SNA Routing. Also see the following:

- Section 4.2, Identifying the BANDIT in the Network
- Section 4.3, Defining Global Paths
- Section 10.2.2, Ping
- Step 4 (Trace Route) in Section 10.1, System Tools

7.1 Routing

The Routing option allows you to perform address mapping, or routing, by establishing routing tables that guide packets on their paths through the network. The unit can route packets conforming to the IP, IPX, Frame Relay, X.25, Annex G (that is, X.25 over Frame Relay), and SNA protocols. This chapter provides detailed information and procedures for configuring Frame Relay, X.25, and SNA routing.
Note: IP and IPX routing are discussed in Chapter 6, IP Routing and IPX Routing.

The units are designed to look at the address portion of these packets and route them to the corresponding port, according to the routing tables. If routing entries have already been made, you are given the option to add, modify, or delete entries.

1. On the Main Menu, select Advanced Configurations, then Routing.

   - When you select Routing on the Advanced Configurations menu, the Configure Routing menu is displayed:

```
  Configure Routing
  ------------------
  1) IP Routing
  2) IPX Routing
  3) Frame Relay Routing
  4) X.25 Routing
  5) SNA Routing
  Enter Choice :
```

### 7.2 Frame Relay

You can configure use of synchronous or asynchronous Frame Relay in the BANDIT devices. Transporting data over a Frame Relay network has many benefits:

- Can carry many connections over a single line.
- Shares bandwidth with multiple applications and/or call sessions.
- Can handle bursty traffic.
- Provides high-speed and low-delay similar to Time Division Multiplexing (TDM).
- Provides access to public Frame Relay services (not based on usage) that are usually lower cost than those for leased lines.
The BANDIT provides a cost-efficient means for connecting legacy equipment to a Frame Relay network by translating protocols into a format that can be transmitted over a Frame Relay network. After the unit translates the data, it routes the data across the Frame Relay network to another unit or Frame Relay-compatible device. When it reaches the destination device, the data is translated back to the original protocol.

The BANDIT can also concentrate and switch multiple sources of Frame Relay traffic simultaneously.

**Note:** Before configuring Frame Relay parameters, study the information in Section 7.2.2, *Heartbeat Polling*, and Section 7.2.3, *FastPROTECT with Priority.*

### 7.2.1 Using DLCIs for Frame Relay

Because a single physical connection to a Frame Relay network can support a large number of applications or sessions, a method is required to uniquely identify the data flow associated with each application or session. This is performed in Frame Relay by way of logical connections or Virtual Circuits (VCs). Frame Relay’s VCs are called Data Link Connections (DLCs). Each DLC has an identifying number, known as a Data Link Connection Identifier (DLCI). This DLCI is used in the Frame Relay packet header as an address for the data contained in the packet.

Although Frame Relay supports switched service that allows connections to be temporarily established, most Frame Relay services (and equipment used to provision the services) implement DLCs as Permanent Virtual Circuits (PVCs)—i.e., the connections are preconfigured by the network operator at the time of subscription. The assigned DLCIs must be configured for your unit. It is important to note that a DLCI has local significance only; the other end of a PVC probably has a different DLCI.

For example, suppose a PVC has been provisioned between site A and site B. The PVC is assigned a DLCI of 100 at site A, and a DLCI of 500 at site B. Data sent from site A with a DLCI of 100 is carried over the first PVC to arrive at site B. Similarly, data sent from site B must use a DLCI of 500 to arrive at site A.

The Frame Relay interface standard defines a maximum of 1024 possible DLCIs. Of these, two DLCIs (0 and 1023) have been reserved for signaling, and 30 DLCIs (1 to 15 and 1008 to 1022) have been reserved for future use. That leaves 992 DLCIs (16 to 1007) available for subscriber use on each physical interface to the network.
7.2.2 **Heartbeat Polling**

Heartbeat polling is the procedure by which the user device requests PVC status information and detects faults in the network connection or the user-to-network interface, as follows:

**Note:** This information can be acquired from the Frame Relay carrier. The defaults set in the unit are appropriate for most networks.

1. Every $T_1$ seconds (time value 1, in seconds), the user device sends a STATUS_ENQUIRY message to the network. This message is typically a request for the Sequence Number Exchange Only (report type = “00000001”).

2. Every $N_1$ polling intervals, the user device sends a Full Status Message request (report type = “00000000”) to the network.

3. The network responds to the STATUS_ENQUIRY message with a STATUS message. The STATUS report type matches the report type of the STATUS_ENQUIRY message—i.e., either Sequence Number Exchange Only or Full Status Message.

4. The unit examines the STATUS message, and updates its internal database according to the PVC Status Information Element (IE).

5. An error has occurred if:
   - The report type of the STATUS message does not match the report type of the most recently transmitted STATUS_ENQUIRY request.
   - The unit does not receive a STATUS message within $T_1$ seconds after sending the STATUS_ENQUIRY message.
   - The network device does not receive a STATUS_ENQUIRY message within $T_2$ seconds of the last STATUS_ENQUIRY.

7.2.3 **FastPROTECT with Priority**

FastPROTECT™ is a congestion management feature that allows traffic to be discarded to protect the unit from memory overload. In the congestion management scheme, only data going out a Frame Relay port is subject to discarding. The discard algorithm discards packets, based on the number of memory buffers available and according to the priority assigned to that
packet. At 25% of available buffers, both Low and Medium priority data are discarded. At 10% of available buffers, High priority traffic is discarded. At 20 or fewer buffers, Immediate priority data is also discarded.

7.2.4 Frame Relay Routing

This procedure configures Frame Relay ports and their corresponding DLCIs when the BANDIT is used as a Frame Relay switch.

**Note:** To configure the Frame Relay protocol (in addition to Frame Relay routing), see Section 7.2.5, Frame Relay Protocol.

1. To configure Frame Relay routing, do the following:

   a. Log in to the BANDIT. (See Section 3.2, Connecting a Supervisory Terminal and Logging in to the BANDIT.)

   b. On the Main Menu, select Advanced Configurations. (See Section 3.3, The Main Menu.)

   c. On the Advanced Configurations Menu, select Routing. (See Section 3.3.4, The Advanced Configurations Menu.)

   d. On the Routing menu, select Frame Relay Routing. (See Section 7.1, Routing.)

      • If the routing table is empty, prompts will ask you to add a path name and to indicate the priority for outgoing traffic.

Empty Frame Relay Routing Table
Add Frame Relay Routing Table Entry

Add First Frame Relay Path Name
Enter Path Name (1 to 10 Characters): FR01
2  Type a name for a Frame Relay path.
   ✗ If the path name does not exist, a prompt asks whether you wish to add it to the Path table.

Path Name Does Not Exist In GPT Table.
   To Add Global Path Entry, Press 'Y' or Enter. Press Escape Otherwise.  y

3  Answer y (or n, if you choose not to add the path name to the table).
   ✗ A prompt lets you choose the path type.

   Global Path Types
   ------------------
   1) X25 SVC
   2) X25 PVC
   3) Frame Relay PVC
   4) Port Type
   5) IP/UDP

   Enter Choice : (1 to 5)[1] : 3

4  Choose Frame Relay PVC.
   ✗ A prompt asks which port the path uses.

   Enter FR Port Number  (L (LAN), W (WAN), M (MODEM), S (SERIAL),) : S

5  Choose the port that uses Frame Relay (in this example, we choose the serial port).
   ✗ A prompt asks for the Frame Relay DLCI.

   Enter FR DLCI Number (16-1007) : 16
6. Enter the DLCI assigned by the Frame Relay carrier.
   - A prompt asks whether there is a backup DLCI.

   ![Do You Want Backup DLCI? (Y/N)[N] : N]

7. Answer **y** or **n** to indicate whether there is a backup DLCI.
   - If there is a backup DLCI, you must enter its information.
   - When configuration of the path is complete, a message indicates that the path has been added to the Global Path Table (GPT).

   ![GPT Entry added.]

   - Then a prompt asks for the priority of traffic on the DLCI.

   ![Enter Priority { default = Medium } for outgoing traffic on DLCI 16, port: SERIAL
   (1) Immediate
   (2) High
   (3) Medium
   (4) Low
   Enter Choice : 3]

8. Select the DLCI’s traffic priority.
   - A message indicates the DLCI information.

   ![Priority set to Medium for DLCI 16 on port: SERIAL]
Then the BANDIT asks for another path name.

Add Second Frame Relay Path Name
Enter Path Name (1 to 10 Characters):

9 Do one of the following:

a If you wish to enter another path name, return to Step 2

b If there is not another path name, press Escape.

A prompt indicates that configuration of the Frame Relay Routing Table has completed.

Frame Relay Routing Table Handling Complete

When the routing table has been set up, the Configure Routing menu is displayed again.

Configure Routing
-----------------
1) IP Routing
2) IPX Routing
3) Frame Relay Routing
4) X.25 Routing

Enter Choice :

10 When you have finished configuring Frame Relay routing, press Escape to return to the Routing menu. (See Section 7.1, Routing.)
7.2.5  Frame Relay Protocol

**Note:** If you are using the Frame Relay port for Frame Relay Passthrough or for Frame-Relay-to-Frame-Relay Switching, you must complete the Frame Relay Routing Table (see Section 7.2.4, Frame Relay Routing).

See Section 9.2.7, Frame Relay Statistics, for a description of the statistics used to monitor this protocol.

1. From the Main Menu, select Advanced Configurations, Data Configurations >> Serial Port >> Undefine Logical Port. Then select Protocol >> Frame Relay.

   - When you select Frame Relay from the Logical Port Protocol Selection Menu, the following menu is displayed:

     Frame Relay Management Parameters : SERIAL
     ---------------------------------------------------------------------------
     1) Type     : Synchronous Frame Relay
     2) Speed    : 56000
     3) Protocol : Adaptive Management - User
     4) Value N1 : 6
     5) Value N2 : 3
     6) Value N3 : 4
     7) Timer T1 : 10
     8) Timer T2 : 15
     9) Priority / CIR Enforcement : Disabled
        A) High to Medium Ratio : 4:1
        B) Medium to Low Ratio : 4:1
        C) DLCI CIR Information
        D) FRF-12 Fragmentation : Disabled

     Enter Choice :

2. Select Type. This parameter specifies whether the clock type is synchronous or asynchronous.

   - The following menu options are displayed:
Select the type of clocking you want.

3 Select **Speed**. This parameter sets the clock speed.

- One of the following list of speeds is displayed:
  - **Synchronous speeds:**

    | Configure Synchronous Clock Speed |
    |-----------------------------------|
    | 1) 2400                           |
    | 2) 4800                           |
    | 3) 9600                           |
    | 4) 19200                          |
    | 5) 38400                          |
    | 6) 48000                          |
    | 7) 56000                          |
    | 8) 64000                          |
    | 9) 96000                          |
    | A) 128000                         |
    | B) 192000                         |
    | C) 256000                         |
    | D) 384000                         |
    | E) 512000                         |
    | F) 768000                         |
    | G) 1024000                        |
    | H) 1536000                        |
    | I) 2048000                        |

Enter Choice:
• Asynchronous speeds:

<table>
<thead>
<tr>
<th>Configure Asynchronous Clock Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) 1200</td>
</tr>
<tr>
<td>2) 2400</td>
</tr>
<tr>
<td>3) 4800</td>
</tr>
<tr>
<td>4) 9600</td>
</tr>
<tr>
<td>5) 19200</td>
</tr>
<tr>
<td>6) 38400</td>
</tr>
<tr>
<td>7) 48000</td>
</tr>
<tr>
<td>8) 57600</td>
</tr>
<tr>
<td>9) 115200</td>
</tr>
<tr>
<td>A) 230400</td>
</tr>
</tbody>
</table>

Enter Choice :

**Note:** When the port is configured as DTE, as opposed to DCE, the parameters menu reflects that the speed is provided by the device connected to the unit. In this case, you do not need to configure speed. If you attempt to configure the speed, the following message is displayed, and you are returned to the parameters menu:

**Port is DTE, Can Not Change Speed**

**4 Protocol.** This option allows you to select the Frame Relay management protocol you are using. Select Protocol.

- The following menu is displayed:

<table>
<thead>
<tr>
<th>Frame Relay Management Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) ANSI T1.617 Annex D - User</td>
</tr>
<tr>
<td>2) CCITT Q.933 Annex A - User</td>
</tr>
<tr>
<td>3) LMI - User</td>
</tr>
<tr>
<td>4) Adaptive Management - User</td>
</tr>
<tr>
<td>5) ANSI T1.617 Annex D - Network</td>
</tr>
<tr>
<td>6) CCITT Q.933 Annex A - Network</td>
</tr>
<tr>
<td>7) LMI - Network</td>
</tr>
<tr>
<td>8) Adaptive Management - Network</td>
</tr>
<tr>
<td>9) None</td>
</tr>
</tbody>
</table>

Enter Choice :
**Note:** Frame Relay can also be run without management protocol. Your Frame Relay carrier or Network Administrator can tell you which protocol to use. The default is *Adaptive Management - User*.

a Select the Frame Relay Management protocol you want to use.

- The new protocol is displayed on the Frame Relay Management Parameters menu.

**Note:** The Frame Relay Management protocol provides access procedures for the detection and notification of:

- Addition of a PVC
- Deletion of a PVC
- Availability (active state) of a configured PVC
- Unavailability (inactive state) of a configured PVC
- Local In-channel Signaling link reliability errors
- Local In-channel Signaling link protocol errors
Note: Currently there are three management standards and two additional options. The management standards include:

- ITU Q.933 Annex A
- ANSI T1.617 Annex D
- Frame Relay Forum’s Local Management Interface (LMI)

Annex A and Annex D are quite similar; however, they are incompatible with LMI. Annex A and Annex D use DLCI 0, whereas LMI uses DLCI 1023. Our products can support either the Network or User side of these protocols.

There are two additional Frame Relay network management options: Adaptive Management/User and Adaptive Management/Network. These protocols allow the unit to automatically detect whether ANSI T1.617 Annex-D or LMI is being used. Once LMI or Annex D has been identified, the port continues to use that protocol until the unit is reset. If in Network mode, the unit determines its actual protocol from the first received Status Enquiry. If in User mode, the unit alternates between issuing Annex-D and LMI Status Enquiries until a Status Response is received. The Frame Relay statistics screen indicates which protocol is being used.

5

Select Value N1. This parameter determines the number of Status Inquiry/Status Polling Cycles that occur before a Full Status Polling Cycle is initiated.

△ The following prompt is displayed:

```
Enter Desired Frame Relay Value N1 (1 - 255):
```
Enter the Frame Relay value you want to use and press Enter.

- This changes the value to the number you typed and returns you to the “Frame Relay Management Parameters” menu.

Select Value **N2**. This parameter sets the error threshold count (N2). The error threshold count (N2) reflects the number of Local In-channel Signaling Link Reliability Errors that are allowed to occur during a Sliding Monitored Events Window before the link is considered down.

- The following prompt is displayed:

```
Enter Desired Frame Relay Value N2 (1 - 10):
```
Enter Desired Frame Relay Value N3 (1 - 10):

**Note:** The Value and Timer defaults were set to match the Frame Relay Forum standards. They should not be changed unless necessary.

**Note:** Value N3 is the number of monitored events (such as the expiration of a timer, the receipt of a Status Enquiry message, etc.) within which a predetermined number of N2 errors must be detected before the link is considered down. This value also reflects the number of monitored events that must occur with no N2 errors before the link is considered back up.

**a** Enter the Frame Relay value you want to use and press **Enter**.

❖ This changes the value to the number you typed and returns you to the “Frame Relay Management Parameters” menu.

**Note:** LMI Default = 4 events
Annex D N393 Default = 4 events
Annex A N393 Default = 4 events

**8** **Timer T1.** This parameter sets the Link Integrity Verification Timer, which indicates how frequently the unit should initiate a Status Inquiry Message. Select Timer T1.

❖ The following prompt is displayed:

Enter Desired Frame Relay Timer T1 (5 - 30):
Note: The Value and Timer defaults were set to match the Frame Relay Forum standards. They should not be changed unless necessary.

Note: When N2 errors of the last T1 number of monitored events contain an error, the device declares a failed link.

For example, assuming the default values of N2 = 2 and T1 = 10 seconds, it takes 20 seconds to detect a failed link. All PVCs on the failed link are set to inactive.

T1 is the length of the time spent waiting for a STATUS message after sending STATUS_ENQUIRY (user devices).

Note: The device continues to send STATUS_ENQUIRY messages. The link is removed from the failed state after receiving N3 consecutive messages without an error.

For example, assuming the default values of N3 = 4 and T1 = 10, it would take 40 seconds for the link to restore to active status.

When the link is restored to active status, the network device immediately sets all PVCs on the link to active. The user device sets the PVCs to the status indicated by the first PVC status Information Element that is successfully received.

Type the Frame Relay value you want to use and press Enter.

This changes the value to the number you typed and returns you to the “Frame Relay Management Parameters” menu.

Note: LMI Default = 10 seconds
Annex D T391 Default = 10 seconds
Annex A T391 Default = 10 seconds
9  **Timer T2.** This option allows you to set the Polling Verification Timer, which indicates the length of time the network should wait between Status Inquiry messages. Select Timer T2.

- The following prompt is displayed:

```
Enter Desired Frame Relay Timer T2 (5 - 30):
```

**Note:** The Value and Timer defaults were set to match the Frame Relay Forum standards. They should not be changed unless necessary.

**Note:** If no Status Inquiry message is received within T2 seconds, the network records an error.

a  Type the Frame Relay value you want to use and press **Enter**.

- This changes the value to the number you typed and returns you to the “Frame Relay Management Parameters” menu.

**Note:** LMI Default = 15 seconds  
Annex D T392 Default = 15 seconds  
Annex A T392 Default = 15 seconds

10  Select **Priority/CIR Enforcement.** This parameter enables or disables priority queuing on the Frame Relay port. Priority queuing allows you to assign Immediate, High, Medium, or Low priority to data being transmitted. Priorities can be set for a given DLCI’s protocol or address range, or for an entire DLCI, without restrictions.

For example, you can assign a priority to particular protocol. In this way, you might assign SNA traffic a high priority level, IPX traffic a medium priority, and IP traffic a low priority.
You can assign different priority levels to distinct address ranges going out the same DLCI. You might do this in the IP Routing Table when configuring IP traffic. For instance, you might assign high priority to IP traffic with a given address range going to users and assign low priority to IP traffic with a different address range going to a printer. This feature cannot be used with routing protocols that automatically build their own routing tables, such as IP RIP, or IPX, unless you configure the priority on their interfaces individually.

In some cases, you can assign a priority to a given DLCI, so that any traffic traveling through that DLCI maintains the assigned priority, regardless of data type or address. For example, you might set up a Frame Relay routing table, assigning a high priority to a Network DLCI being used to send traffic to an ATM machine and a low priority to a different Network DLCI used to send traffic to a server. In this table, you cannot assign two or more priorities to the same DLCI as you can in the IP Routing Table example above.

When buffer space is low, as in the case of a network malfunction, data may be discarded in the following order: low, medium, high and then immediate priority. This phenomenon occurs regardless of whether the queuing function is enabled or disabled in the Priority field.

You can monitor data throughput and the reception of BECN bits, which indicate congestion in the Frame Relay network, on an overall or DLCI basis. Statistics for available and excess bandwidth are maintained and recalculated as needed for each DLCI.

The following options are displayed:

```
Frame Relay Priority / CIR Enforcement
---------------------------
1) Enable
2) Disable
Enter Choice :
```

- Select the option you want.
- Select High to Medium Ratio or Medium to Low Ratio.
**High to Medium Ratio** and **Medium to Low Ratio.** These options define a byte ratio of high-to-medium or medium-to-low traffic. The Priority level is set according to average ratio of bytes. However, all transmissions are sent in whole frames.

Suppose a transmission contains 230 bytes, and these 230 bytes are composed of:

- 2 frames at 160 and 10 bytes, respectively, of High priority
- 40 bytes of Medium priority traffic
- 20 bytes of Low priority traffic.

If the high-to-medium ratio is set to 4:1, and the medium-to-low ratio is set to 2:1, the transmission would rotate between priority levels in an order similar to the following:

- 160 bytes of High priority traffic is transmitted first
- 40 bytes of Medium priority traffic is transmitted next
- 20 bytes of Low priority traffic is transmitted next
- 10 bytes of High priority traffic is transmitted next.

With every transmission, the unit checks for traffic of all priority levels in order to apply the ratio you have specified. However, if all of the traffic in queue is set at the same priority level, this traffic is sent continually until traffic with another priority level requests transmission. At this point, the unit applies the ratio to the existing traffic in queue.

✈️ One of the following traffic ratio menus is displayed:

```
High To Medium Priority Ratio Selection
1) 1:1
2) 2:1
3) 4:1
4) 8:1
5) 16:1
6) 32:1
7) 64:1
Enter Choice :
```
Select the ratio you want to use.

**Note:** The cycle of ratios is High to Medium to Low, and then to High again. This allows lower priority traffic from the first transmission to be sent before additional higher priority level traffic from the second transmission is sent.

### DLCI CIR Information

When configuring DLCIs, you can allocate a designated amount of committed bandwidth to a DLCI, as long as this bandwidth does not exceed the speed of the Frame Relay line. This committed bandwidth, called Committed Information Rate (CIR), is the amount of bandwidth a DLCI is guaranteed to have available at all times for transmitting data. If the DLCI attempts to send more data than can be carried within the boundary of its CIR, such as in the case of bursty traffic, there is no guarantee that this excess data is sent.

You must configure an excess bandwidth range for the DLCI. If traffic is within the excess bandwidth range, it is delivered as long as the Frame Relay line has space available to carry it. Both CIR and excess bandwidth is negotiated with the service provider and must be agreed upon and purchased before you configure the unit with these values.

Any traffic exceeding the excess bandwidth range ($B_e$) can be automatically discarded by the service provider, regardless of available bandwidth.

The priority queuing function monitors each DLCI’s committed and excess CIR. Traffic being transmitted within its CIR is transmitted before traffic using any allotted excess bandwidth.
Transmissions are made in the following order of priority:

CIR Immediate ➔ CIR High ➔ CIR Medium ➔ CIR Low ➔ Excess Immediate ➔ Excess High ➔ Excess Medium ➔ Excess Low

**Note:** Immediate priority data, as long as it is within its allocated CIR, preempts all other traffic in the queue (except management traffic).

The **DLCI CIR Information** option allows you to configure CIR and excess bandwidth for each DLCI. Select the DLCI CIR Information field on the Frame Relay Management Parameters Menu.

- The following prompts are displayed:

  - **Table Is Empty.**
  - **Add Table Entry**
  - **Add DLCI Information**
  - **Enter DLCI Number (16 - 1007):**

  **a** Enter the first DLCI number and press ENTER.

  - The following prompt is displayed:

  - **Enter CIR (committed information rate) in bits per second:**

  **b** **CIR.** Type the CIR you negotiated with the service provider, and press Enter.

  - The following prompt is displayed:
c **Committed Burst Size (Bc).** Type the Burst Size that you negotiated with the service provider. Bc is the number of bits you can transmit within a given time (T) in seconds. (T usually equals one second.) \( \frac{Bc}{T} = CIR \)

**Note:** If T = 1 second, you can transmit X number of bits (Bc), wait one second and transmit another X number of bits (Bc). In this manner, the number of bps transmitted never exceeds the amount of bandwidth the DLCI has been allocated.

d Enter the Committed Burst Size (Bc) and press ENTER.

- The following prompt is displayed:

```plaintext
Enter Bc (committed burst size) in bits:
```

e **Burst Excess Rate, B(e).** Type the Burst Excess rate you negotiated with the service provider. B(e) is the number of bits you can transmit within a given time (T) in seconds. \( \frac{B(e)}{T} = CIR \). The value for B(e) is typically the line speed less the CIR and Bc.

```plaintext
Enter Be (excess burst size) in bits:
```
Note: If the line speed is 56000 bps and the CIR is 4000 bps, the B(e) is 52000 bits, assuming T = 1.

f Enter the B(e) value.

When all values for a DLCI are entered, the following prompt is displayed and you have the opportunity to enter values for additional DLCIs:

<table>
<thead>
<tr>
<th>Entry Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter DLCI Number (16 - 1007):</td>
</tr>
</tbody>
</table>

g When you are finished entering values for all DLCIs, press Escape to view the table of DLCI entries.

You are given the opportunity to add, change, or delete any entry.

h After you review the table and make any necessary changes, press Escape again to return to the Frame Relay Management Parameters Menu.

13 FRF-12 Fragmentation. Fragmentation of data packets on Frame Relay allows for proper voice and data quality while sharing the same port. If you wish, enable and configure this feature.

<table>
<thead>
<tr>
<th>FRF.12 Parameters : SERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Fragmentation            : Disabled</td>
</tr>
<tr>
<td>2) Fragmentation Type       : Buffer Boundary</td>
</tr>
<tr>
<td>3) Fragmentation Size       : 128 bytes</td>
</tr>
</tbody>
</table>

Enter Choice :

Note: To save the new configuration, you must WRITE and RESET. (See Section 3.3.7, Write Configuration, and Section 3.3.8, Reset Unit.)
7.2.6 Frame Relay Unicasting and Multicasting

A standard Frame Relay transmission uses the same DLCI to transmit to and receive from one specified device. This is the default in the BANDIT.

The BANDIT can also set up a unicast transmission. The unicast feature transmits on one DLCI (to one specified device) and receives on another DLCI (from that same device). The unicast feature is specifically geared for transmissions over satellite networks, to save bandwidth and support most of the Frame Relay applications. (However, unicast can also be used over ground-based networks.)

You can also set up multicast transmissions (to two or more specified recipients). This option provides the capability for a device to transmit the same application data to multiple DLCIs or the ability for a single device to receive data from multiple DLCIs. This can be used as a replacement for multidrop modems. At present, this feature is applicable only to data; it cannot be used to multicast voice. (The multicast feature is not geared for nor limited to satellite networks.)

Frame Relay multicasting can be used to send information from a central point to several endpoints or to all endpoints.

Note: The BANDIT’s Frame Relay does not broadcast transmissions (that is, it does not transmit to unspecified recipients, of any number).

How to Configure Frame Relay Unicasting or Multicasting

In this procedure, first we set up three standard Frame Relay paths. With each standard path, you use one DLCI to send and receive information from a single remote device.

Then we configure a unicast transmission, which includes an outgoing Frame Relay path (to the remote device) and an incoming Frame Relay path (from the remote device), on different DLCIs.

Finally, we configure a multicast group to include all three standard paths and the outgoing unicast path. The local device sends a multicast transmission to all remote devices at the same time.

1 From the Main Menu, select Advanced Configurations, Global Paths.
If the Global Path Table already contains records, the table is displayed. Go to Step 8.

If the Global Path Table is empty, the following prompt is displayed.

2 Do all of the following:

a Type the name of a Frame Relay path (for example, `remote1`) and press Enter.

   The Global Path Types menu is displayed.

b Select Frame Relay PVC.

   The following prompt is displayed.

c Select the port for the Frame Relay PVC.
The following prompt is displayed.

```
Enter FR DLCI Number (16-1007) :
```

**d** Indicate the DLCI for this path.

The following prompt is displayed.

```
Any Advanced Features ?
(B - Backup Path       H - Help)
(U - FrameRelay Unicasting N - None) [N] :
```

**e** For a standard path, select **None**.

The following message is displayed.

```
Entry added.
To View the entry press ESC or To Add another entry
Enter Path Name (1 to 10 Characters): 
```

3. Set up another standard Frame Relay path, called `remote2`. (See Step 2.)

4. Then set up another standard Frame Relay path, called `remote3`. (See Step 2.)

5. Then set up a unicast Frame Relay path, as follows:

**a** Type the name of a Frame Relay path (for example, `uni-out`), and press **Enter**.

The Global Path Types menu is displayed.
Frame Relay

Global Path Types
------------------
1) X25 SVC
2) X25 PVC
3) Frame Relay PVC
4) Port Type
5) IP/UDP
6) Voice
7) FR Multicast Path

Enter Choice : (1 to 7)[1] :

b  Select Frame Relay PVC.

  ❖  The following prompt is displayed.

Enter Port Number  (S(SERIAL),E(EXPANSION),R = RDU Ports,1-24) :

c  Select the port for the Frame Relay PVC.

  ❖  The following prompt is displayed.

Enter FR DLCI Number (16-1007) :

d  Indicate the DLCI for this path.

  ❖  The following prompt is displayed.

Any Advanced Features ?
(B - Backup Path  H - Help)
(U - Frame Relay Unicasting  N - None) [N] :

e  For a unicast path, select Frame Relay Unicasting.
The following message is displayed.

```
Is this path Outgoing or Incoming?
```

**f** Select **Outgoing**.

The following message is displayed.

```
Enter Incoming Path Name (1 to 10 Characters):
```

**g** Type the name of the Frame Relay path for the other direction (for example, `uni-in`), and press **Enter**.

The Global Path Types menu is displayed.

```
  Global Path Types
  ------------------
  1) X25 SVC
  2) X25 PVC
  3) Frame Relay PVC
  4) Port Type
  5) IP/UDP
  6) Voice
  7) FR Multicast Path

Enter Choice : (1 to 7){1} :
```

**h** Select **Frame Relay PVC**.

The following prompt is displayed.

```
Enter Port Number  (S(SERIAL),E(EXPANSION),R = RDU Ports,1-24):
```

**i** Select the port for the incoming Frame Relay PVC.
The following prompt is displayed.

```
Enter FR DLCI Number (16-1007) :
```

j Indicate the DLCI for the incoming path. This DLCI cannot be the same as the outgoing DLCI.

The following prompt is displayed.

```
Entry added.
To View the entry press ESC or To Add another entry
Enter Path Name (1 to 10 Characters):
```

6 Add a multicast Frame Relay path, as follows:

a Type the path name (for example, `multi`).

The Global Path Types menu is displayed.

```
Global Path Types
-----------------
1) X25 SVC
2) X25 PVC
3) Frame Relay PVC
4) Port Type
5) IP/UDP
6) Voice
7) FR Multicast Path
```

```
Enter Choice : (1 to 7)[1] :
```

b Select FR Multicast Path.

The following prompt is displayed.
7-30  Chapter 7: Routing with Frame Relay, X.25, and SNA

**c** Type the first path *(remote1)* for this multicast group, and press Enter.

- The following prompt is displayed.

```
Want to add more paths ? (Y/N) [Y] :
```

**d** Do one of the following:

- To add another path to the multicast group, answer Y. Repeat Step 6c. (Do this to add the paths *remote2*, *remote3*, and *uni-out*).

- When you have finished adding paths, answer N.

- The following prompt is displayed:

```
Enter Path Name (1 to 10 Characters):
```

```
Entry added.
To View the entry press ESC or To Add another entry
Enter Path Name (1 to 10 Characters):
```

**7** Press *Escape*.

- The Global Path Table is displayed.
Do one of the following:

a To return to the Advanced Configurations menu, press Escape.

b To add an entry, type a. Go to Step 2.

c To modify an entry, type m and follow the instructions on the screen.

d To delete an entry, type d and follow the instructions on the screen.

7.3 X.25 Routing

Note: To configure the X.25 protocol (in addition to X.25 routing), see Section 7.4, X.25 Protocol.

1 To configure X.25 routing, do the following:

a Log in to the BANDIT. (See Section 3.2, Connecting a Supervisory Terminal and Logging in to the BANDIT.)

b On the Main Menu, select Advanced Configurations. (See Section 3.3, The Main Menu.)

c On the Advanced Configurations Menu, select Routing. (See Section 3.3.4, The Advanced Configurations Menu.)

d On the Routing menu, select X.25 Routing. (See Section 7.1, Routing.)
The X.25 Routing Configuration menu appears. This menu lets you configure the X.25 global parameters, including the X.25 switching table. You can configure the parameters as described in the following steps.

Select X.25 Switching Table to enter an X.121 destination address to be mapped to a given port. Outbound calls destined to this address will be routed through this port. Observe the following addressing rules:

- Addresses must use digits; that is, permitted characters are 0 (zero) to 9.
- Addresses cannot start with 0 (zero).
- A question mark (?) is a one-digit wildcard. It can be used to replace only one digit. You can have any number of question marks. For example, if an address assigned to a port is 44?4, valid addresses include 4404, 4474, 4424, etc., but not 44004.
- An asterisk (*) is a multidigit wildcard, to replace any number of digits, from none to the entire address. In addition, you can use an asterisk in as many positions as you wish. For example, if an address assigned to a port is 12*, the port accepts any address whose first two digits are 12. It does not matter how many digits, if any, follow the 12. Valid addresses include 12, 128, 1209, and 12309, but not 1029. Or if an address on a port is configured as 55*9, valid addresses include 559, 5509, and 551239, but not 55001122933. It does not matter how many digits, if any, fall between the initial 55 and the 9, but no digits are allowed to follow the 9. (However, 55*9* does allow digits following the 9.)

The following prompt is displayed:
a Enter the X.121 destination address of the remote device or network, and press Enter.

- The following prompt is displayed:

```
Enter X25Sw Port Number (S(SERIAL),E(EXPANSION),R = RDU Ports,1-24):```

b Enter the port that X.25 calls will use to reach this remote X.121 address.

- The following message and prompt are displayed.

```
Entry added.
To View the entry press ESC or To Add another entry
Enter Remote X121 Address(1 to 15 digits):```

3 Do one of the following:

a To add another record to the table, go to Step a.

b To view the X.25 Switching Table, press Escape. You can continue entering addresses or make changes to an existing entry. When you finish, press Escape to return to the X.25 Routing Configuration menu.
Select **Proprietary Traffic Idle VC Timer** to specify the number of seconds the line may remain idle before the call is cleared, when no characters are being transmitted in either direction.

- The following option is displayed:

```
Enter Prop. Prot. Idle Tmr(0 to 600)[180] :```

**Note:** Proprietary Traffic Idle VC Timer is specific only to the following proprietary protocols: Async Encapsulation, Bit Sync Encapsulation, and Byte Sync Encapsulation.

4. Type the number of seconds the line may remain idle, and press **Enter**.

5. Select **SNA Traffic Idle VC Timer** to set the maximum number of seconds the X.25 connection established for SNA QLLC may remain idle.

- The following option is displayed:

```
Enter SNA Idle VC Timer(0 to 600)[180] :```

a. Type the number of seconds for this timer, and press **Enter**.
Note: When the timer expires, the call is cleared.

If you type 0 (zero) in this field, the timer is disabled and the virtual circuit always remains up.

- The X.25 Routing Configuration menu is redisplayed.

6 Select **IP/IPX Traffic Idle VC Timer** to set the maximum number of seconds an IP or IPX connection may remain idle.

- The following prompt is displayed:

```plaintext
Enter Idle VC Timer(0 to 600)[180] : 
```

Type the number of seconds for this timer, and press **Enter**.

Note: When the timer expires, the call is cleared.

- The X.25 Routing Configuration menu is redisplayed.

7 Select **IP/IPX SVC Retry Timer** to set the maximum number of seconds to wait before the next IP or IPX call attempt can be made if the previous call attempt was unsuccessful.

- The following prompt is displayed:

```plaintext
Enter IP/IPX SVC Retry Timer(0 to 600)[60] : 
```

Type the number of seconds and press **Enter**.

- The X.25 Routing Configuration menu is redisplayed.
**Note:** When the timer expires, the call will be attempted again. (To limit the number of retries, see Step 8.)

---

**8** Select **IP/IPX SVC Retry Count** to set the number of times an IP or IPX call attempt will be made if the previous call attempt was unsuccessful.

- The following prompt is displayed:

```
Enter IP/IPX SVC Retry Count (0 to 10)[3] :
```

**a** Type the number of retries and press **Enter**.

- The X.25 Routing Configuration menu is redisplayed.

**Note:** If the call is not successful after the configured number of call attempts, the next IP or IPX call will be triggered by the IP/IPX traffic.

---

**9** Select **X.121 Sub-Address Length** to specify the maximum number of digits that a sub-address can have.

- The following prompt is displayed:

```
Enter X.121 Sub-Address Length(1 to 5)[2] :
```

**a** Enter the number of digits allowed in the sub-address, and press **Enter**.

- The X.25 Routing Configuration menu is redisplayed.

---

**10** When you have finished configuring X.25 routing, press **Escape** to return to the Routing menu. (See **Section 7.1, Routing.**)
11 Press Escape until you return to the Main Menu.

7.4 X.25 Protocol

The BANDIT supports use of synchronous or asynchronous X.25. The X.25 protocol can be used for switching or for carrying QLLC, IP, or IPX traffic.

Note: In addition to standard X.25, the BANDIT can perform some additional applications of X.25. See the following sections:

- Section 5.14, X.25 over IP
- Section 5.15.3, Converting AX.25 to MATIP.

7.4.1 X.25 Level-1 Configuration

Note: You must complete the X.25 Routing Table with the addresses of all units in your network. (See Section 7.3, X.25 Routing.)

See Section 9.2.17, X.25 Statistics, for a description of the statistics monitored in this protocol.

1 From the Main Menu, select Advanced Configurations, Data Configurations; then select a port. Then select Undefine Logical Port >> Protocol >> X.25+.

❖ When you select X.25+ from the Logical Port Protocol Selection Menu, the following menu is displayed:

```
X.25 Parameters : Port 1
------------------------
1) X.25 Level-1 Configuration
2) X.25 Level-2 (LAPB) Configuration
3) X.25 Level-3 (PLP) Configuration

Enter Choice :
```
2 Enter the number of the X.25 level you want to configure.

- The corresponding menu is displayed on the screen.

Note: Make sure at least one X.25 port is enabled when Frame Relay is not available.

1 Select **X.25 Level-1 Configuration**. This option allows you to configure the physical level of X.25.

- A menu similar to the following menu is displayed:

```
X.25 Level-1 Parameters : SERIAL
-------------------------------------
1) Type : Synchronous
2) Speed : 9600
3) Frame Relay Global Path Name : N/A
4) Encapsulation : N/A

Enter Choice :
```

Note: A virtual port’s menu does not show speed.

a Select **Type**; then select **Synchronous** or **Asynchronous**.

b **Speed**. This option allows you to set the synchronous clock speed that units configured as DCE will use to provide clocking to the user’s equipment. Select Speed.

Note: The Speed field is applicable only if you are configuring a physical port. If you are configuring a logical port, proceed to Step 2.

- One of the following menus is displayed:
• Synchronous:

```
Configure Synchronous Clock Speed
-------------------------------
1) 2400
2) 4800
3) 9600
4) 19200
5) 38400
6) 48000
7) 56000
8) 64000
9) 96000
A) 128000
B) 192000
C) 256000
D) 384000
E) 512000
F) 768000
G) 1024000
H) 1536000
I) 2048000

Enter Choice :
```

• Asynchronous:

```
Configure Asynchronous Clock Speed
----------------------------------
1) 1200
2) 2400
3) 4800
4) 9600
5) 19200
6) 38400
7) 48000
8) 57600
9) 115200
A) 230400

Enter Choice :
```

**Note:** When the port is configured as DTE, as opposed to DCE, the parameters menu reflects that the speed is provided by the device connected to the unit. In this case, you do not need to configure speed. If you attempt to configure the speed, the following message is displayed and you are returned to the parameters menu:
2 Select **Global Path Name** and indicate the path this port will use. See Section 4.3, *Defining Global Paths*.

**Note:** This field is not applicable for a physical port.

3 Select **Encapsulation** and indicate the encapsulation method to use.

```
X.25 Level-1 Parameters : Port 4
---------------------------------------
1) Type : Synchronous
2) Frame Relay Global Path Name : <NONE>
3) Encapsulation : Annex G

Enter Choice :
```

**Note:** This field is not applicable for a physical port. Use an encapsulation method only on a virtual port.

4 Press **Escape** to return to the X.25 Parameters menu.

### 7.4.2 X.25 Level-2 Configuration

1 Select **X.25 Level-2 Parameters (LAPB) Configuration**. This option allows you to configure the link level of the X.25 protocol.

- The following menu is displayed:
Select **Interface Mode (DTE/DCE)**. This option allows you to specify whether the Interface Mode of the link level is DCE or DTE.

**Note:** In X.25, the Interface Mode must be opposite the mode of the network or device to which the unit is connected. When the unit is connecting to a public network, the unit must be in DTE mode. If local unit is connected to an X.25 device, which is configured for DCE, then the local unit should be configured for DTE. If the X.25 device is configured for DTE, then the local unit should be configured for DCE.

- The following prompt is displayed:

```
Enter IF Mode value 1->DTE or 2->DCE : (1 to 2) [1] : 
```

3 Select the correct mode and press ENTER.

4 Select **Link Activator (DTE/DCE)**. This option allows you to specify which node (the node configured as DCE or the node configured as DTE) will initiate or activate the link.

- If the Interface Mode matches the Link Activator mode, this unit will send SABMs. If the two modes do not match, this unit will wait for SABMs. The following prompt is displayed:
Note: This default value is set to a universally accepted value. If you change the default value, make sure the new setting is consistent with the device or network to which the unit is connected.

a Select the mode (DCE or DTE) of the node that will initiate the link, press ENTER.

- The X.25 Parameters menu is redisplayed.

5 Select Acknowledgement Timer (T1) (seconds). This option allows you to set the maximum number of seconds that the Level 2 protocol must wait for acknowledgment of receipt of a transmitted frame.

- The following prompt is displayed:

```
Enter T1 Timer value (1 to 10)[3] :
```

a Enter the number of seconds to wait for acknowledgment and press ENTER.

- If no acknowledgment is received, the unit will re-send the frame a configured number of times. If an acknowledgment is not received after N2 retries, the link is disconnected. To set N2 (the number of retries), see Step 8.)

6 Select Response Timer (T2) (tenths of a second). This option allows you to set the maximum number of time units (in tenths of a second) to wait before sending an acknowledgment for a sequenced I-frame that has been received.

- The following option is displayed:
Enter the number of tenths of a second and press Enter.

**Note:** A value of zero means there will be no delay in acknowledgment generation.

7 Select **Disconnect Timer (T3)**. This option allows you to set the number of seconds to wait before the link is considered disconnected.

- The following option is displayed:

```
Enter T3 Disconnect Timer(30 to 180)[60] :
```

Enter the number of seconds and press Enter.

8 Select **Retry Count (N2)**. This option allows you to set the number of times a frame is retransmitted when no acknowledgment is received and when the T1 timer has expired. (To set the T1 timer, see **Step 5**.)

- If an acknowledgment is not received after N2 retries, the link is disconnected. The following option is displayed:

```
Enter N2 Retransmit Count(1 to 30)[10] :
```

Enter the number of retries allowed and press Enter. The X.25 Parameters menu is redisplayed.
Chapter 7: Routing with Frame Relay, X.25, and SNA

9 Select **Frame Sequencing**. This option allows you to set the frame sequencing number. All frames must be assigned a number that designates the individual frame’s proper sequential placement within a stream of data to ensure that they arrive at their destination in their original order and are not shuffled. The X.25 protocol allows two measures of consecutive frame numbers: Modulo 8 and Modulo 128.

Modulo 8 allows frame numbers to start at 0 and end at 7. After frame number 7 is received at its destination, the number assignment of frames begins again at 0. Modulo 128 allows frame numbers to start at 0 and end at 127. After frame number 127 is received at its destination, the number assignments of frames begins again at 0.

- The following prompt is displayed:

```
Enter the Sequence Number Modulo 8 --> 1, Modulo 128 --> 2 (1 to 2) [1]:
```

a Enter the sequence number and press Enter. The X.25 Level-2 Parameters menu is redisplayed.

10 Select **Transmit Window Size**. This option allows you to set the maximum number of sequenced I-frames this unit is allowed to have outstanding (outstanding frames are frames that have been sent but not acknowledged).

For Example: Suppose you assign a value of three (3) in the **Transmit Window Size** field. This unit can transmit up to three frames without receiving acknowledgment for any of them. Once it has three unacknowledged frames outstanding, the window is considered blocked and it cannot transmit any more frame until at least one frame is acknowledged. As each frame is acknowledged, another frame can be sent, as long as the total number of frames that have been sent but not acknowledged (the total number of frames outstanding) does not exceed three. It is important, then, that the **Transmit Window Size** of a given unit port match the **Receive Window Size** of the connected device.

**Note:** The **Transmit Window Size** must be less than the number in the **Frame Sequencing** field.
The following prompt is displayed:

```
Enter Transmit Window Size (1 to 127) [7] :
```

a Enter the transmit window size and press ENTER.

Select **Receive Window Size**. This option allows you to set the maximum number of sequenced I-frames this unit is allowed to receive before it must send an acknowledgment.

The following prompt is displayed:

```
Enter Receiver Window Size (1 to 127) [7] :
```

Suppose the device to which this unit is connected has been configured with a Transmit Window Size of 7. The connected device in this example, then, can have a maximum of seven frames outstanding. (Outstanding frames are frames that have been sent but have not been acknowledged.)

The unit for which you are configuring the Receive Window Size can withhold acknowledgment, then, for up to seven frames. If it receives seven frames and does not acknowledge any of them, the window is considered blocked and it cannot receive more frames until it acknowledges at least one of those frames. As this unit acknowledges each frame, it can receive another frame, as long as the total number of frames that have been received but not acknowledged (the total number of frames outstanding) does not exceed seven.

It is important, then, that the **Receive Window Size** of a given unit port match the **Transmit Window Size** of the connected device.

**Note:** The **Receive Window Size** must be less than the number in the **Frame Sequencing** field.
Enter the receive window size and press Enter. The X.25 Level-2 Parameters menu is redisplayed.

12 Press Escape to return to the X.25 Parameters menu.

7.4.3 X.25 Level-3 Configuration

1 Select X.25 Level-3 (PLP) Configuration to configure the packet level of the X.25 protocol.

   The following menu is displayed:

```
X.25 Level-3 Parameters : SERIAL
-----------------------------------
 1) Interface Mode (DTE/DCE)                    : DTE
 2) Transmit Packet Size                        : 128
 3) Receive Packet Size                         : 128
 4) Packet Sequencing                           : Modulo 8
 5) Transmit Window Size                        : 2
 6) Receive Window Size                         : 2
 7) Packet Restart Timer (T20) (seconds)        : 60
 8) Packet Call Request Timer (T21) (seconds)   : 60
 9) Packet Reset Request Timer (T22) (seconds)  : 60
A) Packet Clear Request Timer (T23) (seconds)  : 60
B) Incoming Call Facility Options              : PASS THROUGH FACILITIES
C) Outgoing Call Facility Options              : PASS THROUGH FACILITIES
D) High SVC Channel Number                     : 10
E) Low SVC Channel Number                      : 1
F) High PVC Channel Number                     : 0
G) Maximum Number of Active SVCs Permitted     : 10

Enter Choice :
```

Note: Default values are set to universally accepted values. If you change a default value, make sure the new setting is consistent with the device or network to which the unit is connected.

2 Select Interface Mode. This option allows you to set the packet level Interface Mode as DCE or DTE.
**Note:** In X.25, the Interface Mode must be opposite the mode of the network or device to which the unit is connected. For example, if a local unit is connected to an X.25 device, which is configured for DCE, then the local unit should be configured for DTE. If the X.25 device is configured for DTE, then the local unit should be configured for DCE. The DTE/DCE selection governs the selection of LCNs as calls are placed. DTE starts at the highest LCN and uses LCNs in descending order. DCE starts at the lowest LCN and uses LCNs in ascending order. LCN 0 is reserved for RESTART packets that use LCN 0. LCNs are allocated in this manner to prevent call collision.

- The following prompt is displayed:

```
Enter IF Mode value  1->DTE or 2->DCE : (1 to 2) [1] :
```

a Select the mode you want and press Enter.

- The X.25 Level-3 Parameters menu is redisplayed.

3 Select **Transmit Packet Size**. This option allows you to set the maximum length (in octets) of packets that can be sent on the line.

- The following option is displayed:

```
Enter Transmitting Packet Size (128 to 4096) [128] :
```

a Enter the size of the transmitting packet and press Enter.

- The X.25 Level-3 Parameters menu is redisplayed.

4 Select **Receive Packet Size**. This option allows you to set the maximum length (in octets) of packets that can be received on the line.

- The following prompt is displayed:
Enter the size of the receiving packet and press Enter.

- The X.25 Level-3 Parameters menu is redisplayed.

5 Select **Packet Sequencing**. This option allows you to set the packet sequencing number.

Each packet must be assigned a number that designates the packet’s proper sequential placement within a stream of data to ensure that packets arrive at their destination in the original order and are not shuffled. The X.25 protocol allows two measures of consecutive packets numbers: Modulo 8 and Modulo 128.

Modulo 8 allows packets numbers to start at 0 and end at 7. After packet number 7 is received at its destination, the number assignment of packets begins again at 0. Modulo 128 allows packets numbers to start at 0 and end at 127. After packet number 127 is received at its destination, the number assignment of packets begins again at 0.

- The following prompt is displayed:

Enter the Sequence Number Modulo 8 --> 1 , Modulo 128 --> 2(1 to 2)[1] :

Enter the sequence number and press Enter.

- The X.25 Level-3 Parameters menu is redisplayed.

**Note:** Default values are set to universally accepted values. If you change a default value, make sure the new setting is consistent with the device or network to which the unit is connected.
Select **Transmit Window Size**. This option sets the maximum number of sequenced packets this unit is allowed to have outstanding. (Outstanding packets are packets that have been sent but not acknowledged.)

**Note:** Suppose you assign a value of 2 in the **Transmit Window Size** field. This unit can transmit up to two packets without receiving acknowledgment for either of them. Once it has two unacknowledged packets outstanding, the window is considered blocked and it cannot transmit any more packets until at least one packet is acknowledged. As each packet is acknowledged, another packet can be sent, as long as the total number of packets that have been sent but not acknowledged (the total number of packets outstanding) does not exceed two.

It is important, then, that the **Transmit Window Size** of a given unit port match the **Receive Window Size** of the connected device.

The **Transmit Window Size** must be less than the **Packet Sequencing** number (modulo 8 or 128). At the link level, the **Transmit Window Size** normally matches the **Packet Sequencing** number.

- The following option is displayed:

```
Enter Transmitting Window Size (1 to 127) [2] :
```

- Enter the transmitting window size and press Enter.

- The X.25 Level-3 Parameters menu is redisplayed.

Select **Receive Window Size**. This option allows you to set the maximum number of sequenced packets this unit is allowed to receive before it must send an acknowledgment.
Note: Suppose the device to which this unit is connected has been configured with a Transmit Window Size of 7. The connected device in this example, then, can have a maximum of seven packets outstanding. (Outstanding packets are packets that have been sent but have not been acknowledged.) The unit for which you are configuring the Receive Window Size can withhold acknowledgment for up to seven packets. If it receives seven packets and does not acknowledge any of them, the window is considered blocked and it cannot receive more packets until it acknowledges at least one of those packets. As this unit acknowledges each packet, it can receive another packet, as long as the total number of packets that have been received but not acknowledged (the total number of packets outstanding) does not exceed seven. It is important, then, that the Receive Window Size of a given unit match the Transmit Window Size of the connected device.

The Receive Window Size must be less than the Packet Sequencing number (modulo 8 or 128). At the link level, the Receive Window Size normally matches the Packet Sequencing number.

- The following prompt is displayed:

```
Enter Receiving Window Size(1 to 127)[2] :
```

- Enter the receiving window size and press Enter.

- The X.25 Level-3 Parameters menu will be redisplayed.

- Select Packet Restart Timer (T20) (seconds). This option allows you to set the number of seconds that the Level 3 protocol must wait for a restart confirmation after issuing a Restart Packet. When this timer expires, another Restart will be issued.

- The following prompt is displayed:

```
Enter Restart timer value(10 to 600)[60] :
```
a Enter the number in seconds and press Enter.

- The X.25 Level-3 Parameters menu is redisplayed.

9 Select **Packet Call Request Timer (T21) (seconds)**. This option allows you to set the number of seconds allowed between issuing Packet Call Requests and receiving either a Call Confirmation or a Call Clear for SVC links. If this timer expires, a Clear is generated and the LCN is freed.

- The following prompt is displayed:

  ```
  Enter Call Request Timer(10 to 600)[60] :
  ```

a Enter the number in seconds and press Enter.

- The X.25 Level-3 Parameters menu is redisplayed.

10 Select **Packet Reset Request Timer (T22) (seconds)**. This option allows you to set the number of seconds allowed between issuing a Packet Reset Request and receiving either a Reset Confirmation or a Clear. If this timer expires, the Reset Packet is retried the number of times configured in the R22 parameter. (R22 is a system default that cannot be configured by the user. The value currently set for R22 is 3 retries.)

- The following prompt is displayed:

  ```
  Enter Reset Request Timer(10 to 600)[60] :
  ```

a Enter the number in seconds and press ENTER. The “X.25 Level-3 Parameters” menu is redisplayed.
11 Select **Packet Clear Request Timer (T23) (seconds)**. This option allows you to set the number of seconds allowed between issuing a Packet Clear Request and receiving a Clear Confirmation. If a Clear Confirmation is not received before this timer expires, a Clear Request is generated. If a Clear Confirmation is still not received, a Clear Request is generated again. The Clear Request message can be generated up to the number of times specified in the R23 value. (R23 is a system default that cannot be configured by the user. The value currently set for R23 is 3 tries.)

- The following prompt is displayed:

```
Enter Clear Request Timer (10 to 600) [60] :
```

a Enter the number in seconds and press ENTER.

- The X.25 Level-3 Parameters menu is redisplayed.

12 Select **Incoming Call Facility Options**. This option allows you to control the manner in which this port responds when presented with any incoming Call Packet containing facilities that are not actively supported by the system.

- The following menu is displayed:

```
Options for Incoming Call Received with Facilities:
1. PASS THROUGH FACILITIES
2. REMOVE FACILITIES
3. CLEAR CALL
Enter Choice: (1 to 3) [1] :
```

- If you select **Pass through Facilities**, facilities (such as Reverse Charging, NUI Passwords, etc.) that are not supported by the receiving unit are passed through the system unchanged.

When a packet is received by the unit, the unit checks the negotiation facilities (Window Size Negotiation and Packet Size Negotiation) in the incoming packet. If the parameters being negotiated in the incoming packet match the parameters configured for the packet level in the unit, the unit strips the
negotiation facilities from the packet and passes the remaining facilities to their destination.

If the parameters being negotiated in the incoming packet do not match the parameters configured for the packet level in the unit, the unit clears the call with a specific Cause and Diagnostic code (Cause 03, Diagnostic 142 for Window Size Mismatch; and Cause 03, Diagnostic 141 for Packet Size Mismatch).

- If you select **Remove Facilities**, all facilities are stripped from incoming packets, and then the incoming packet is passed through to its destination.

- If you select **Clear Call**, all incoming calls that have facilities are cleared by the system with the Invalid Facility Clear Cause and Diagnostic Code combination (Cause 83hex, Diagnostic 90hex).

Enter the number of the option you want to use and press ENTER.

- The X.25 Level-3 Parameters menu is redisplayed.

13 Select **Outgoing Call Facility Options**. This option allows you to control the manner in which this port responds when presented with any output Call Packet containing facilities that are not actively supported by the system.

- The following options are displayed:

```
Options for Outgoing Call Facilities:
1. PASS THROUGH FACILITIES
2. REMOVE FACILITIES
3. CLEAR CALL
Enter Choice:[1 to 3][1] :
```

- If you select **Pass through Facilities**, facilities (such as Reverse Charging, Passwords, etc.) that are not supported by the transmitting unit are passed through the system unchanged.

- If you select **Remove Facilities**, all facilities are stripped from outgoing packets, and then the outgoing packet is passed through to its destination.

- If you select **Clear Call**, all outgoing calls that have facilities are cleared by the system with the Invalid Facility Clear Cause and Diagnostic Code combination (Cause 03, Diagnostic 65).
Enter the number of the option you want and press ENTER.

- The X.25 Level-3 Parameters menu is redisplayed.

14 Select **High SVC Channel Number**. This option allows you to set the highest SVC channel number allowed in the SVC range.

**Note:** When assigning the highest SVC number, be certain to select a number that is higher than all the SVC numbers you plan to assign, and that is also higher than all of the PVC numbers you want to configure.

**Example:** If you plan to configure a range of five SVCs, and you also want to configure PVCs on logical channel numbers (LCNs) 15-25, the **High SVC Channel Number** must be set at 31 or higher because it must be, obviously, higher than the lowest SVC number, and the lowest SVC number must be higher than any PVC.

- The following option is displayed:

```
Enter High SVC Number(1 to 4095)[10] :
```

Enter the highest SVC number allowed in the SVC range and press Enter.

- The X.25 Level-3 Parameters menu is redisplayed.
Note: If you change a default value, make sure the new setting is consistent with the device or network to which the unit is connected. The DTE/DCE mode governs the selection of Logical Channel Numbers as calls are placed. Calls placed from a device or network configured as DTE use the highest LCN available, with each successive call using LCNs in descending order. Calls placed from a device network configured as DCE use the lowest LCN first, with each successive call using LCNs in ascending order. LCN 0 is reserved for RESTART packets that use LCN 0. LCNs are allocated in this manner to prevent call collision.

15  
Select **Low SVC Channel Number**. This option allows you to set the lowest SVC number allowed in the SVC range.

When you set the high end of the SVC range (in Step 14), the system automatically adjusts the range of channel numbers offered in the Low SVC Channel Number option so that the lowest SVC number cannot be higher than the High SVC Channel Number.

Note: The highest SVC and the lowest SVC can be the same number. If you configure the lowest and highest SVC fields with the same number, only one SVC is permitted.

- The following prompt is displayed:

```
Enter Low SVC Number(1 to 10)[1] :```

a  
Enter the lowest SVC number allowed in the range and press Enter.

- The X.25 Level-3 Parameters menu is redisplayed.

16  
Select **High PVC Channel Number**. This option allows you to set the maximum number of PVCs that can be configured for this port.

- The following prompt is displayed:
Enter High PVC Number (0 to 0) [0] :

Enter the highest number for a PVC configured on this port, and press Enter.

- The X.25 Level-3 Parameters menu is redisplayed.

17 Select Maximum Number of Active SVCs Permitted. This option allows you to set the highest number of SVC channels that can be active at any one time.

- The following prompt is displayed:

Enter High SVC Number (0 to 100) [10] :

Enter the number of SVCs allowed and press Enter.

- The X.25 Level-3 Parameters menu is redisplayed.

18 Press Escape until you return to the Main Menu.

7.5 SNA Routing for 1490

The SNA routing feature enables the unit to reduce the traffic over Frame Relay by spoofing SDLC supervisory traffic locally. It also allows the unit to extend the seven-hop limitation in the Token Ring architecture by another six hops by terminating each Token Ring connection locally. These six hops are added in the Token Ring network connected to the remote side of the Frame Relay network.

The unit carries only the traffic of end-to-end significance (except when the connection is idle for a configured amount of time, at which time it also carries keep-alive messages).

This feature supports SNA connectivity through synchronous serial ports (for Frame Relay and SDLC), as well as Ethernet and Token Ring ports on the unit. All unit serial ports (including the Network port) can be configured
for SNA 1490. The SNA feature is fully standards-based, ensuring compatibility with any device using the same standard.

**Note:** See Section 9.2.17.3, **LLC Statistics**, Section 9.2.17.4, **QLLC Statistics**, and Section 9.2.12, **SNA Switching Statistics**, for descriptions of statistics used to monitor these routing protocols.

**Note:** SNA routing is available only on units with SNA software. If your unit is coded with X.25-track software, this module is not available.

Before configuring a port for SNA 1490 routing, have the following information:

- Connectivity scenario (SDLC–FR, LLC–FR, or SDLC–LLC)
- Type of end device (host or terminal) on each side of the connectivity scenario
- In the case of an SDLC end device: the physical port number and the control unit (CU) address
- In the case of a Frame Relay end device or a connection through Frame Relay:
  - Frame Relay port number
  - DLCI number
  - Whether you are using BNN (default) or BAN Encapsulation
  - SAP addresses configured in the immediate Frame Relay device
  - MAC addresses configured in the immediate Frame Relay device (only for BAN)
- In the case of a Token Ring end device: the MAC and SAP addresses configured in the end-device
- If the Token Ring end device is in a multi-hop Token Ring network:
  - Local Ring Number. This is the Ring Number assigned to the Ring connected to the Token Ring port. The default value is “1.” To change this, select Advanced Configurations, Data Configurations from the Main Menu, then select Token Ring and then Local Ring Number.
- Ring and Bridge Numbers of the Token Ring network connected to the local ring. These are used only to identify whether the default pseudo Ring Number or the default pseudo Bridge Number is a duplicate of any other Ring or Bridge number in the local Token Ring network.

You can use a standard SNMP manager or an async terminal connected to the supervisory port to manage a BANDIT port configured for SNA 1490.

### 7.5.1 SNA Configuration

1. From the Main Menu, select **Advanced Configurations, Routing, SNA Routing**.

   ❖ When you select SNA Routing, the following screen is displayed. This screen lets you enable SNA 1490 and change its parameters.

   ```
   SNA Configuration
   -----------------
   1) SNA Global Parameters
   2) LLC-FR Switching Table
   3) SDLC-FR Switching Table
   4) SDLC-LLC Switching Table
   5) SDLC-QLLC Switching Table
   6) LLC-QLLC Switching Table
   7) LLC Stations Table (Optional)

   Enter Choice:
   ```

2. See the following sections to configure the items in this menu:

   - **Section 7.5.1.1, SNA Global Parameters**
   - **Section 7.5.1.2, LLC–FR Switching Table**
   - **Section 7.5.1.3, SDLC–FR Switching Table**
   - **Section 7.5.1.4, SDLC–LLC Switching Table**
   - **Section 7.5.1.5, SDLC–QLLC Switching Table**
   - **Section 7.5.1.6, LLC–QLLC Switching Table**
   - **Section 7.5.1.7, LLC Stations Table**
7.5.1.1 **SNA Global Parameters**

1. On the SNA Configuration menu (see Section 7.5.1, *SNA Configuration*), select **SNA Global Parameters**.

   ✷ The SNA Global Parameters Configuration menu is displayed. This menu lets you set SNA global parameters.

   ```plaintext
   SNA Global Parameters Configuration
   ------------------------------------
   1) SNA Modules' Status             : UP
   2) SNA TEST/XID Max Retries         : 10
   3) SNA TEST/XID Retry Timer (Seconds) : 5
   4) SNA Session Restart Timer (Seconds) : 20
   5) SNA QLLC Call Retry Timer (Seconds) : 5
   6) SNA QLLC Query Retry Timer (Seconds) : 5
   7) SNA QLLC Max Retries            : 3
   8) SNA FRAD Pseudo-Bridge Number    : 2
   9) SNA FRAD Pseudo-Ring Number      : 5
   Enter Choice :
   ```

2. Select **SNA Modules’ Status** to enable SNA 1490 functionality. (By default, this functionality is enabled.)

   ✷ The following menu is displayed:

   ```plaintext
   SNA Modules' Status
   -------------------
   1) DOWN
   2) UP
   Enter Choice :
   ```

   a. Select **Up** to enable SNA 1490 functionality or **Down** to disable it.

   ✷ The SNA Global Parameters Configuration menu is redisplayed.

3. Select **SNA TEST/XID Max Retries** to enter the number of times the system will re-send TEST/XID frames on a Token Ring or Frame Relay LLC in the event of unsuccessful TEST/XID polls.

   ✷ The following prompt appears:
Enter TEST/XID Retry Count (1 to 20) [10]:

Type the number of times to send TEXT/XID frames (until successful), and press Enter.

- The SNA Global Parameters Configuration menu is redisplayed.

Select SNA TEST/XID Retry Timer to specify how many seconds the system attempts to send TEST/XID frames (until successful).

- The following prompt appears:

Enter TEST/XID Retry Timer in Seconds (1 to 60) [10]:

Type the number of seconds for this timer, and press Enter.

- The SNA Global Parameters Configuration menu is redisplayed.

Select SNA Session Restart Timer to enter the amount of time the unit must wait before restarting a session with TEST polls, in the event that there were no successful TEST/XID polls within the number of retries specified in the TEST/XID Retry Count.

- The following prompt appears:

Enter SNA Session Restart Timer (1 to 180) [20]:

Type the number of seconds for this timer, and press Enter.

- The SNA Global Parameters Configuration menu is redisplayed.

Select SNA QLLC Call Retry Timer to set the maximum number of seconds to wait before the next QLLC call attempt can be made, if the previous call attempt was unsuccessful.
The following prompt is displayed:

```
Enter QLLC Call Retry Timer(1 to 60)[5] :
```

- Type the number of seconds for this timer, and press **Enter**.

**Note:** When this timer expires, the call is attempted again for the number of times configured in the **SNA QLLC Max Retries** field. If the call is still not successful, the BANDIT waits for the time specified in the **SNA Session Restart Timer** field before the call is retried again.

- The SNA Global Parameters Configuration menu is redisplayed.

7

Select **SNA QLLC Query Retry Timer** to set the maximum number of seconds to wait before the next QLLC command is sent, in the event that the previous QLLC command attempt was not acknowledged.

The following prompt is displayed:

```
Enter QLLC Query Retry Timer(1 to 60)[5] :
```

- Enter the maximum number of seconds to wait before sending the QLLC command again (until successful), and press **Enter**.

**Note:** When the timer expires, the query is attempted again for the number of times configured in the **SNA QLLC Max Retries** field. If the QLLC command is still not successful, the call is cleared.

- The SNA Global Parameters Configuration menu is redisplayed.
Select **SNA QLLC Max Retries** to set the number of times a QLLC call retry mechanism or QLLC command query mechanism is retried.

- The following prompt is displayed:

```
Enter QLLC Max Retry Count(1 to 20)[3] :
```

Enter the maximum number of times a call or QLLC command can be retried, and press **Enter**.

- The SNA Global Parameters Configuration menu is redisplayed.

Select **SNA FRAD Pseudo-Bridge Number** to enter the Bridge Number assigned to the unit’s entire WAN/SDLC network. This is useful when the unit is communicating over a Token Ring network or over Frame Relay with BAN encapsulation. This number must be unique in the Token Ring network connected to the local Token Ring port.

- The following prompt is displayed:

```
Enter Pseudo-Bridge Number(1 to 15)[2] :
```

Select **SNA FRAD Pseudo-Ring Number** to enter the Ring Number assigned to the unit. This is useful when the unit is communicating over a Token Ring network or over Frame Relay with BAN encapsulation. This number must be unique in the Token Ring network connected to the local Token Ring port.

- The following prompt is displayed:

```
Enter Pseudo-Ring Number(1 to 4095)[5] :
```
Enter the pseudo-ring number and press Enter.

The SNA Global Parameters menu is redisplayed.

12 When you have finished configuring the items discussed in this procedure, press Escape to return to the SNA Configuration menu. (See Section 7.5.1, SNA Configuration.)

### 7.5.1.2 LLC–FR Switching Table

This option allows you to enter parameters for connecting Token Ring or Ethernet devices to Frame Relay SNA devices.

**Note:** The “LLC” in this section refers only to Token Ring LLC. The “FR” in this section indicates that the remote device can be connected by Frame Relay.

1 On the SNA Configuration menu (see Section 7.5.1, SNA Configuration), select LLC-FR Switching Table.

The following prompt is displayed:

```plaintext
Empty LLC-FR Switching Table
Add LLC-FR Switching Table Entry
Enter Path Name(1 to 10 Characters): *
```

2 Type the Global Path Name and press Enter.

If you enter a name that is not already associated with a Global Path, you are prompted to do so now:

```plaintext
Path Name Does Not Exist In GPT Table.
To Add Global Path Entry, Press 'Y'. Press Escape Otherwise.
```
3 Enter Y to open the Global Path option and configure a path with that name. Press ESC to return to the GPT prompt and enter a different name.

**Note:** You cannot save this configuration if a valid GPT Name has not been entered.

```
Enter LLC Local MAC Address (6 Hex Digits): 00A0EB
```

4 As shown, 6 digits are automatically supplied for this address. Type the additional 6 hexadecimal digits in the LLC Local MAC Address (for a total of 12 digits), and press **Enter**.

- The following prompt is displayed:

```
Enter LLC Local SAP Address(2 Hex Digits):
```

5 Type the 2-digit hexadecimal LLC Local SAP Address, and press **Enter**.

- The following prompt is displayed:

```
Enter BNN Local SAP Address(2 Hex Digits):
```

6 Type the 2-digit hexadecimal BNN Local SAP Address, and press **Enter**.

- The following prompt is displayed:
7 As shown, 6 digits are automatically supplied for this address. Type the additional 6 hexadecimal digits in the Frame Relay Remote MAC Address (for a total of 12 digits), and press Enter.

- The following prompt is displayed:

```
Enter FR Remote MAC Address (6 Hex Digits): 00A0EB
```

8 Type the 2-digit hexadecimal Frame Relay SAP Address, and press Enter.

- The following prompt is displayed:

```
Enter FR Remote SAP Address (2 Hex Digits):
```

9 Type the 2-digit hexadecimal BNN Remote SAP Address, and press Enter.

- The following prompt is displayed:

```
Enter BNN Remote SAP Address (2 Hex Digits):
```

10 Enter the Global Path Name and press Enter.

- If you enter a name that is not already associated with a Global Path, you are prompted to do so now:
11 Enter Y to open the Global Path option and configure a path with that name. Press ESC to return to the GPT prompt and enter a different name.

**Note:** You cannot save this configuration if a valid GPT Name has not been entered.

- The following prompt is displayed:

```
Path Name Does Not Exist In GPT Table.
To Add Global Path Entry, Press 'Y'. Press Escape Otherwise.
```

12 Select the priority level you want traffic on this path’s DLCI to have. If you have no preference, use **Medium** (the default).

- The following confirmation is displayed:

```
Priority set to Medium for DLCI 17 on port: Port 1
```

- Next, the Enter XID prompt is automatically displayed, indicating the only option currently available: End-to-End. The End-to-End option indicates that the XID is passed transparently and that the unit does not interpret incoming XIDs.
A LLC Station Entry with Default Parameters
has been created for Port 1, DLCI 18.
To View/Modify the above LLC Station Entry,
Select "LLC Stations Table" from the "SNA Routing" Menu.

A LLC Station Entry with Default Parameters
has been created for Port E, DLCI 0.
To View/Modify the above LLC Station Entry,
Select "LLC Stations Table" from the "SNA Routing" Menu.
SAP 22 has been Added to the LLC Station for Port 1, DLCI 16.
SAP 22 has been Added to the LLC Station for Port E, DLCI 0.

Enter LLC Port Number (E-Ethernet): E
Enter LLC Local MAC Address (12 Hex Digits):

Then a confirmation indicates that an LLC-FR switching entry has been added.

A confirmation is displayed for the entries you have made in the table.

Then a prompt appears for another entry in the table.

Do one of the following:

a  If you wish to add another record to the table, go to Step 2.

b  If you have finished adding records, press Escape.
The LLC–FR switching table is displayed.

<table>
<thead>
<tr>
<th>Num</th>
<th>LLC</th>
<th>Local MAC</th>
<th>BNN</th>
<th>Remote MAC</th>
<th>LLC</th>
<th>BNN</th>
<th>FR</th>
<th>Prio</th>
<th>XID</th>
<th>LSAP</th>
<th>LSAP</th>
<th>RSAP</th>
<th>RSAP</th>
<th>Path Name</th>
<th>rity</th>
<th>OPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LLCFR</td>
<td>00A0EB000000</td>
<td>0A</td>
<td>0C</td>
<td>00A0EB000001</td>
<td>1A</td>
<td>1C</td>
<td>LLCFR</td>
<td>M</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>abc</td>
<td>00A0EB000000</td>
<td>0A</td>
<td>0C</td>
<td>00A0EB000001</td>
<td>1A</td>
<td>1C</td>
<td>def</td>
<td>M</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Add, Modify, or Delete an Entry? (Enter A, M, or D):

14 Do one of the following:

a  If you wish to add an another record, type a.

   The following prompt appears. Go to Step 2.

   Add LLC-FR Switching Table Entry
   Enter Path Name (1 to 10 Characters):

b  To modify a record, type m and follow the directions on the screen.

c  To delete a record, type d and follow the directions on the screen.

d  If you have finished preparing the table, press Escape.

   The following prompt is displayed. Then the SNA Configuration menu is redisplayed. (See Section 7.5.1, SNA Configuration.)

LLC-FR Switching Table Handling Complete

7.5.1.3 **SDLC–FR Switching Table**

This option configures parameters for connecting SDLC devices to Frame Relay SNA devices.
**Note:** The “FR” in this section indicates that the remote device can be accessed through Frame Relay.

1. On the SNA Configuration menu (see Section 7.5.1, *SNA Configuration*), select **SDLC-FR Switching Table**.
   - The following prompt is displayed:

   Empty SDLC-FR Switching Table
   Add SDLC-FR Switching Table Entry
   Enter SDLC Port Number (S(SERIAL), E(EXPANSION), R = RDU Ports, 1-24):

2. Type the SDLC port number you want to use, and press **Enter**.
   - The following prompt is displayed:

   Enter SDLC Controller Address (2 Hex Digits):

3. Type the 2-digit hexadecimal SDLC Controller Address, and press **Enter**.
   - The following prompt is displayed:

   Enter SDLC Emulated MAC Address (6 Hex Digits): 00A0EB

4. As shown, 6 digits are already in place. Type the additional 6 hexadecimal digits in the SDLC Emulated MAC Address (for a total of 12 digits), and press **Enter**.
   - The following prompt is displayed:
5 Type the 2-digit hexadecimal SDLC Emulated SAP Address, and press Enter.

- The following prompt is displayed:

```
SDLC Emulated SAP Address (2 Hex Digits):
```

6 As shown, 6 digits are already in place. Type the additional 6 hexadecimal digits in the Frame Relay Remote MAC Address (for a total of 12 digits), and press Enter.

- The following prompt is displayed:

```
Enter FR Remote MAC Address (6 Hex Digits): 00A0EB
```

7 Type the 2-digit hexadecimal Frame Relay Remote SAP Address, and press Enter.

- The following prompt is displayed:

```
Enter FR Remote SAP Address (2 Hex Digits):
```

8 Type the Global Path Name and press Enter.

- If you enter a name that is not already associated with a Global Path, you are prompted add the path name:

```
Enter Path Name (1 to 10 Characters):
```
Enter Y to open the Global Path option and configure a path with that name. Or press ESC to return to the GPT prompt and enter a different name.

**Note:** You cannot save this configuration if a valid GPT Name has not been entered. For details of setting up a global path, see Section 4.3, *Defining Global Paths*.

- After you set up a path, the following prompt is displayed:

```
Enter Priority ( default = Medium )
for outgoing traffic on DLCI 16, port: Port 1

(1) Immediate
(2) High
(3) Medium
(4) Low

Enter Choice:
```

Select the priority level you want traffic on this DLCI to have. If you have no preference, use Medium (the default).

- A confirmation prompt, similar to the following, is displayed:

```
Priority set to Medium for DLCI 17 on port: Port 2
```

- Then the next prompt is displayed.
Select one of the following options:

- The **End-to-End** option indicates that the XID is passed transparently and that the unit does not interpret incoming XIDs.

- The **Poll-FR** option indicates that the unit initiates TEST/XID polls to a Frame Relay device to start a connection. In the case of SDLC terminal sessions, the SDLC terminal and Frame Relay host are both in the listening mode. They require initiation by the unit. (In the case of SDLC-to-SDLC connections using two BANDITs, this may not be required.)

- The **Resp-SDLC** option enables the unit to spoof incoming SDLC XID frames locally with the configuration’s XID string. This is applicable only to SDLC host sessions.

- The **Resp-FR** option enables the unit to respond to incoming XID frames with the configured XID string. This is useful in the case of local devices that do not support XIDs.

- If you selected **End-to-End**, go to the result after Step 12.

- If you selected **Poll-FR**, **Resp-SDLC**, or **Resp-FR**, the following prompt appears.

The XID PU type is the physical unit (PU) associated with the terminal device. This information is used in the unit-initiated XID frames. Select the option you want to use.

- The following prompt is displayed:

The XID string is a hexadecimal string. Select the option you want to use.
The XID string is the exchange identifier information required for the unit-initiated XID frames. Typically this is the block ID/node ID information associated with a terminal device. Type the 8-digit hexadecimal number for the XID string, and press Enter.

- A confirmation is displayed for the record you just entered in the SDLC–FR Switching Table. Then a message indicates that a record has also been created in the LLC Stations Table.

- Then a prompt appears for another entry in the SDLC–FR Switching Table.

Do one of the following:

a. If you wish to add another record to the table, go to Step 2.

b. If you have finished adding records, press Escape.

- The SDLC–FR switching table is displayed.
14 Do one of the following:

a If you wish to add another record, type a.

✓ The following prompt appears. Go to Step 2.

b To modify a record, type m and follow the directions on the screen.

c To delete a record, type d and follow the directions on the screen.

d If you have finished preparing the table, press Escape.

✓ The following prompt is displayed. Then the SNA Configuration menu is redisplayed. (See Section 7.5.1, SNA Configuration.)

7.5.1.4 SDLC–LLC Switching Table

This option configures parameters for connecting SDLC devices to Token Ring or Ethernet SNA devices.

Note: The “LLC” in this section refers only to Token Ring LLC.

1 On the SNA Configuration menu (see Section 7.5.1, SNA Configuration), select SDLC-LLC Switching Table. The following prompt appears:
<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2    | Type the SDLC Port Number you want to use, and press **Enter**.  
  - The following prompt is displayed:  
    
    Enter SDLC Controller Address (2 Hex Digits):  

| 3    | Type the 2-digit hexadecimal SDLC Controller Address, and press **Enter**.  
  - The following prompt is displayed:  
    
    Enter SDLC Emulated MAC Address (6 Hex Digits): 00A0EB  

| 4    | As shown, the first 6 digits of this address are automatically supplied.  
  Type the remaining 6 hexadecimal digits in the SDLC Emulated MAC Address (for a total of 12 digits), and press **Enter**.  
  - The following prompt is displayed:  
    
    Enter SDLC Emulated SAP Address (2 Hex Digits):  

| 5    | Type the 2-digit hexadecimal SDLC Emulated SAP Address, and press **Enter**.  
  - The following prompt is displayed:  

---

*BANDIT Products Software Configuration and Maintenance Guide*
As shown, the first 6 digits of this address are automatically supplied. Type the remaining 6 hexadecimal digits in the LLC Local MAC Address (for a total of 12 digits), and press Enter.

- The following prompt is displayed:

```
Enter LLC Local MAC Address (6 Hex Digits): 00A0EB
```

7. Type the 2-digit hexadecimal LLC Local SAP Address, and press Enter.

- The following prompt appears:

```
Enter LLC Local SAP Address(2 Hex Digits):
```

8. Type the path name and press Enter.

**Note:** If you have not already created this path names, you are prompted to do so now. For information on creating path names, see Section 4.3, *Defining Global Paths*.

- After the path information is completed, the following prompt is displayed:

```
```
a  Select an option. (These options are discussed in Step 10a of Section 7.5.1.3, SDLC–FR Switching Table.)

- If you selected the **End-to-End** option, go to the result after Step 10.

- If you selected **Poll-LLC, Resp-SDLC, or Resp-LLC**, the following prompt is displayed.

```
Enter the XID PU Type(1-PU1.0, 2-PU2.0, 4-PU4.0) :
```

9  Select the physical unit (PU) associated with the terminal device. This information is used in the unit-initiated XID frames.

```
Enter XID String(8 Hex Digits):
```

10 Enter the 8-digit hexadecimal XID String and press **Enter**.

- A confirmation is displayed for the entries you have made in the SDLC-LLC Switching table. Another message indicates that a record has also been created in the LLC Stations Table.

```
SDLC-LLC Switching Entry Added
A LLC Station Entry with Default Parameters has been created for path "your entry path name"
To View/Modify the above LLC Station Entry, Select "LLC Stations Table" from the "SNA Routing" Menu.
SAP 44 has been Added to the LLC Station for Path "your entry"
```

- Then a prompt appears for another entry in the SDLC-LLC Switching table.
Do one of the following:

a If you wish to add another record to the table, go to Step 2.

b If you have finished adding records, press Escape.

- The SDLC–LLC switching table is displayed.

---

Do one of the following:

a If you wish to add another record, type a.

- The following prompt appears. Go to Step 2.

b To modify a record, type m and follow the directions on the screen.

c To delete a record, type d and follow the directions on the screen.

d If you have finished preparing the table, press Escape.

- The following prompt is displayed. Then the SNA Configuration menu is redisplayed. (See Section 7.5.1, SNA Configuration.)
7.5.1.5 SDLC–QLLC Switching Table

This option allows you to create a routing table, that maps SDLC controller addresses to QLLC paths. You can enter multiple addresses.

**Note:** Before you start, make certain you have configured a Path Name and a Main Address in the Global Paths option on the Main Menu.

1. On the SNA Configuration menu (see Section 7.5.1, SNA Configuration), select SDLC-QLLC Switching Table.

   - The following prompt is displayed:

```
Empty SDLC-QLLC Switching Table
Add SDLC-QLLC Switching Table Entry
Enter SDLC Port Number (S(SERIAL), E(EXPANSION), R = RDU Ports, 1-24):
```

2. Type the physical port to which the SDLC device is connected, and press Enter.

   - The following prompt is displayed:

```
Enter SDLC Controller Address(2 Hex Digits):
```

3. Type the control unit (CU) address of the SDLC device, and press Enter.

   - The following prompt is displayed:
4 Type the path name that you assigned to the destination X.25 QLLC device (when you selected the Global Paths option on the Main Menu), and press **Enter**.

- The following prompt is displayed:

```
Enter QLLC Path Name (1 to 10 Characters):
```

5 When DTEs are attached to a host device in the network, you must assign a unique sub-address to each DTE. The sub-address can be up to four digits in length and is appended to the main X.121 address, which was assigned to the host device in the Global Paths option on the Main Menu. Enter the sub-address assigned to the first DTE.

**Note:** All sub-addresses must have the same number of digits. If the first sub-address assigned consists of 2 digits, then all sub-addresses you assign must consist of 2 digits.

Let \( x \) represent the number of digits you use in assigning sub-addresses. When a call is received, the system will look at the last \( x \) digits in the address, and will check the sub-address for a match.

**Note:** When a complete address is received, you must check the sub-address appended to the main address, and enter the sub-addresses into the SNA Routing Table.

- The following prompt is displayed:

```
Enter Call Initiator Type (1. No, 2. YES) :```
The Call Initiator Type parameter specifies whether the unit will initiate SVC call attempts. Select Yes (the unit will initiate) or No (the unit will not initiate).

**Note:** If the unit is the Call Initiator, the unit will clear all calls received from the destination device, using Cause 0 and Diagnostic 97 codes (see Section 9.3.1, Cause and Diagnostic Codes).

The following prompt is displayed:

```
```

Select one of the following options:

- The **End-to-End** option indicates that the XID is passed transparently and that the unit does not interpret incoming XIDs.

- The **Poll-QLLC** option indicates that the unit initiates XID polls to a QLLC device after an X.25 connection is established. In the case of SDLC terminal-to-LLC host sessions over QLLC, the SDLC terminal and LLC host are both in the listening mode. They require initiation by the unit. (In the case of SDLC-to-SDLC connections using two BANDITs, this may not be required.)

- The **Resp-SDLC** option enables the unit to spoof incoming SDLC XID frames locally with the configuration’s XID string. This is applicable only to SDLC host sessions.

- The **Resp-QLLC** option enables the unit to respond to incoming XID frames with the configured XID string. This is useful in the case of local devices that do not support XIDs.

If you select End-to-End, proceed to the result after Step 8.

If you select Poll-QLLC, Resp-SDLC, or Resp-QLLC, the following prompt is displayed:
7-82  Chapter 7: Routing with Frame Relay, X.25, and SNA

Note: The PU Type is the Physical Unit type associated with the unit session from which XID polls or XID responses should be initiated. This information is used in the unit-initiated XID frames.

7  Select the XID PU Type you want to use.

   ▶ The following prompt is displayed:

   Enter the XID PU Type(1-PU1.0, 2-PU2.0, 4-PU4.0) :

8  Type the 8-digit hexadecimal Exchange Identifier String and press Enter.

   Note: The Exchange Identifier is the node number/block number combination that represents the SNA device corresponding to this session. This information is used in the FRAD-initiated XID frames.

   ▶ A confirmation is displayed for the record you have entered in the SDLC–QLLC Switching Table.

   SDLC–QLLC Switching Entry Added

   ▶ Then a prompt appears for another entry in the table.

   Enter SDLC Port Number (S(SERIAL),E(EXPANSION),R = RDU Ports,1-24) :
9  Do one of the following:

a  If you wish to add another record to the table, go to Step 2.

b  If you have finished adding records, press Escape.

   The SDLC–QLLC switching table is displayed.

---

<table>
<thead>
<tr>
<th>Num</th>
<th>SDLC Port</th>
<th>SDLC CU</th>
<th>SDLC PATH</th>
<th>QLLC Addr</th>
<th>QLLC Initr</th>
<th>QLLC OPT</th>
<th>SDLC CALL</th>
<th>XID</th>
<th>PU</th>
<th>XID String</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>E</td>
<td>F</td>
<td>a</td>
<td>29</td>
<td>NO</td>
<td>3</td>
<td>4.0</td>
<td>0000ADB3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Add, Modify, or Delete an Entry? (Enter A, M, or D):

10  Do one of the following:

a  If you wish to add another record, type a.

   The following prompt appears. Go to Step 2.

b  To modify a record, type m and follow the directions on the screen.

c  To delete a record, type d and follow the directions on the screen.

d  If you have finished preparing the table, press Escape.

   The following prompt is displayed. Then the SNA Configuration menu is redisplayed. (See Section 7.5.1, SNA Configuration.)

SDLC-QLLC Switching Table Handling Complete
7.5.1.6 **LLC–QLLC Switching Table**

**Note:** Before you start, configure the local LLC device with the unit’s MAC address, as the destination MAC address for connectivity with this session.

In addition, the local LLC device must be configured with the destination SAP address for connectivity with this session.

Make certain you have configured a path name in the Global Paths option on the Main Menu.

1. On the SNA Configuration menu (see Section 7.5.1, *SNA Configuration*), select **LLC-QLLC Switching Table**.

   - The following prompt is displayed:

   ![Empty LLC-QLLC Switching Table](image)

2. Type the path name and press Enter.

   - If the path does not already exist, you are asked to configure it. See Section 4.3, *Defining Global Paths*.

   - After the path information has been completed, the following prompt appears:

   ![Enter LLC Local MAC Address](image)

3. As shown, the first 6 digits of this address are automatically supplied. Type the remaining 6 hexadecimal digits in the MAC Address of the local LLC device (for a total of 12 digits), and press Enter.
Type the 2-digit hexadecimal SAP Address of the local LLC device, and press Enter.

**Note:** The SAP address must be a non-null even two-digit hexadecimal number.

The following prompt is displayed:

```
Enter LLC Local SAP Address (2 Hex Digits):
```

As shown, the first 6 digits of this address are automatically supplied. Type the remaining 6 hexadecimal digits in the MAC Address of this unit (for a total of 12 digits), and press Enter.

The following prompt is displayed:

```
Enter QLLC MAC Address (6 Hex Digits): 00A0EB
```

Type the two-digit hexadecimal SAP Address assigned to this session, and press Enter.

**Note:** The SAP address must be a two-digit non-null even hexadecimal number.

The following prompt is displayed:
7 Type the path name that you assigned to the destination X.25 QLLC device (in the Global Paths option on the Main Menu), and press Enter.

- If the path does not already exist, you are asked to configure it. See Section 4.3, Defining Global Paths.

- After the path information has been completed, the following prompt is displayed:

```
Enter QLLC Path Name (1 to 10 Characters):
```

8 When DTEs are attached to a host device in the network, you must assign a unique sub-address to each DTE. The sub-address can be up to four digits in length and is appended to the main X.121 address, which was assigned to the host device in the Global Paths option from the Main Menu. Enter the sub-address assigned to the first DTE and press Enter.

**Note:** All sub-addresses must have the same number of digits. If the first sub-address assigned consists of two digits, then all sub-addresses must consist of two digits.

Let \( x \) represent the number of digits you use in assigning sub-addresses. When a call is received, the system will look at the last \( x \) digits in the address, and will check the sub-address for a match.

**Note:** When a complete address is received, you must check the sub-address appended to the main address, and enter the sub-addresses into the SNA Routing Table.

- The following prompt is displayed:
Select one of the following XID options:

- The **End-to-End** option indicates that the XID is passed transparently and that the unit does not interpret incoming XIDs.

- The **Poll-LLC** option indicates that the unit initiates XID polls to a LLC device after an X.25 connection is established. In the case of SDLC terminal-to-LLC host sessions over QLLC, the SDLC terminal and LLC host are both in the listening mode. They require initiation by the unit. (In the case of LLC-to-LLC connections using two units, this may not be required.)

- The **Poll-LLC-with-Learned-XID** option enables the unit to learn about the XID string of the remote device over QLLC and use the learned XID string in the XID polls initiated by the unit. This is useful when a third-party QLLC terminal device across X.25 must be connected with the local LLC host. In this case, the unit first issues an XID command to the QLLC terminal and receives an XID string in the XID response frame. This XID string is used in the XID polls sent to the LLC host.

- The **Resp-LLC** option enables the unit to respond to incoming XID frames with the configured XID string. This is useful to avoid XIDs over QLLC.

- If you select End-to-End or Poll-LLC-with-Learned-XID, proceed to the result after Step 12.

- If you selected Poll-LLC or Resp-LLC, the following prompt is displayed:

```
Enter the XID PU Type(1-PU1.0, 2-PU2.0, 4-PU4.0) :
```
Note: The PU Type is the physical unit type associated with the unit session from which XID polls or XID responses should be initiated. This information is used in the unit-initiated XID frames.

10 Select the XID PU Type you want to use.

- The following prompt is displayed:

```
Enter XID String (8 Hex Digits):
```

11 The Exchange Identifier is the Node number/Block number combination that represents the SNA device corresponding to this session. This information is used in the unit-initiated XID frames. Type the 8-digit hexadecimal Exchange Identifier String and press Enter.

- The following prompt is displayed:

```
Enter Call Initiator Type (1. No, 2. YES):
```

12 The Call Initiator Type specifies whether the unit will initiate SVC call attempts. Select Yes (the unit will initiate) or No (the unit will NOT initiate).

Note: If the unit is the Call Initiator, the unit will clear all calls received from the destination device, using Cause 0 and Diagnostic 97 Codes.

- A confirmation is displayed for the record you have entered in the LLC–QLLC Switching Table. Another message indicates that a record has also been entered in the LLC Stations Table.
Then a prompt appears for another entry in the table.

Do one of the following:

a) If you wish to add another record to the table, go to Step 2.

b) If you have finished adding records, press Escape.

The SDLC-QLLC switching table is displayed.

Do one of the following:

a) If you wish to add another record, type a.

The following prompt appears. Go to Step 2.

b) To modify a record, type m and follow the directions on the screen.
To delete a record, type **d** and follow the directions on the screen.

If you have finished preparing the table, press **Escape**.

- The following prompt is displayed. Then the SNA Configuration menu is redisplayed. (See Section 7.5.1, *SNA Configuration*.)

```
LLC-QLLC Switching Table Handling Complete
```

### 7.5.1.7 LLC Stations Table

LLC Station Tables are automatically created with standard default values when you enter information into the switching tables. However, this item on the SNA Configuration menu allows you to change the entries you have made, as well as the default values.

SNA 1490 supports independent LLC entities for each DLCI configured for SNA traffic, enabling independent LLC configurations for each DLCI on any Frame Relay port. Because of this LLC configuration, each DLCI can be tuned according to the characteristics of any particular DLCI without affecting SNA end devices. DLCIs are entered in the Global Paths Table and are reflected in the LLC Path Name field.

1. On the SNA Configuration menu (see Section 7.5.1, *SNA Configuration*), select **LLC Stations Table**.

- The LLC Stations Table is displayed.

```
<table>
<thead>
<tr>
<th>Entry Path Name</th>
<th>LLC Encap</th>
<th>Rx Wnd</th>
<th>Tx Wnd</th>
<th>T1 Tmr</th>
<th>T2 Tmr</th>
<th>N2 Cnt</th>
<th>Inact Tmr</th>
<th>Busy Tmr</th>
<th>Rej Tmr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BNN</td>
<td>7</td>
<td>7</td>
<td>100</td>
<td>50</td>
<td>5</td>
<td>5</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>802.2</td>
<td>7</td>
<td>7</td>
<td>100</td>
<td>50</td>
<td>5</td>
<td>5</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>802.2</td>
<td>7</td>
<td>7</td>
<td>100</td>
<td>50</td>
<td>5</td>
<td>5</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>
```

This table can only be auto created by SNA Switching table configuration.

Modify or Delete an Entry? (Enter M or D):

2. Do one of the following:
a Press Escape to return to the SNA Configuration menu.

❖ The following prompt appears. Then the SNA Configuration menu is redisplayed. (See Section 7.5.1, SNA Configuration.)

```
LLC Station Table Handling Complete
```

b Select d to delete an entry. Follow the instructions on the screen.

c Select m to modify an entry.

❖ The following prompt appears.

```
Enter Number of Entry to be Modified:
```

3 Select the line to modify

❖ The selected record’s list of fields and values is displayed.

```
1) LLC Path Name : a
2) LLC/FR Encapsulation : 802.2
3) LLC Receive Window Size : 7
4) LLC Transmit Window Size : 7
5) LLC Acknowledge Timer T1 (1/100 Seconds) : 100
6) LLC Response Timer T2 (1/100 Seconds) : 50
7) LLC Maximum Retries N2 : 5
8) LLC P Timer (Seconds) : 5
   a) LLC Inactivity Timer (Seconds) : 30
   b) LLC Busy State Timer (Seconds) : 30
   c) LLC Reject Timer (Seconds) : 5
   d) LLC SAP Table Entry Under this Station
```

```
Enter Choice :
```

4 Select a parameter that you wish to modify.
**Note:** You cannot change the LLC Path Name, because it serves as the index for the record.

- A prompt is displayed for the selected parameter.

![Prompt](image)

5 Select a value for the parameter (or press **Escape** to retain the current value).

- The record’s list of fields is redisplayed.

6 Do one of the following:

a To modify another field, go to **Step 4**.

b When you have finished configuring this record’s fields, press **Escape** to return to the LLC Stations Table. Go to **Step 2**.