# 8225
# Reference Manual

Unit 15, Riverside Business Centre, Victoria Street, High Wycombe, Bucks HP11 2LT
Web: www.casecomms.com Email: sales@casecomms.com
Tel (UK): 08700 263 740 Tel (International): +44 (0) 1494 833 740
Fax (UK): 08700 263 741 Fax (International): +44 (0) 1494 833 741

## STATUTORY NOTICES

### APPROVALS

**8225 Release 1.1**

The 8225 X.25 Switch is approved for physical connection to BT Kilostream and PSS (and similar services provided by Kingston-upon-Hull City Council) under number:

**NS/1282/1/F/450824**

### WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

CE 168 X

Case Communications Ltd declare that this product conforms with the protection requirements of Council Directive 89/336/EEC on the approximation of the laws of the member states relating to electromagnetic protection.

Case Communications Ltd. declare that this product conforms with the requirements of the European Communities Directive of 73/23/EEC on the harmonisation of the laws of Member States to electrical equipment designed for use within certain voltage limits.

Case Communications Ltd. declare that this product conforms with the requirements of the Council Directive of 91/263/EEC on the approximation of the laws of the Member States concerning telecommunications terminal equipment, including the mutual recognition of their conformity covering the following port types:

| Port | Public Telecommunications Network(s) |
|---|---|
| Network Port, fitted with the appropriate cable as specified below. | Private Circuits using interfaces compatible with X.25 (1984) using interfaces compatible with X.21 (V.11) or X.21*bis* (V.28) or X.21*bis* (V.35) or X.21*bis* (V.36).<br>Private Circuits using interfaces compatible at the physical layer with X.21 (V.11) or X.21*bis* (V.28) or X.21*bis* (V.35) or X.21*bis* (V.36). |

| Interface Type | Cable Part Number |
|---|---|
| X.21 (V.11) | X890-401011 |
| X.21bis (V.28) | X818-401211 |
| X.21bis (V.35) | X818-401311 |
| X.21bis (V.36) | X890-406611 |



Published by Case CommunicationsTechnical Publications Department

# Contents

# Appendices



# Figures



# Tables

# 1 Introduction

## 1.1 The 8225 X.25 Switch

The 8225 is a small, high speed X.25 switch which is fully operational over leased lines and public or private X.25 data networks. It provides the powerful combination of nine X.25 links, and X.25 switching, in a compact communications processor. Each link is capable of working as either a DTE or DCE and may have its own X.25 call routing table entries, allowing each link to be given different access to the X.25 network. Additionally, links can be set to 'dial-up' to provide bandwidth on demand.

There are two product variants: the 8225/9 and the 8225 Application.

### The 8225/9

The 8225/9 supports three modes of operation. Mode 1 provides the five-link functionality of the 8225/5. Mode 2 provides the high speed 64000 bps link, together with eight X.25 links each supporting speeds up to 9600 bps. Mode 3 provides nine X.25 links, each supporting speeds up to 19200 bps.

### The 8225 Application

The 8225 Application comes in two other forms: as a Card for use with the 8210, 8310 and 8325, or as a Module for use with the 8425 and 8525.

The 8225 Application Card has superior performance and supports a high speed 64000 bps link, together with eight X.25 links each supporting speeds up to 28800 bps.

## 1.2 The 8225 in Networks

The 8225 features enable it to be used:

- To build entire X.25 networks (see Figure 1-1).
- To link X.25 devices (PADs etc) together providing both local switching and concentration access (saving online rental costs) into larger networks (see Figure 1-2).

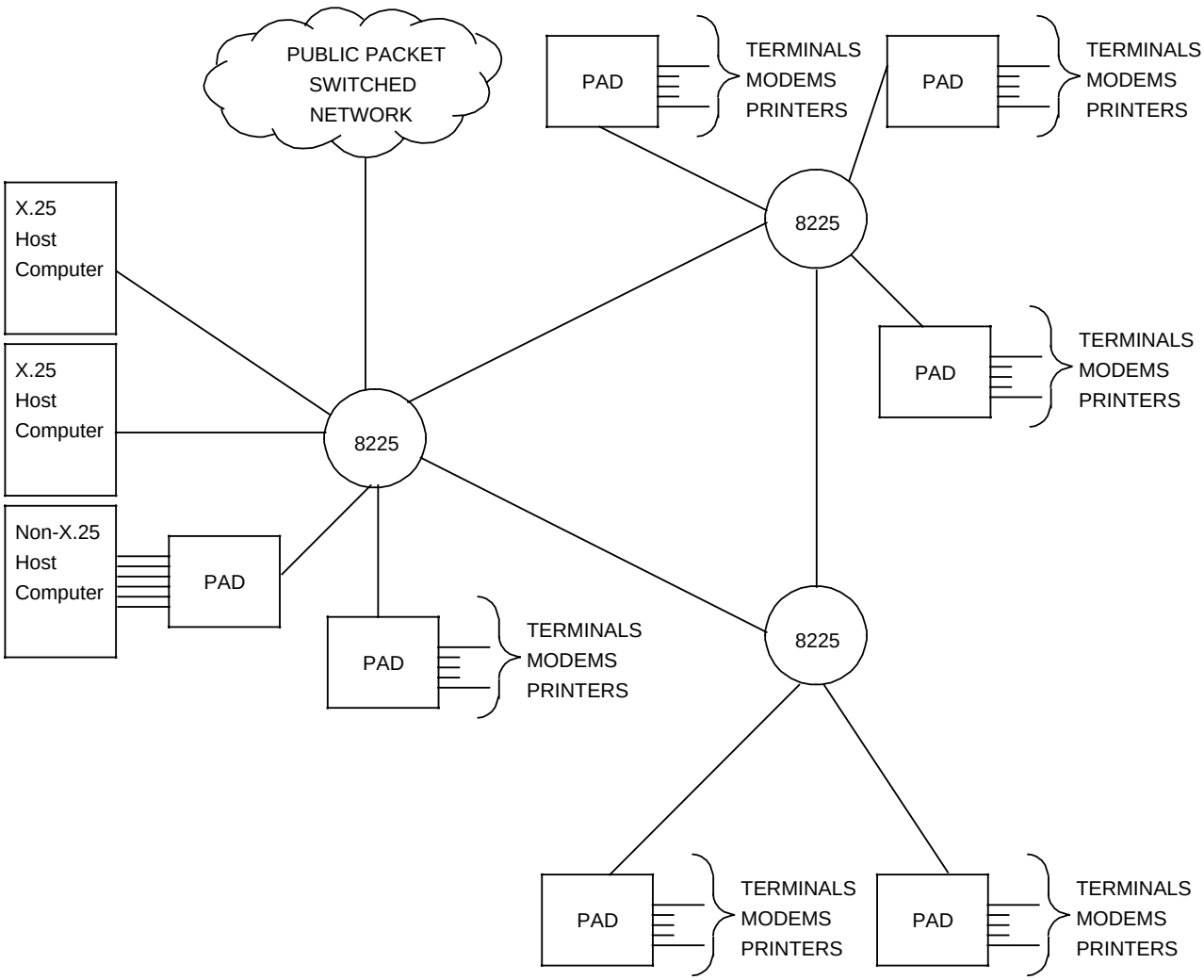



**Figure 1-1 Example X.25 Network with Secondary Routing**

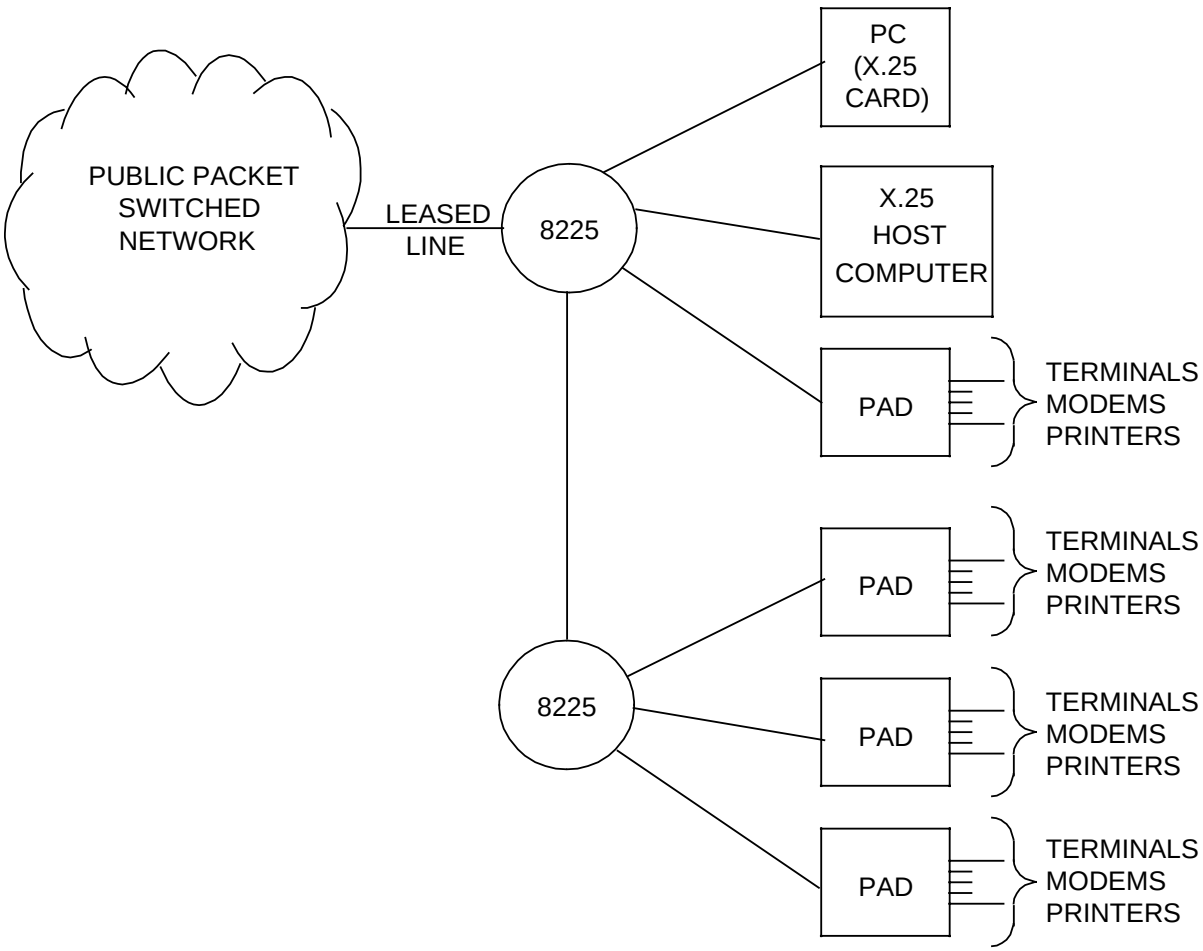



**Figure 1-2 Example Local Switching and Concentrator Access into Larger Network**

## 1.3 Terms, Conventions and Abbreviations

The following terms, conventions and abbreviations are used throughout this manual.

The person configuring the 8225 is referred to as the 'supervisor', to avoid confusion with the 8225 software 'manager'.

The 'supervisor terminal' is a terminal connected to the 8225 manager, either via an X.25 PAD, or via the asynchronous manager port.

Messages between the 8225 and the supervisor terminal are distinguished by being shown in 'modern font'.

Non-literal entries are shown in angle brackets and in lower case: e.g. **<1 to 5>** means enter a number in the range 1 to 5 inclusive. Entry from the supervisor terminal of the carriage return and space character are shown as **<CR>** and **<SP>** respectively.

General Abbreviations:

| | |
|---|---|
| ASCII | American Standard Code for Information Interchange |
| bps | Bits per second |
| BRAM | Battery-backed memory where configuration is stored |
| CCITT | International Telegraph and Telephone Consultative Committee |
| CPU | Central Processor Unit |
| ISO | International Standards Organisation |
| LED | Light Emitting Diode |
| OSI | Open Systems Interconnection |
| VDU | Visual Display Unit |

X.25 Abbreviations:

| | |
|---|---|
| CUG | Closed User Group. |
| DTE | Data Terminating Equipment (the user side of a link). |
| DCE | Data Circuit-terminating Equipment (the network side of a link). |
| LAPB | Balanced Link Access Procedure (subset of HDLC protocol). |
| LCN | Logical Channel Number (a level 3 multiplexed channel used for a connection). |
| LCGN | Logical Channel Group Number (a range of 512 logical channel numbers). |
| Link | An X.25 level 2 connection. |

| | |
|---|---|
| NUA | Network User Address (a 14- or 15-digit number assigned to an X.25 device by the network). |
| PAD | Packet Assembler/Disassembler (a device for converting asynchronous data, such as that generated by terminals, into packets for transport across X.25 links). |
| Port | A physical 25-pin connector on the back of the 8225. |
| PVC | Permanent Virtual Circuit (a connection which is always present). |
| SVC | Switched Virtual Circuit (an X.25 connection which is established dynamically). |

An overview of the X.25 protocol is given in Appendix A.

# 2 Functional Description

This chapter details the functionality offered by the 8225. It provides a specification summary followed by a description of the procedures used during X.25 call establishment and data transfer. Facilities which are configurable via the manager are described in Chapter 3.

## 2.1 Functional Specification

The 8225 conforms to the 1980 and 1984/1988 CCITT Recommendations of X.25 for communication with Public Packet Switched Networks, and X.121 for international network addressing.

It is designed to be fully compatible with X.25 Public Packet Switched Networks such as:

| | | |
|---|---|---|
| Canada | - | Datapac |
| Denmark | - | Paxnet |
| France | - | Transpac |
| Germany | - | Datex-P |
| Japan | - | KDD |
| Netherlands | - | DN-1 |
| Spain | - | IBERPAC |
| Britain | - | PSS or IPSS |
| USA | - | Telenet |
| Sweden | - | Datapac |
| Finland | - | Datapac |

Product Certification is required for attachment to Public Networks: contact your supplier for up-to-date information.

## X.25 Physical Layer – Level 1

### Mode 1

#### Composite Link

| | |
|---|---|
| Interface | V.24/V.28 or X.21/V.11 |
| Speed | Up to 64000 bps (X.21/V.11)<br>Up to 19200 bps (V.24/V.28) |
| Clocking | Internal or external (V.24/V.28)<br>External only (X.21/V.11) |
| Connector | 25-way D-type |

#### Links 1 to 4

| | |
|---|---|
| Interface | V.24/V.28 |
| Speed | Up to 19200 bps |
| Clocking | Internal or external |
| Connector | 25-way D-type |

### Mode 2

#### Composite Link

| | |
|---|---|
| Interface | V.24/V.28 or X.21/V.11 |
| Speed | Up to 64000 bps (X.21/V.11)<br>Up to 9600 bps (V.24/V.28) |
| Clocking | Internal or external (V.24/V.28)<br>External only (X.21/V.11) |
| Connector | 25-way D-type |

#### Links 1 to 8

| | |
|---|---|
| Interface | V.24/V.28 |
| Speed | Up to 9600 bps |
| Clocking | Internal or external |
| Connector | 25-way D-type |

### Mode 3

#### Links 0 to 8

| | |
|---|---|
| Interface | V.24/V.28 |
| Speed | Up to 19200 bps |
| Clocking | Internal or external |
| Connector | 25-way D-type |

**Mode 4** (Available on Application Card and Module only)

### Composite Link

| | |
|---|---|
| Interface | V.24/V.28 or X.21/V.11 |
| Speed | Up to 64000 bps (X.21/V.11)<br>Up to 64000 bps (V.24/V.28) |
| Clocking | Internal or external |
| Connector | 25-way or 15-way D-type |

### Links 1 to 8

| | |
|---|---|
| Interface | V.24/V.28 |
| Speed | Up to 28800 bps |
| Clocking | Internal or external |
| Connector | 15-way Micro D-type |

### X.25 Data Link Layer – Level 2

| | |
|---|---|
| Protocol | HDLC/LAPB |
| Interface Operation | DTE or DCE |
| Frame Sequence Numbering | Modulo 8 and Modulo 128 |

### X.25 Network Layer – Level 3

| | |
|---|---|
| CCITT X.25 Support | 1980/84/88 |
| Logical Channel Types | SVC and PVC |
| Logical Operation | DTE or DCE |
| Packet Sequence Numbering | Modulo 8 and Modulo 128 |
| Variable Default Window | Default 2 |
| Default Packet Size | 128, 256 or 512 |
| Maximum Throughput | 100 (128 byte packets) per second<br>100 (1 byte packets) per second |
| Maximum Call Setup Rate | 40 calls per second |
| Maximum Logical Channels | 256 per unit<br>128 per link |
| Special Features | Packet fragmentation and recombination<br>Calling address insertion or substitution<br>Called address translation |

## 2.2 X.25 Links

### 2.2.1 Physical Layer - Level 1

The 8225 utilises nine of the ten ports on the 8100 hardware unit as X.25 links. All X.25 links offer a physical interface conforming to the V.24/V.28 specification. In addition, in mode 1 and mode 2, link 0 may be configured to provide an electrical interface conforming to the X.21/V.11 specification. External clocking is supported on all links. Clocking may be supplied by the 8225 on links configured for V.24/V.28 physical interface.

Link 0 uses the composite port and is a physical DTE. DCE operation is available using the appropriate cross-over cable. Ports 1 to 8 are physical DCE ports which may be directly connected to DTE devices. DTE operation is available using the appropriate cross-over cable.

### 2.2.2 Data Link Layer - Level 2

The functionality supported at level 2 is identical for all links. Each link may be configured to provide either DTE or DCE logical operation. The default values for all other configurable parameters are chosen to be compatible with most X.25 networks, and normally need never be changed. All X.25 timers are also available for configuration.

### 2.2.3 Network Layer - Level 3

The functionality supported at level 3 is identical for all links. Each link may be configured to provide either DTE or DCE logical operation.

PVCs, and incoming, outgoing and both-way SVCs are supported. Each link may be configured to support up to 128 logical channels to a maximum of 256 for the whole unit. Hence, up to 128 simultaneous connections may be supported.

The default window and packet sizes are configurable together with all the X.25 timers. The default values of these are chosen to be compatible with most X.25 networks, and normally need never be changed.

## 2.3 Call Establishment Procedure

### 2.3.1 Primary Routing

When an X.25 call request is received by the 8225, the procedure used to route the call to the required destination is the same for all links.

Routing information is specified as a table of comparison addresses containing a combination of digits and wildcard digits. Each comparison address is associated with a destination link and a list of links to which this routing information is to be applied. This allows access to particular addresses and links to be restricted.

The full 14- or 15-digit called address is compared with each comparison address that is valid on the originating link, in descending order. If a match is found, then the destination link is obtained from the routing table.

### 2.3.2 Facilities Handling

Before sending the call request to the destination link, the facilities are verified. The call is rejected if:

- The facility field has an invalid format.
- The length of the facility field exceeds 63 (1980) or 109 (1984) bytes.
- A facility parameter has an invalid format.
- The window size is negotiated and is 0 or more than 7 (127 for Modulo 128).
- The packet size is negotiated and is less than 16 or more than 1024 (1980) or 4096 (1984).
- Facility negotiation in call accept packets is disabled on the receiving link and window or packet size is negotiated to values different from the default values configured for that link.
- Reverse charge is requested but this facility is configured to be rejected on the destination link.
- Fast select is requested but this facility is configured to be rejected on the destination link.
- Fast select, with restriction on response, is requested together with window or packet size negotiation.
- Facility marker options are requested but these facilities are configured to be rejected on the destination link.
- Unrecognised facilities are requested but these facilities are configured to be rejected on the destination link.

- D bit is requested but this request is configured to be rejected on the destination link.
- A closed user group is requested which is outside the configured range for the destination link.
- Calling address extension is requested before a facility marker (1984).
- Called address extension is requested before a facility marker (1984).
- Minimum throughput class is requested before a facility marker (1984).
- End-to-end transit delay is requested before a facility marker (1984).
- Expedited data negotiation is requested before a facility marker (1984).
- The user data length exceeds 16 bytes, or 128 bytes with fast select.

The following facilities are always passed transparently:

- Basic format throughput class negotiation.
- Extended format throughput class negotiation (1984).
- Basic format RPOA.
- Extended format RPOA (1984).
- User data.
- Network user identifier (NUI) (1984).
- Requesting service charging information.
- Transit delay selection and indication (1984).

The following facilities may optionally be passed transparently, or cause the call to be rejected:

- Fast select.
- Reverse charge request.
- Basic format closed user group selection.
- Extended format closed user group selection (1984).
- Basic format closed user group with outgoing access selection.
- Extended format closed user group with outgoing access selection (1984).
- Bilateral closed user group selection.

The following facilities may optionally be passed transparently, be removed, or cause the call to be rejected:

- Facility marker options.
- Unrecognised facilities.
- D bit request.

The window and packet size negotiation may be modified, in the call request transmitted on the destination link, in the following ways:

- If the packet size is negotiated and is less than 128 then the negotiated packet size is changed to 128.
- If the packet size is negotiated and is more than 256 then the negotiated packet size is changed to 256.
- If facility negotiation in call request packets is disabled on the destination link, then window and packet size negotiation are removed.

The called address may be modified, in the call request transmitted on the destination link, in the following way:

- If called address translation is enabled on the receiving link, and a called address translation mask is configured on the destination link which will cause that address to change.

The calling address may be modified, in the call request transmitted on the destination link, in the following ways:

- If calling address insertion is enabled on the destination link, and no calling address is included in the received call request, then the configured default calling address of the receiving link is inserted.
- If calling address substitution is enabled on the destination link, then the configured default calling address of the receiving link is inserted, replacing the original calling address. If there is no default calling address configured, then the calling address is removed.

When the call confirm is received from the destination link, the facilities are verified. The call is cleared if:

- The facility field has an invalid format.
- The length of the facility field exceeds 63 (1980) or 109 (1984) bytes.
- A facility parameter has an invalid format.
- The window size is negotiated and is 0 or more than 7.
- The packet size is negotiated and is not 128, 256 or 512.
- Fast select is requested.
- Reverse charge is requested.
- Fast select, with restriction on response, was requested in the original call request packet.
- Extended format throughput class negotiation is requested (1984).
- Basic format closed user group selection is requested.
- Extended format closed user group selection is requested (1984).

- Basic format closed user group with outgoing access selection is requested.
- Extended format closed user group with outgoing access selection is requested (1984).
- Bilateral closed user group selection is requested.
- Facility marker options are requested but these facilities are configured to be rejected on the destination link.
- Unrecognised facilities are requested but these facilities are configured to be rejected on the destination link.
- D bit is requested but this request is configured to be rejected on the destination link.
- Basic format RPOA is requested.
- Extended format RPOA is requested (1984).
- Calling address extension is requested before a facility marker (1984).
- Called address extension is requested before a facility marker (1984).
- Minimum throughput class is requested before a facility marker (1984).
- End-to-end transit delay is requested before a facility marker (1984).
- Expedited data negotiation is requested before a facility marker (1984).
- The user data length exceeds 16 bytes, or 128 bytes with fast select.

The following facilities are always passed transparently:

- Basic format throughput class negotiation.
- Network user identifier (NUI) (1984).
- Requesting service charging information (1984).
- Called line address modified notification (1984).
- Transit delay selection and indication (1984).
- User data.

The following facilities may optionally be passed transparently, be removed, or cause the call to be cleared:

- Facility marker options.
- Unrecognised facilities.
- D bit request.

The window and packet size negotiation included in the call accept packet transmitted on the originating link obeys the following rules:

- If the packet size was negotiated in the original call request packet, then it is negotiated in the call accept packet unless facility negotiation in call accept packets is disabled on that link.
- If the window size was negotiated in the original call request packet, then it is negotiated in the call accept packet unless facility negotiation in call accept packets is disabled on that link.
- If the packet size was not negotiated in the original call request packet, then it is never negotiated in the call accept packet.
- If the window size was not negotiated in the original call request packet, then it is never negotiated in the call accept packet.
- If the packet size negotiated in the original call request packet was less than 128, then it is always negotiated up to 128.
- If the packet size negotiated in the original call request packet was more than 512, then it is always negotiated down to 512.
- If facility negotiation in call accept packets is disabled on that link, then it is never negotiated in the call accept packet.

Once the call is established, the window and packet sizes used on each link are independent and may differ.

Network layer acknowledgements are provided locally and unacknowledged packets are stored by the 8225.

Fragmentation of large packets into smaller packets is performed if packet sizes differ on each link. Specifically, packets exceeding 128 bytes, received on a link using a maximum packet size of 256, are fragmented into a full 128-byte packet, with the M bit set, followed by a second packet containing the remaining data, for another link using a maximum packet size of 128.

Conversely, recombination of small packets, with the M bit set, into larger packets is performed. Specifically, a full 128 byte packet, with the M bit set, received on a link using a maximum packet size of 128, is combined with the following packet for another link using a maximum packet size of 256. In addition, if both packets have the M bit set, then the resulting 256-byte packet will also have it set.

### 2.3.3 Secondary Routing

If the X.25 call request sent by the 8225 is rejected, or the destination link of the primary route is not operational, then the original call may be redirected to the secondary route, which in turn can be redirected to another secondary route.

Each link has its own secondary routing table. Secondary routing information is configured as a table of comparison addresses containing a combination of digits and wildcard digits. Each comparison address is associated with a destination link

The full 14- or 15-digit called address is compared with each comparison address in turn. If a match is found, then the new destination link is obtained from the routing table.

The call establishment procedure is then repeated.

## 2.4 Management

The 8225 manager is menu-driven and is suitable for use with a 'glass teletype' terminal. Access to the manager is provided, from X.25, using a configurable manager address, and may optionally be restricted to particular ports. Access may also be achieved via the asynchronous channel 9. Manager access, both remotely via X.25 or locally via the asynchronous channel, is password-protected.

After cold start the 8225 installs its default configuration. This is designed to allow the 8225 to be installed with a minimum of, or even zero, configuration.

The manager provides statistical information both at level 2 and level 3. Level 2 statistics display the link state and frame counters. Level 3 statistics display the active LCNs on each link, the window and packet sizes being used, a count of the data transferred, the direction of the call, and the called and calling addresses used by it.

## 2.5 Network Management Centre

The 8225 may be accessed by the Case Communications Network Management Centre (NMC) for configuration upload/download, device restart, or for status. A connection to the Network Management Centre facility is achieved by using a called address which matches a comparison address in the SVC Primary Routing Table with a corresponding destination link of NMC. If these facilities are not required, then this entry should not be included in the table. Disabling this feature does not prevent transparent logon from the Network Management Centre.

Additionally, the 8225 may access the NMC to report significant events e.g. an X.25 link up, or link down. This feature is enabled via the Management configuration menu, where addresses for 8225 Event Reporting calls to the NMC can be configured.

Event reporting calls will always use Link 0 and do not require an entry in the Routing Table.

# 3 Manager Configuration

## 3.1 Introduction

This chapter explains the operation of the menu-driven 8225 manager. It details menu operation, facilities offered and configuration options. The manager is password-protected to prevent unauthorised access. After password entry initial menu display starts with the Main Menu and each subsequent menu is displayed on request. The manager menus display operational information and contain options to make configuration changes. Several of the options available are designed to allow the supervisor to optimise the performance and efficiency of the 8225 to the particular application and environment in which it is to be used.

A minimum default configuration is initially present and is suitable for simple concentrator applications. These configuration values may have to be amended to conform to the values agreed with the administration of the particular network to which the 8225 is linked.

## 3.2 Manager Access

Only one supervisor connection to the 8225 manager may be made at a time.

### 3.2.1 Local Manager Access

The 8225 manager may be accessed locally with an asynchronous terminal attached to channel 9. This interface operates to the following specification.

| | |
|---|---|
| speed | 2400 bps |
| data bits | 7 |
| parity bits | 1 |
| parity | space |
| stop bits | 1 |
| CTS | high |
| DSR | high |
| DCD | high |

### 3.2.2 Remote Manager Access

The 8225 manager may be accessed remotely from an X.25 PAD by making a call using an address which matches the 8225 manager address. Initially the 8225 is configured with the manager on subaddress 99. Therefore any calls received with an address ending in 99 will be sent to the manager. If they are configurable, the following PAD parameter values should be set:

| | |
|---|---|
| Parameter 2 : | 0 (Echo off) |
| Parameter 3 : | 2 (Packet forwarding on carriage return) |
| Parameter 4 : | 0 (Timeout forwarding off) |
| Parameter 15 : | 1 (Local editing on) |

If no manager password is configured then the Main Menu is displayed and configuration may proceed. Otherwise the 8225 will prompt for a password first.

| **8225 Message** | **Supervisor Response** |
|---|---|
| **Enter Password :** | **<password><CR>** |

Four attempts are allowed for the correct password. If all passwords entered are incorrect then the supervisor terminal is disconnected.

## 3.3 Operating the Menus

The 8225 menus are controlled from the supervisor terminal using the following principles:

| | |
|---|---|
| **<number><CR>** | Selects the specified item number from the menu. |
| **X<CR>** | Returns to the menu level above the current one. |
| **<CR>** | Causes the currently selected menu to be redisplayed. |

Where a menu option has only two possible values, then selecting that option will often cause the value to toggle, and the menu to be redisplayed showing the new value.

In this manual, every menu option is given its own sub-section, titled to correspond with the phrase which appears in the manager menus. Each title is followed by the number sequence (shown in brackets) that is required to reach that menu from the Main Menu. For example, entering 3.1 (**3 <CR> 1 <CR>**) will take the supervisor to the Manager Password option.

The manager responds to invalid entries with a help message before re-displaying the prompt.

## 3.4 Operating Mode (1)

The 8225 provides four operating modes, mode 1, mode 2, mode 3 or mode 4.

Mode 1 provides five X.25 links using the composite port together with ports 1 to 4. In this mode, link 0, which uses the composite port, may be operated at speeds up to 64000 bps, and provides either a V.24/V.28 or an X.21/V.11 electrical interface. In addition, links 1 to 4 may be operated at speeds up to 19200 bps. This mode is particularly useful for concentrator applications or for high speed data transfer where no more than five X.25 links are required. Mode 1 is supported by the 8225/9.

Mode 2 provides nine X.25 links using the composite port together with ports 1 to 8. In this mode link 0 may be operated at speeds up to 64000 bps and provides either a V.24/V.28 or an X.21/V.11 electrical interface. Links 1 to 8 may be operated at speeds up to 9600 bps and provide a V.24/V.28 electrical interface. This mode is particularly useful for concentrator applications requiring extra links. Mode 2 is supported by the 8225/9 only.

Mode 3 provides nine X.25 links using the composite port together with ports 1 to 8. In this mode all links may be operated at speeds up to 19200 bps and provide a V.24/V.28 electrical interface. This mode is particularly useful for switching applications where the extra links are required. Mode 3 is supported by the 8225/9.

Mode 4 provides nine X.25 links using the composite port together with ports 1 to 8. In this mode link 0 may be operated at speeds up to 64000 bps and provides either a V.24/V.28 or an X.21/V.11 electrical interface. Links 1 to 8 may be operated at speeds up to 28800 bps and provide a V.24/V.28 electrical interface. This mode supercedes all other modes. It is the only mode supported on the 8225 Application Card and Module.

The default value is Mode 1.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter operating mode** : | **<mode1, mode2, or mode 3><CR>** |

## 3.5 CCITT Operation (2)

The 8225 provides the facility to connect to networks conforming to either the 1980 or the 1984/1988 CCITT X.25 recommendation. The default value is 1980.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter CCITT standards conformance requirements :** | **<1980 or 1984><CR>** |

## 3.6 Management Configuration Menu (3)

The Management Configuration Menu contains manager access parameters. It should be noted that if local, remote and NMC access are all disabled then, after logoff or warm start, a cold start would be required to re-enter the manager.

In addition, loading and dumping of configuration data is managed from here; i.e. data may be saved ('dumped') onto a magnetic medium and subsequently sent ('loaded') to other 8225s on the network. This enables installation, upgrades and global configuration changes to be applied easily. This procedure can be done in one of two ways: via the NMC or using an asynchronous capture device.

When the 8225 receives an X.25 call from an NMC with a subaddress which matches a comparison address in the SVC Primary Routing Table with the NMC as its destination link, the call will be accepted and the NMC will then specify the required action. Initially the 8225 is configured so that any calls received with an address ending in 98 will go to the NMC. If a configuration upload is required then the NMC (in terms of IEEE 802.1 request parameters) requests receipt of the alternate configuration. In response to each request, the 8225 will make X.25 calls back to the NMC to send the configuration data. After loading data the NMC has the capability to restart the 8225 to activate the new configuration.

Alternatively, an asynchronous device capable of saving captured data to a file, such as a PC with communications software, can be connected locally or remotely to the 8225 manager. This device may then be used to carry out and save a configuration dump. Subsequently the same device may be used to load the saved configuration to any 8225 in the network.

- **Manager Password (3.1)**

The 8225 has a manager access password. This password must be entered to gain access to the 8225 manager. The default value is none (i.e. <CR>).

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Old Password :** | **<old password><CR>** |
| **Enter New Password :** | **<0 to 12 alphanumeric characters><CR>** |
| **Please Re-enter New Password :** | **<new password><CR>** |

- **Reference Name (3.2)**

It may be useful for each 8225 in the network to be allocated a unique name. If configured, this name appears on the Main Menu, thus providing immediate identification of the 8225 on entry to the manager.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter 8225 name :** | **<0 to 16 alphanumeric characters><CR>** |

- **Local Manager (3.3)**

The 8225 provides an asynchronous management interface on port 9. This interface operates to the following specification.

| | |
|---|---|
| speed | 2400 bps |
| data bits | 7 |
| parity bits | 1 |
| parity | space |
| stop bits | 1 |
| CTS | high |
| DSR | high |
| DCD | high |

This facility may optionally be disabled if access to the manager from this interface is to be barred. The default value is Enabled.

| 8225 Message | Supervisor Response |
|---|---|
| **Local Manager Enabled ?** | **<yes or no><CR>** |

- **Echo of Commands (3.4)**

The manager facility optionally echoes the data that it receives from X.25. In order to prevent corruption of the menu displays, each full command is echoed rather than individual characters. If remote echo is not required then this facility should be disabled. The default value is Enabled.

| 8225 Message | Supervisor Response |
|---|---|
| Echo Enabled ? | <yes or no><CR> |

- **Manager Idle Timeout (3.5)**

For security reasons the 8225 manager provides an optional idle timeout facility. If no commands are entered for a period exceeding this interval then the supervisor is logged off automatically. This timeout is configured in minutes. A value of 0 disables the facility. The default value is 5.

| 8225 Message | Supervisor Response |
|---|---|
| Enter Manager Idle Timeout : | <0 - 255><CR> |

- **Load Configuration (3.6)**

Saved data can be loaded by choosing the Load Configuration option, to which the 8225 issues the following prompt:

| 8225 Message | Supervisor Response |
|---|---|
| Load Configuration ? | <yes or no> <CR> |

If the response is YES then the 8225 issues the following:

| 8225 Message |
|---|
| Awaiting Configuration: |

The 8225 will then wait for 1 minute to receive the first S-Record. If this is not received within 1 minute a time-out message will be displayed. The 8225 should always be warm started after a successful load so that the new configuration takes effect.

If a configuration load fails one of the following error messages may be displayed:

| | |
|---|---|
| **Timed Out** | A valid S-record has not been received within 1 minute. |
| **Unable to read S0-record** | An invalid S0-record was received when an S0 record was expected. |
| **Unable to read S1-record** | An invalid S1-record was received when an S1 record was expected. |
| **Unable to read S9-record** | An invalid S9 record was received when an S9 record was expected. |
| **Bad S0-record** | An invalid S0-record was received. |
| **Bad S1-record** | An invalid S1-record was received. |
| **Bad S9-record** | An invalid S9-record was received. |
| **Checksum error** | An S-record was corrupted. |
| **Unrecognised format** | An S-record transfer was successful but the file contents were invalid. |
| **Memory Shortage** | The configuration file is too large or other activity on the 8225 is using all the available memory. |

- **Dump Configuration (3.7)**

This menu allows the supervisor to dump the 8225 configuration.

| **8225 Message** | **Supervisor Response** |
|---|---|
| **Dump Configuration ?** | **<yes or no> <CR>** |

If the response is YES then the 8225 issues the following prompt:

| **8225 Message** |
|---|
| **Prepare device, type <CR> when ready.** |

The 8225 will wait 1 minute for a <CR>. If this is not received then a timeout message will be displayed. On receipt of a <CR> the requested data will be sent in Motorola S-Record format. Note that it is up to the user to prepare the capture device. On completion, the Management Configuration Menu is re-displayed after a <CR> is entered or after 1 minute.

- **Event Reporting to NMC (3.9)**

When Event Reporting is enabled the 8225 may access the Network Management Centre (NMC) to report significant events e.g. an X.25 link up, or link down. The 8225 will make calls to the NMC using the called and calling addresses configured in 3.10 and 3.11 Event reporting calls always use Link 0. The default is Disabled.

| 8225 Message | Supervisor Response |
|---|---|
| **Event Reporting to NMC Enabled?:** | **<yes or no><CR>** |

- **Calling Address for Calls to NMC (3.10)**

This should be the same as 'The Network Management X.121 Address' configured on the NMC for this unit. The default is <*blank*>.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Calling Address to Use in Calls to the NMC:** | **<0 to 15 digits><CR>** |

- **Called Address for Calls to NMC (3.11)**

The network address of the NMC. The default is 99990000000000.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Address of the NMC:** | **<0 to 15 digits><CR>** |

- **Transparent Manager Menu (3.12)**

The 8225 manager may be used to manage other devices in the X.25 network using the transparent management facility. If this feature is enabled then a menu of up to 18 configured destination descriptions is displayed during the logon procedure. Selection of any of these options will cause the 8225 to request a connection to the destination device. Note that if the destination device cannot clear the X.25 call then a BREAK or a NULL code may be used by the local manager, or clear requested by the remote manager. The default value is Disabled.

| 8225 Message | Supervisor Response |
|---|---|
| **Transparent Logon Menu Enabled ?** | **<yes or no> <CR>** |

- **Transparent Manager Configuration Menu (3.13)**

Transparent manager destinations may be added or changed using the Transparent Manager Configuration Menu. All the details of the configured transparent manager destinations are displayed and the required connection number requested. Entries are added or changed by configuring the destination description, link number, X.121 address and password within the Transparent Manager Configuration menu.

- **Description (3.13.1)**

The destination description is displayed on the Transparent Manager menu at logon. It should be used to describe the device to be configured.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Destination Description** | **<0 to 20 characters> <CR>** |

- **Destination Link Number (3.13.2)**

Transparent connections do not use the primary routing table to be routed to the correct link. Instead, the destination link number is specified for each transparent connection. The link number chosen should correspond to the link most appropriate to send calls to the destination device.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Destination Link Number** | **<0 to 8 or manager> <CR>** |

- **X.121 Address (3.13.3)**

The X.121 address is the address used to access the manager of the remote device. Note that the subaddress may be required to match the configured manager subaddress of that device.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter X.121 address** | **<0 to 15 digits> <CR>** |

- **Password (3.13.4)**

Remote managers of many X.25 devices may take the logon password from the call user data field. This avoids the necessity to follow the full logon procedure on the remote device. The password is inserted after the protocol identifier field.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Password** | **<0 to 12 alphanumeric characters><CR>** |

## 3.7 X.25 Configuration Menu (4)

There are five X.25 links on the 8225/5 and, depending on the mode of operation, either five or nine X.25 links on the 8225/9. The configuration procedures for the data link layer and the network layer are the same for all links. However, those for the physical layer differ slightly because, in mode 1 and mode 2, the composite port offers an extra physical interface type.

On selecting this menu the specific link number is requested.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter X.25 link number :** | **<0 to 8><CR>** |

The X.25 Configuration Menu defines the values of the X.25 parameters. These values must be agreed with the administration of the X.25 network to which the 8225 is to be connected. Refer to the appendices for more information.

Two X.25 configurations are maintained: the 'alternate' and the 'current'. The supervisor is only able to update the alternate configuration. The newly specified values do not become active until the 8225 is warm started.

- **Physical Layer Menu (4.L.1)**

The X.25 Physical Layer is concerned with the electrical interface, clock source, clocking rate of the X.25 link and the interface mode (leased line or dial-up).

- **Physical Interface (4.0.1.1)**

Note that this option is only available in mode 1, mode 2 or mode 4.

The physical interface defines the electrical interface used on the X.25 link. Links 1 to 8 provide a V.24 interface only, so this option is not available. In mode 1 and mode 2, Link 0 offers the choice of V.24 or X.21 interfaces.

Selecting this option toggles the value between V.24 and X.21. The default value is V.24.

- **Clock Speed (4.L.1.1)**

The clocking value limits the rate of data transfer across the X.25 link. In mode 1, links 1 to 4 provide clocking rates of 2400, 4800, 7200, 9600 and

19200 bps; link 0 provides the additional clocking rates of 48000, 56000, 64000 bps. These higher rates should only be used in conjunction with the X.21 physical interface. The default value of all links is 19200 bps.

In mode 2 links 1 to 8 provide clocking rates of 2400, 4800, 7200 and 9600 bps; link 0 provides the additional clocking rates of 19200, 48000, 56000 and 64000. The default value of links 1 to 8 is 9600 bps, and the default value of link 0 is 9600 bps.

In mode 3 all links provide clocking rates of 2400, 4800, 7200, 9600 and 19200 bps. The default value of all links is 19200 bps.

In mode 4 links 1 to 8 provide clocking rates of 2400, 4800, 7200, 9600, 19200 and 28000 bps; link 0 provides the additional clocking rates of 48000, 56000 and 64000. The default value of all links is 19200 bps.

- **Clock Source (4.L.1.2)**

Clocking should be provided by a single source on each X.25 link. It may be provided by a modem or line driver, by the X.25 network DCE or by the 8225 itself. Where the clock source is provided by the 8225 then Clock Source should be Internal. Otherwise it should be External. *The clocking speed should be correctly configured, regardless of the clock source.*

Selecting this option toggles the value between Internal and External. The default value of link 0 is External, and of links 1 to 8 is Internal.

Note that internal clocking is not available on link 0 for mode 1, 2 or 3 if the X.21/V.11 electrical interface is configured.

- **Interface Mode (4.L.1.3)**

The X.25 physical interface mode may be set to either Leased or Dial. When set for Leased the 8225 permanently supplies DTR, RTS, DRS, (ON) and requires DSR (ON). In the case of X.21 the 8160 supplies Control and requires indicate.

When set to Dial the physical interface signals DTR, RTS (or in the case of X.21 – Control) will be off until either:

a) an X.25 call is routed to a dial-up port which causes the 8225 to raise DTR to its local modem which then dials the phone number of the remote modem.

b) the modem starts pulsing Ring Indicator which causes the 8225 to raise DTR to instruct the modem to answer the phone.

See Appendix H for further details.

When set to Dial the following items (4.L.1.4 to 4.L.1.10) apply. Default is Leased.

- **Dial-up – DCD/I stabilisation (4.L.1.4)**

This is the length of time that the modem DCD/Indicate control must be ON before the 8160 activates the X.25 link. The range is from 0 to 20 seconds. Default is 2 seconds.

- **Dial-up – DCD/I dip (4.L.1.5)**

This is the length of time that the modem DCD/Indicate control must stay OFF (after being ON) before the 8225 de-activates the X.25 link and drops control to the modem.

While the link is up, a brief loss of the carrier detect interface signal (due to line hits etc) will be tolerated by the PAD, providing such dip lasts for less than the 'DCD/I Dip' time. The range is from 0 to 20 seconds. Default is 2 seconds.

- **Dial-up – DTR/C held (answering) (4.L.1.6)**

This is the time DTR/Control is held on in response to RI/DCD/Indicate. If when answering a dial-up call the modem fails to get properly trained up within the 'DTR/C held' time, the 8225 turns off DTR/Control, causing the modem to clear the call. The range is from 1 to 180 seconds. Default is 15 seconds.

- **Dial-up – DTR/C dial wait (originating) (4.L.1.7)**

This is the time DTR/Control is held on when dialling out. If the modem fails to get connected and trained up to the remote modem the 8225 turns off DTR/Control, causing the modem to clear the call. The range is from 1 to 180 seconds. Default is 15 seconds.

- **Dial-up – link start up timeout (4.L.1.8)**

This is the time allowed for the X.25 link to start up once the 8225 detects that DCD/Indicate has stayed on for 'DCD/I stabilisation' time. If the X.25 link does not activate in that time, the 8225 gives up the attempt, and turns off DTR/Control to clear the modem call. The range is from 0 to 600 seconds. Default is 90 seconds.

- **Dial-up – Idle link timeout (4.L.1.9)**

This is the time the X.25 link is allowed to be idle after all X.25 calls have cleared. The 8225 waits for the idle link timeout to expire, and then de-activates the X.25 link and turns off DTR/Control which causes the modem to clear the call. The range is from 0 to 600 seconds. Default is 90 seconds.

- **Dial-up – Wait DCD/I drop (4.L.1.10)**

The time to wait for DCD/Indicate to respond, before answering another dial-up call, when DTR/Control is dropped. The range is from 0 to 20 seconds. Default is 1 second.

- **Data Link Layer Menu (4.L.2)**

The Data Link Layer provides error-free data transmission over the circuit provided by the physical layer.

- **Logical Operation (4.L.2.1)**

For correct LAPB operation, data transmission is provided between a DCE and a DTE. Normally the X.25 network provides DCE operation. Therefore, 8225 links which present a network interface to terminal type devices (e.g. an X.25 PAD) must provide DCE operation, while links interfacing to the network must provide DTE operation. The default value of link 0 is DTE, and of links 1 to 8 is DCE.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter logical operation :** | **<DTE or DCE><CR>** |

- **Protocol Variant (4.L.2.2)**

The LAPB link start-up procedures used by 8225 are compatible with all CCITT 1984 conformant products, allowing Protocol Variant 1 to be used with most networks. However, some assertive networks may require passive link start-up procedures provided by protocol variant 2. Protocol Variant 1 complies with NET 2 (1988) Section 9.1.4, DTE initiated – DISC start. Protocol Variant 2 complies with NET 2 Section 9.1.1, DCE initiated. Two additional options are provided: Protocol Variant 3 is a DM0 start-up, Protocol Variant 4 is a SABM start-up. Default is 1.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter protocol variant :** | **<1 to 4><CR>** |

- **Retry Count N2 (4.L.2.3)**

The retry count N2 is the maximum number of frame re-transmissions after expiry of the command timeout period T1. The default value is 10.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Retry Count:** | **<1 to 20><CR>** |

- **Command Timeout T1 (4.L.2.4)**

The command timeout T1 defines the delay between successive polls of command frames while no response is being received. This timeout is configured in tenths of a second. The default value is 30.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Timeout:** | **<10 to 100><CR>** |

- **Extended Windows (4.L.2.5)**

If this option is enabled the 8225 will send and receive MOD 128 frame level windows. Default is disabled.

- **Window Size K (4.L.2.6)**

The window size K defines the maximum number of unacknowledged information frames which may be transmitted. The range is from 1 to 127 and the default is 7.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Window size K:** | **<1 to 7><CR>** |

- **Network Layer Menu (4.L.3)**

The network layer provides error-free data transmission over the data link layer for multiple X.25 calls.

- **Logical Channel Allocation**

The 8225 supports a maximum of 128 logical channels on each link, up to a total of 256 for all links.

Both permanent and switched virtual circuits are supported.

Each PVC must be allocated a logical channel number on both the X.25 links that it uses. These logical channel numbers must then be mapped

together in the PVC Routing Table. Hence, each PVC uses two logical channel numbers on the 8225.

Each X.25 call received by the 8225 is assigned a logical channel number associated with an SVC on the receiving X.25 link. This call is routed using the SVC Routing Table, and another logical channel number associated with an SVC is selected from the destination link to make the resultant X.25 call request. Hence each X.25 call through the 8225 uses two logical channel numbers.

There are three types of SVC supported by the 8225: incoming, 2-way and outgoing.

When the network layer logical operation is specified as DCE, incoming SVCs are used in preference to 2-way SVCs for making X.25 calls. Outgoing SVCs may only be used for receiving calls.

When the network layer logical operation is specified as DTE, outgoing SVCs are used in preference to 2-way SVCs for making X.25 calls. Incoming SVCs may only be used for receiving calls.

The total number of PVCs and SVCs configured must not exceed 128 logical channels per link. Links violating this rule will have the default ranges in the current configuration after a warm start.

The total number of PVCs and SVCs configured for all links must not exceed 256, and there must be at least one SVC available for management. If these rules are violated, then all links will have the default ranges in the current configuration after a warm start.

The order of logical channel allocation is also significant. PVCs must be allocated lower logical channel numbers than SVCs. Incoming SVCs must be allocated lower logical channel numbers than 2-way SVCs, which in turn must be allocated lower logical channel numbers than outgoing SVCs. If these rules are violated then that link will have the default ranges in the current configuration after a warm start.

Note that some networks specify LCNs in terms of LCGNs and LCNs, where the X.25 LCN is a 12-bit number comprising a 4-bit LCGN (high order bits) and an 8-bit LCN. For this type of network the LCGN plus LCN supplied by the network administration must be translated into an X.25 LCN acceptable to the 8225. Refer to Logical Channel Group Numbers in Appendix D.

- **Logical Operation (4.L.3.1)**

The 8225 supports both DTE and DCE logical operation. Normally the X.25 network provides DCE operation. Therefore, 8225 links which present a network interface to terminal type devices (eg. an X.25 PAD) must provide DCE operation, while links interfacing to the network must provide DTE operation.

When requesting X.25 calls, the DCE allocates the lowest available logical channel, while the DTE allocates the highest. Therefore frequent call collisions are avoided if the logical operation is different at both ends of each X.25 link.

The default value of link 0 is DTE.

The default value of links 1 to 8 is DCE.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter logical operation :** | **<DTE or DCE><CR>** |

- **Low PVC (4.L.3.2)**
- **High PVC**

Refer to the Logical Channel Allocation above. The Low PVC specifies the lowest logical channel number in the range of channels allocated as PVCs. The High PVC specifies the highest logical channel number in that range. A value of 0 specifies that no PVCs are defined. The default value is 0.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter <Low High> or <CR> to delete :** | **<0 to 4095> <SP> <0 to 4095><CR>** |

- **Low In SVC (4.L.3.3)**
- **High In SVC**

Refer to the Logical Channel Allocation above. The Low In SVC specifies the lowest logical channel number in the range of channels allocated as incoming SVCs. The High In SVC specifies the highest logical channel number in that range. A value of 0 specifies that no In SVCs are defined. The default value of link 0 is 1. The default value of links 1 to 8 is 0.

| 8225 Message | Supervisor Response |
|---|---|

| | |
|---|---|
| **Enter <Low High> or <CR> to delete :** | **<0 to 4095> <SP> <0 to 4095><CR>** |

- **Low 2-way SVC (4.L.3.4)**
- **High 2-way SVC**

Refer to the Logical Channel Allocation above. The Low 2-way SVC specifies the lowest logical channel number in the range of channels allocated as 2-way SVCs. The High 2-way SVC specifies the highest logical channel number in that range. A value of 0 specifies that no 2-way SVCs are defined. The default value is 1024 to 1031.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter <Low High> or <CR> to delete :** | **<0 to 4095> <SP> <0 to 4095><CR>** |

- **Low Out SVC (4.L.3.5)**
- **High Out SVC**

Refer to the Logical Channel Allocation above. The Low Out SVC specifies the lowest logical channel number in the range of channels allocated as outgoing SVCs. The High Out SVC specifies the highest logical channel number in that range. A value of 0 specifies that no outgoing SVCs are defined. The default value is 0.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter <Low High> or <CR> to delete :** | **<0 to 4095> <SP> <0 to 4095><CR>** |

- **Extended Windows (4.L.3.6)**

If this option is enabled the 8160 will send and receive MOD 128 packet level windows.

- **Default Window Size (4.L.3.7)**

The network layer window size defines the maximum number of unacknowledged packets that may be transmitted. If no window size negotiation occurs during X.25 call establishment, then the value of the default window size is used for the duration of that call. The range is from 1 to 7 (1 to 127 when Extended Windows is enabled) and the default is 2.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Window Size :** | **<1 to 7><CR>** |

- **Maximum Packet Size (4.L.3.8)**

This is the maximum packet size the 8160 will negotiate. This can be 512, 256, or 128. The default is 256.

- **Default Packet Size (4.L.3.9)**

The network layer packet size defines the maximum number of data characters that may be contained by each packet. If no packet size negotiation takes place during X.25 call establishment, then the value of the default packet size is used for that call. There are three possible values, 128, 256 and 512. Default is 128.

- **Restart Timeout T10 or T20 (4.L.3.10)**

The restart timeout defines the delay, while waiting for a response to a restart request, before a definitive action is taken. This timeout is configured in seconds. The default value is 180.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter new timeout :** | **<10 to 500><CR>** |

- **Call Timeout T11 or T21 (4.L.3.11)**

The call timeout defines the delay, while waiting for a response to a call request, before a definitive action is taken. This timeout is configured in seconds. The default value is 200.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter new timeout :** | **<10 to 500><CR>** |

- **Reset Timeout T12 or T22 (4.L.3.12)**

The reset timeout defines the delay, while waiting for a response to a reset request, before a definitive action is taken. This timeout is configured in seconds. The default value is 180.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter new timeout :** | **<10 to 500><CR>** |

- **Clear Timeout T13 or T23 (4.L.3.13)**

The clear timeout defines the delay, while waiting for a response to a clear request, before a definitive action is taken. This timeout is configured in seconds. The default value is 180.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter new timeout :** | **<10 to 500><CR>** |

- **X.25 Facilities Menu (4.L.4)**

During X.25 call establishment, facilities are requested, negotiated and validated. Values configured in the X.25 facilities menu are used during all X.25 call establishment procedures to determine the type and value of facilities transmitted on this link.

- **Accept Facility Negotiation (4.L.4.1)**

Accept Facility Negotiation must be enabled if window or packet size negotiation is required in call accept packets transmitted on this link. If disabled, then window and packet size negotiation will be excluded from all call accept packets transmitted on this link. In addition, call request packets received on this link containing window or packet negotiation will be rejected unless the sizes negotiated match the default sizes configured for this link. The default value is Enabled.

| 8225 Message | Supervisor Response |
|---|---|
| **Window and packet negotiation in call accepts enabled ?** | **<yes or no><CR>** |

- **Request Facility Negotiation (4.L.4.2)**

Request Facility Negotiation must be enabled if window or packet size negotiation is required in call request packets transmitted on this link. If disabled, then window and packet size negotiation will be excluded from all call request packets transmitted on this link. The default value is Enabled.

| 8225 Message | Supervisor Response |
|---|---|
| **Window and packet negotiation in call requests enabled ?** | **<yes or no><CR>** |

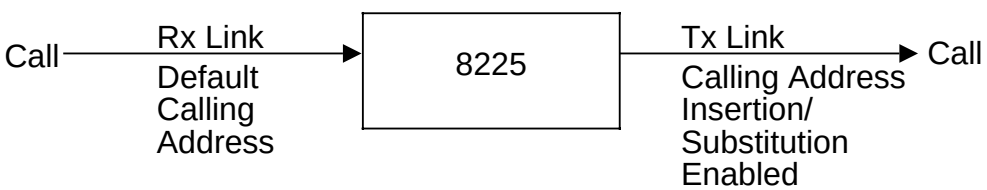
- **Calling Address Insertion (4.L.4.3)**

Calling address insertion should be enabled on a link connected to a network or X.25 device which requires a calling address in all call request packets. If a call request packet is routed through the 8225 to this link, and no calling address is present, then the default calling address of the 8225 link which received the call is inserted into the subsequent call request packet transmitted on this link. If calling address insertion is disabled, then the calling address is passed through transparently. The default value is Disabled.

| 8225 Message | Supervisor Response |
|---|---|
| **Insert default calling address for calls without a calling address ?** | **<yes or no><CR>** |

- **Calling Address Substitution (4.L.4.4)**

Calling address substitution should be enabled on a link connected to a network or X.25 device which requires either a specific calling address, or no calling address, in all call request packets. If a call request packet is routed through the 8225 to this link, then the default calling address of the 8225 link which received the call is inserted into the subsequent call request packet transmitted on this link, overwriting any address already present. Note that if there is no default calling address configured, then the calling address will be removed. If calling address substitution is disabled, then the calling address is passed through transparently. The default value is Disabled.




| 8225 Message | Supervisor Response |
|---|---|
| **Substitute calling address with default for all calls ?** | **<yes or no><CR>** |

- **Reverse Charge Request (4.L.4.5)**

Each X.25 link may be protected against reverse charge calls. If this link is configured to pass reverse charge requests, then this facility will be passed transparently in calls routed to this link. If this link is configured to reject reverse charge requests, then calls requesting this facility which are routed to this link will be rejected. The default value is Pass.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter reverse charge request operation :** | **<pass or reject><CR>** |

- **Fast Select Request (4.L.4.6)**

Each X.25 link may be protected against fast select calls. If this link is configured to pass fast select requests, then this facility will be passed transparently in calls routed to this link. If this link is configured to reject fast select requests, then calls requesting this facility which are routed to this link will be rejected. The default value is Pass.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter fast select request operation :** | **<pass or reject><CR>** |

- **Facility Marker Options (4.L.4.7)**

Facilities specific to a particular X.25 network are inserted into call request packets after a facility marker. Each X.25 link may be protected against these facility marker options. If this link is configured to pass facility marker options, then these facilities will be passed transparently in calls routed to this link. If this link is configured to reject facility marker options, then calls requesting these facilities which are routed to this link will be rejected. If this link is configured to remove facility marker options, then these facilities will be removed from calls routed to this link. The default value is Pass.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter facility marker options operation :** | **<pass or reject or remove><CR>** |

- **Unrecognised Facilities (4.L.4.8)**

The 8225 only recognises standard facilities as defined by the CCITT 1980 or 1984 X.25 recommendations. All other facilities not following a facility marker, qualify as unrecognised. In addition, facilities specific to the 1984 recommendation will qualify as unrecognised if the CCITT Operation is configured to conform to the 1980 standards. Each X.25 link may be protected against these unrecognised facilities. If this link is configured to pass unrecognised facilities, then they will be passed transparently in calls routed to this link. If this link is configured to reject unrecognised facilities, then calls requesting these facilities which are routed to this link will be rejected. If this link is configured to remove unrecognised facilities, then they will be removed from calls routed to this link. The default value is Pass.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter unrecognised facilities operation :** | **<pass or reject or remove><CR>** |

- **D Bit Request (4.L.4.9)**

The 8225 does not support D bit procedures. However, calls which request D bit operation may be routed through the 8225. If this link is configured to pass D bit requests, then they will be passed transparently in calls routed to this link. If this link is configured to reject D bit requests then calls requesting the D bit procedures which are routed to this link will be rejected. If this link is configured to remove the D bit, then it will be removed from calls routed to this link. The default value is Pass.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter D bit request operation :** | **<pass or reject or remove><CR>** |

- **Lowest Closed User Group (4.L.4.10)**

The 8225 provides the facility to validate a range of acceptable closed user groups. The lowest closed user group represents the lowest accepted if the facility is requested in a call request packet to be sent on this link. The default value is 0.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Lowest Closed User Group :** | **<0 to 9999><CR>** |

- **Highest Closed User Group (4.L.4.11)**

The 8225 provides the facility to validate a range of acceptable closed user groups. The highest closed user group represents the highest accepted if the facility is requested in a call request packet to be sent on this link. The default value is 9999.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Highest Closed User Group :** | **<0 to 9999><CR>** |

- **Called Address Translation Mask (4.L.4.12)**

If called address translation is enabled on the receiving link, the called address translation mask is used to change the received called address before sending the call to this link. The called address translation mask may contain digits or the characters **d** and **s**. Digits are used to force the value of the address in specific positions. The character **d** is used to indicate that the digit in the corresponding position should remain unchanged. The character **s** is used to preserve the subaddress and may only occur at the end of the mask. The resultant called address can never be longer than the mask.

**Examples:**

| Address | Mask | Result |
|---|---|---|
| **110001230456001** | **ddddddddddddddd** | **110001230456001** |
| **110001230456099** | **ddddddsss** | **110001099** |
| **23421234567800** | **11000019999ss** | **1100001999900** |
| **23421234567800** | **1100dddddd99ss** | **11001234569900** |
| **23421234567888** | **2342123456780s** | **23421234567808** |
| **123456** | **ddddddss** | **12345656** |
| **123456** | **dddddd9999ss** | **123456999956** |
| **123456** | **11000dd9999** | **110006** |

The default value is **ddddddddddddddd**.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Called Address Translation Mask<0 to 15 digits, d or s><CR>** | |

- **Call Accept Addresses (4.L.4.13)**

An X.25 call accept/call connect packet may optionally contain called and calling address fields. However, some networks may refuse the call accept/call connect if the called address is different to the network port address (this is likely to happen if 8225 address translation has been used to reach the DTE). To overcome this effect, call accept/call connect addresses may be optionally (a) changed to match the original call request/incoming call addresses (local), (b) passed through transparently (remote), or (c) removed. The default is local.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Called and Calling Address Operation for Call Accepts:** | **<Local or remote or remove><CR>** |

Note that earlier versions of 8225 which did not have this option operated as 'remote'.

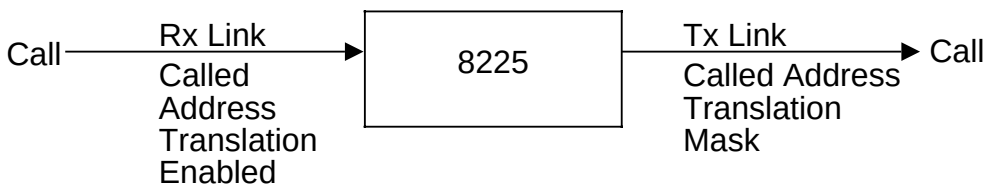
- **Default Calling Address (4.L.5)**

The default calling address will be inserted into call request packets received on this link if insertion or substitution is enabled on the destination link. The corresponding call request sent to the destination link will then include this new calling address. The default value is none.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Calling Address:** | **<0 to 15 digits><CR>** |

- **Called Address Translation (4.L.6)**

Called address translation may be required if a call received from a public network is to be routed through a further subnetwork. If called address translation is enabled on the receiving link, then the called address translation mask of the destination link is used to change the address to suit the requirements of the destination subnetwork. The default value is disabled.




| 8225 Message | Supervisor Response |
|---|---|
| **Calling Address Translation Enabled?:** | **<yes or no><CR>** |

## 3.8 SVC Primary Routing (5)

X.25 calls received by the 8225 are routed to their destination link by comparing the requested called address with entries in the SVC Primary Routing Table. Each entry in the routing table contains a destination address, a destination link number and all the link numbers for which this entry is valid for comparison with a received called address.

When an X.25 call request is received on a link, the called address is compared in ascending order with the destination address of each entry, in the SVC Primary Routing Table, for which that link number is valid. If a match is found then the corresponding destination link is used to forward the call request. If no match is found then the call is rejected.

Routing configuration changes may be done while the 8225 is operating, and take affect immediately.

- **Destination Address (5.S.1)**

A destination address consists of 0 to 15 characters. These characters may be digits, question marks or asterisks. A digit is used to indicate the only digit acceptable in that position. A question mark is used to indicate that any digit is acceptable in that position. An asterisk is used to indicate that any sequence of digits is acceptable in that position. Only two asterisks are permitted in each destination address.

Note that two adjacent asterisks are equivalent to a single asterisk and consequently not permitted.

For example,
suppose that one of the destination addresses is 1234*789*??
and that the called address received is 12345678901

When the addresses are compared, the first asterisk will match 56, the second asterisk matches an empty sequence of digits, and the question marks match 0 and 1 respectively.

Note that the destination address <*> matches all called addresses and causes all calls from links valid on that entry, to be forwarded to the corresponding destination link.

The default value of the first destination address is <*99> and the coresponding destination link is manager.

The default value of the second destination address is <*98> and the corresponding destination link is NMC.

The default value of the last destination address is <*> and the coresponding destination link is 0.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Destination Address:** | **<destination address><CR>** |

- **Destination Link (5.S.2)**

The destination link may be specified as 0 to 8, manager, or NMC. Note that if none of the destination links are specified as manager then remote management will be disabled.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Destination Link:** | **<0 to 8 or manager or NMC><CR>** |

- **Valid on Links (5.S.3)**

Each SVC Primary Routing Table Entry may be restricted to apply to selected links. This security feature enables calls from selected links to be restricted to particular destinations. The default value is all entries valid on all links.

## 3.9 SVC Secondary Routing (6)

If a call request forwarded by the 8225 is rejected, then the 8225 may use the secondary routing table to redirect the call request to a different X.25 link. If this subsequent call request is accepted, then the original call request is accepted and the originator is unaware of the network rerouting. If it is also rejected, then the original call request is rejected. Each link has its own secondary routing table. Each entry in the table has a destination address and a destination link.

On selecting this menu the specific link number is requested.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter X.25 link number :** | **<0 to 8><CR>** |

- **Destination Address (6.L.S.1)**

The destination address is used for comparison with the requested called address and has the same format as the destination address in the SVC Primary Routing Table.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Destination Address :** | **<destination address><CR>** |

- **Destination Link (6.L.S.2)**

The destination link may be specified as 0 to 8.

| 8225 Message | Supervisor Response |
|---|---|
| **Enter Destination Link :** | **<0 to 8><CR>** |

NB. A call can be redirected to another port, which in turn can be redirected.

## 3.10 PVC Routing (7)

Once the PVC logical channel numbers have been allocated in the Network Layer Menus for each link, the PVC Routing Table provides the mechanism to connect together these logical channels from different links. The PVC Routing Table uses the alternate X.25 configuration low and high PVC values to validate the requested connections so that they may be configured before the X.25 configurations are switched.

The PVC connections must be configured for each X.25 link. Once the link number has been selected, the connection information for each PVC logical channel number is displayed.

If the channel is connected then its destination link and channel number is displayed.

If the channel is not connected then this is indicated.

If no PVC logical channels are configured in the alternate configuration for that X.25 link then this is indicated.

No validation takes place during the individual configuration of the destination link or channel number. To confirm that a connection request has been accepted, the connection information for that link should be checked. A connection request is rejected if the destination channel number is not configured as a PVC in the alternate configuration of the destination link. If the channel is reconfigured to connect to a new destination then any previous connections are removed automatically.

A channel may be disconnected by assigning a destination channel number of 0 or any unconfigured link and channel number.

PVC routing configuration changes may be done while the 8225 is operating but do not take affect immediately. The new configuration changes may be activated by resetting PVC connections.

- **Reset PVC Connections (7.10)**

If the PVC ranges in the alternate configuration of all the X.25 links are the same as those in the current configuration then the new connections are established.

If the alternate and current configurations differ then the previous connections are reset, discarding outstanding data.

## 3.11 Status Screens (8)

The status and statistics screens provide details on the current status and operation of the 8225. This assists performance optimisation and analysis of any problems that arise. An additional benefit is the information provided for billing comparison.

- **Data Link Layer Statistics (8.1)**

The data link layer statistics provide the level 2 link status for all links. The status of the buffer pools is also displayed.

**Link State** indicates whether the link is up or down. If the link is down, check the cabling and that there is a clock source. Check that the logical operation is different at each end of the link.

**Link Level Resets** indicates the number of times the link has been re-established. If this number frequently increases, check the cabling and that there is only one clock source.

**Information frames** indicates the number of frames that have been transmitted and received. These counts are given in thousands of frames.

**Rejects** indicates the number of rejects that have been transmitted and received. If rejects are occurring, check that there is only one clock source. Rejects may be caused by a high clocking rate.

**Buffers** indicates the number of memory buffers remaining available. There are two buffer pools. The first is the normal packet pool. These buffers are used to store unacknowledged X.25 packets and other information associated with each call. Consequently, their numbers will decrease when large network layer window sizes are used, or many simultaneous calls are made.

The second pool is used for internal buffering and is included for use by service engineers only.

- **Reset Data Link Layer Statistics (8.2)**

Resetting the statistics causes the values in the data link layer statistics to be cleared.

- **Network Layer Statistics (8.3)**

The network layer statistics display the call status information for this link followed by the X.25 network layer information for each logical channel.

**Calls** indicates the number of X.25 calls that have been transmitted and received.

**Resets** indicates the number of X.25 resets that have been received.

**Clears** indicates the number of X.25 clears that have been transmitted and received.

**LCN** indicates the logical channel number in use.

**Tx-Pkts** indicates the number of X.25 data packets transmitted on this LCN.

**Rx-Pkts** indicates the number of X.25 data packets received on this LCN.

**Tx-Bytes** indicates the number, in thousands, of X.25 data characters transmitted on this LCN.

**Rx-Bytes** indicates the number, in thousands (specifically 1024), of X.25 data characters received on this LCN.

**Tx-P** indicates the transmit packet size in use on this LCN.

**Rx-P** indicates the receive packet size in use on this LCN.

**Tx-W** indicates the transmit window size in use on this LCN.

**Rx-W** indicates the receive window size in use on this LCN.

**Destination**

**Link** indicates the destination link number of this LCN.

**LCN** indicates the LCN in use on the destination link of this LCN.

**Sent/Rcvd** indicates whether the call was sent to this link or received by it.

**(Rx-Called)** indicates the received called address.

**(Rx-Calling)** indicates the received calling address.

**(Tx-Called)** indicates the transmitted called address.

**(Tx-Calling)** indicates the transmitted calling address.

- **Reset Network Layer Statistics (8.4)**

Resetting the statistics causes the values in the network layer statistics to be cleared.

- **Software Version (8.5)**

Selection of this option causes the version of software currently in operation to be displayed. Entry of <CR> causes the current menu to be redisplayed.

## 3.12 Warm Start (9)

The procedure which the 8225 uses to run its hardware diagnostics, initialise memory and activate the software, is called a warm start. During a warm start the configuration, in BRAM, is verified and copied to the RAM. This verification process may cause some values in the current configuration to be changed. The alternate configuration is preserved even if the combination of some of its values is invalid. Invalid values are replaced, in the current configuration, with the default values. The X.25 link is reset, causing all X.25 calls to be cleared. Statistics and diagnostic values which are not stored in BRAM are cleared. PVC connections are reset and all outstanding data is discarded.

A warm start is caused whenever:

- The 8225 is powered up.
- Warm Start is selected by the supervisor.
- A fatal software error occurs.
- A recoverable hardware error occurs.
- A Device restart is requested by the network management centre.

| 8225 Message | Manager Response |
|---|---|
| **Do you want to activate the alternate configuration and restart ?** | **<YES or NO><CR>** |

## 3.13 Cold Start (10)

The procedure which the 8225 uses to restore the default configuration and perform a warm start is called a cold start.

A cold start is caused whenever:

- The 8225 is powered up for the first time.
- The 8225 is powered up with a new version of software.
- Cold Start is selected by the supervisor.
- A fatal software error which corrupts the configuration occurs.
- A recoverable hardware error which corrupts the configuration occurs.

**Warning. This option will cause all configuration changes to be lost.**

| 8225 Message | Manager Response |
|---|---|
| **Do you want to restore the default configuration and restart ?** | **<yes or no><CR>** |

## 3.14 Logoff (11)

Logoff terminates the current manager session and, if remotely accessed, clears the X.25 call. The manager may subsequently be accessed by the methods described under Manager Access.

A logoff is caused whenever:

- Logoff is selected by the supervisor.
- The X.25 call to the manager is cleared.
- The manager idle timeout expires.
- The 8225 is warm started.
- The 8225 is cold started.

# 4 Troubleshooting

This chapter describes and provides diagnoses for the majority of the operational problems that could occur within an 8225 environment.

## 4.1 Link Down

There are a number of reasons why an X.25 link might not start up. Generally, this problem falls into two categories, cabling and configuration.

### 4.1.1 Cabling

If the 8225 is supplying clocks, then these will be present on pins 15 and 17 on ports 1 to 8 (or pin 24 on the composite port). These clocks should be connected to pins 15 and 17 on the remote device.

If the link is supplying clocks, then these should be connected to pins 9 and 24 on ports 1 to 8 (or 15 and 17 on the composite port).

When the composite port is connected to a modem, a straight-through cable must be used. Cable X860-400211 or X860-401311 is recommended for this purpose.

When ports 1 to 8 are connected to modems, cross-over cables must be used. Cable X860-400311 is recommended for this purpose.

Some devices require control signals to be held high before they will either transmit or receive. The 8225 holds pins 5, 6 and 8 high, and these may be used to hold signals high at the remote device. The 8225 does not require any signals to be raised.

### 4.1.2 Configuration

Check which device is supposed to be supplying clocks and configure as necessary. Note that the clock speeds need to be configured correctly on the 8225, even if the other device is supplying clocks. If the actual link speed is unknown then the 8225 should be configured for the slowest speed at which the link will operate.

Check that the Data Link Layer Logical Operation is configured correctly. The configuration of the remote device and the 8225 must differ. The Network Layer Logical Operation may be configured separately, but should match the Data Link Layer Logical Operation unless there is a specific reason for it not to.

## 4.2 Link Errors

Sometimes a link will start up but a large number of errors (Tx-REJ and Rx-REJ) will be reported.

Check that clocks are not being supplied at both ends of the link. Normally the DCE device will supply clocks and the DTE will be configured for external clocking. If the 8225 link is configured for external clocking then check that the clock speed expected does not exceed the actual clock speed being supplied. The clock speed should always be configured correctly on the 8225, even if it is being clocked externally.

The Data Link Layer Window Size (K) must be configured to the same value at both ends of the X.25 link.

## 4.3 Calls Hanging

Check that the link is up and that there are no link errors.

Check that the LCNs configured match at both ends of the link. A call on an undefined LCN will hang and eventually clear after a time-out, normally about 3 minutes.

## 4.4 Network Layer Resets

Check that the Network Layer Default Packet Size matches at both ends.
Check that the Network Layer Default Window Size matches at both ends.

# Appendix A The X.25 Recommendation

## A.1 X.25 Description

The CCITT X.25 Recommendation defines in detail how Packet Switching Public Data Networks are accessed. X.25 specifies the protocol across the interface between a network and equipment connecting to it.

In 1980 the CCITT produced the Yellow Book version which specified a new link level protocol, LAPB. Most networks conform to the 1980 version of X.25 employed by the 8225.

X.25 defines the protocol between Data Terminal Equipment and Data Circuit-terminating Equipment which are operating in packet mode. The DTE may be a terminal or host computer. The DCE may be the entry point into a network such as PSS.

X.25 describes three functional layers: physical, link and network, and is consistent with the ISO OSI model.

- **The Physical Layer – Level 1**

The Physical Layer describes the physical, functional and electrical characteristics of the line connecting the DTE and DCE. It references the X.21 and X.21*bis* standards. X.21 is designed for high speed access to digital networks. X.21*bis* is equivalent to V.24 and makes allowance for modems on analogue networks. The Physical Layer provides a full duplex, synchronous facility at speeds up to 64000 bps.

- **The Data Link Layer – Level 2**

The Data Link Layer describes the procedures across a line between a DTE and DCE, and makes use of the services provided by the Physical layer. It uses LAPB which is consistent with the ISO HDLC procedures. It transfers frames of information between the DCE and DTE. These frames consist of address, control and check sequence fields which may enclose a packet of user data. Frames may hold any data patterns and are delimited by flags.

A flag is a unique bit pattern and, to prevent the pattern occurring within the frame, the technique of 'bit stuffing' is used, whereby the transmitter inserts zero bits into the data stream to avoid the occurrence of flags inside the frame. The receiver carries out the reverse process to remove the extra bits from the data stream and thus restore the original data.

The address field of frames holds little information because, as the Data Link Layer operates over a point-to-point link, only the direction of transfer needs to be identified.

- **The Network Layer – Level 3**

The Network Layer describes the exchange of packets between the DTE and the DCE. It transfers packets by making use of the services provided by the data link layer. The X.25 Network Layer is also covered by the ISO OSI standards.

The Network Layer manages logical channels and provides Switched Virtual Circuits (SVCs) and Permanent Virtual Circuits (PVCs). PVCs are configured by the supervisor and are established after a warm start or after they have been reset. They remain permanently established and are able to exchange data whenever the data link layer connection is operational.

An SVC requires the user to set up a call before exchanging data, and to clear down the call when data transmission is complete. Thus the same channel may be re-used by a second user when the first user releases it by clearing the call. The Network Layer multiplexes virtual circuits over a link so that a DTE may have many concurrent connections to many other DTEs via the Packet Switching Network. It handles flow control independently for each virtual circuit, and provides User Facilities such as Reverse Charging.

The Network Layer handles packets of information, each packet consisting of a header and user information.

Figure A-1 is an example of the normal procedures for SVC call establishment.

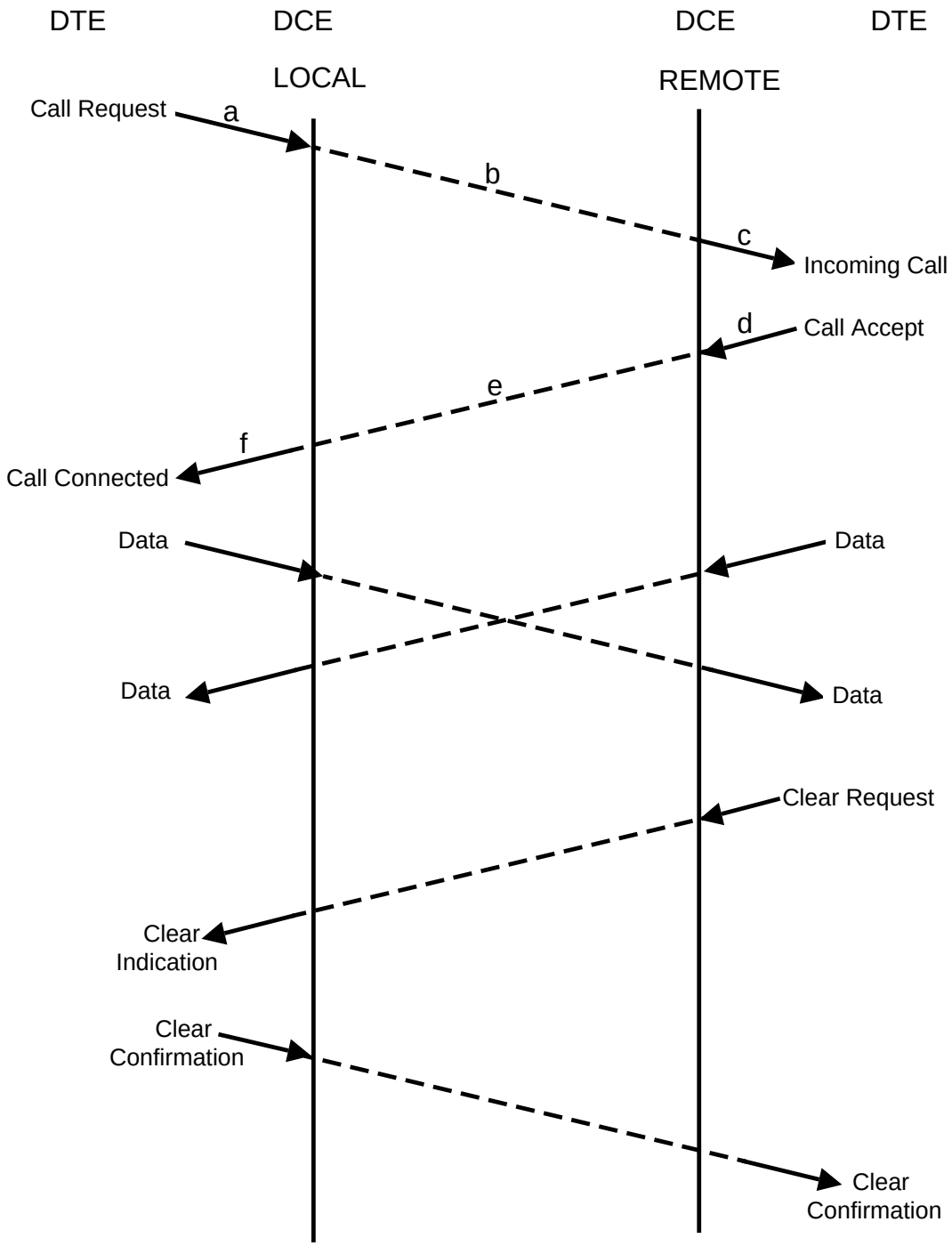



**Figure A-1 Procedure for a Switched Virtual Circuit**

1. A DTE requests an SVC by sending a Call Request packet to the DCE. The DTE allocates the highest available logical channel number to the call. The Call Request packet holds the X.121 address of the called DTE. It contains requests for any User Facilities or User Data that the DTE wishes to send.

2. The DCE uses the specified destination address to route the packet across the Packet Switching Network to the remote, destination DCE.
3. The remote DCE forwards the packet to the called DTE as an Incoming Call packet, choosing the lowest logical channel number which is available at that link.
4. The called DTE accepts the request for a virtual circuit by sending a Call Accept packet to its DCE.
5. This packet is passed back across the network and sent to the calling DTE as Call Connected.

The two DTEs may now exchange data across the SVC.

DTEs exchange data in Data and Interrupt packets over an established SVC. Various other types of packet are used for flow-control or to 'reset' the circuit if a problem arises.

To clear the SVC, either of the DTEs may send a Clear Request packet to its DCE. The packet is forwarded to the remote DTE as a Clear Indication which the DTE acknowledges with a Clear Confirmation. The Clear Confirmation packet is then passed to the DTE which originated the clear request. The SVC has now been removed and the logical channels may be allocated to other virtual circuits.

## A.2 X.25 Diagnostic Codes

Table A-1 specifies the subset of X.25 diagnostic codes which can be generated by the 8225. These codes are included in X.25 Clear and Reset packets, and are listed here to assist in identifying the specific cause of any unexpected call clearing or reset problems.

| HEX | DEC | DIAGNOSTIC CODES |
|---|---|---|
| 0 | 0 | No additional information |
| 1 | 1 | P(S) invalid |
| 2 | 2 | P(R) invalid |
| 10 | 16 | Invalid packet |
| 11 | 17 | Packet type invalid for state R1 |
| 12 | 18 | Packet type invalid for state R2 |
| 13 | 19 | Packet type invalid for state R3 |
| 1B | 27 | Packet type invalid for state D1 |
| 1C | 28 | Packet type invalid for state D2 |
| 1D | 29 | Packet type invalid for state D2 |
| 20 | 32 | Packet not allowed |
| 21 | 33 | Unidentifiable packet |
| 22 | 34 | Call on one way PCN |
| 23 | 35 | Invalid packet type on PVC |
| 24 | 36 | Packet on unassigned LCN |
| 25 | 37 | Reject not subscribed to |
| 26 | 38 | Packet too short |
| 27 | 39 | Packet too long |
| 28 | 40 | Invalid GFI |
| 29 | 41 | Restart with non zero bits 5 to 16 |
| 2A | 42 | Packet type not compatible |
| 2B | 43 | Unauthorised interrupt confirm |
| 2C | 44 | Unauthorised interrupt |
| 30 | 48 | Timer expired |
| 31 | 49 | Timer expired for incoming call |
| 32 | 50 | Timer expired for clear indication |
| 33 | 51 | Timer expired for reset indication |
| 34 | 52 | Timer expired for restart indication |
| 40 | 64 | Unspecified call setup problem |

**Table A-1 X.25 Diagnostic Codes** (Part 1)

| HEX | DEC | DIAGNOSTIC CODES |
|---|---|---|
| 41 | 65 | Facility code not allowed |
| 42 | 66 | Facility parameter not allowed |
| 43 | 67 | Invalid called address |
| 44 | 68 | Invalid calling address |
| 47 | 71 | No LCNs available |
| 48 | 72 | Packet type invalid for state D6 |
| 49 | 73 | DTE buffer exhaustion |
| 4A | 74 | Packet type invalid for state R6 |
| 82 | 130 | Asynchronous DTE inoperable |
| 83 | 131 | Asynchronous DTE operable |
| 84 | 132 | Asynchronous DTE busy |
| 85 | 133 | Asynchronous address invalid |
| 86 | 134 | DTE buffer shortage |
| A2 | 162 | Interrupt packet too long |
| A3 | 163 | Interrupt packet too short |
| A4 | 164 | Interrupt confirm packet too long |
| A5 | 165 | Receive ready packet too long |
| A6 | 166 | Receive not ready packet too long |
| A7 | 167 | Reset packet too long |
| A8 | 168 | Reset confirm packet too long |
| B1 | 177 | Call attempt while link down |
| B6 | 182 | Packet format invalid |
| B7 | 183 | Facility field too long |
| B9 | 185 | Facility count greater than 63 (1980) or 109 (1984) |
| BD | 189 | Called address too long |
| C3 | 193 | BCD error in called address |
| C4 | 194 | BCD error in calling address |
| C5 | 195 | User data field too long |
| F5 | 245 | Packet type invalid for state D4 |
| F6 | 246 | Packet type invalid for state D5 |
| FC | 252 | Packet type invalid for state R4 |

**Table A-1 X.25 Diagnostic Codes** (Part 2)

# Appendix B The X.121 Recommendation

The CCITT Recommendation X.121 concerns the international numbering of Packet Switched Networks.

On most networks it has the form of a 14 digit decimal number, though 15 digits, where a 3 (instead of 2) digit subaddress is present, can be used. Its composition is shown in Figure B-1.

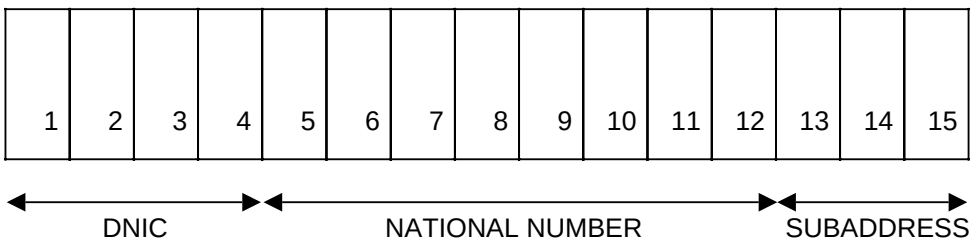



**Figure B-1 X.121 Address Format**

Note that the DNIC is subdivided into

1. The Continent (e.g. 2 for Europe).

2 and 3. The Country (e.g. 34 and 35 for Britain).

4. The Network

# Appendix C Logical Channel Groups

| LCGN | LCN |
|---|---|
| 0 | 0 |
| 1 | 256 |
| 2 | 512 |
| 3 | 768 |
| 4 | 1024 |
| 5 | 1280 |
| 6 | 1536 |
| 7 | 1972 |
| 8 | 2048 |
| 9 | 2304 |
| 10 | 2560 |
| 11 | 2816 |
| 12 | 3072 |
| 13 | 3328 |
| 14 | 3584 |
| 15 | 3840 |

**Table C-1 Logical Channel Group Numbers**

# Appendix D Bandwidth on Demand

## D.1 Overview

Previous to software Version 12 every X.25 link was assumed to be permanently available and 'up' at levels 2 and 3, i.e. the links were always assumed to be provided by digital leased circuits, synchronous leased line modems, etc.

Software Version 12 onwards no longer has this restriction. It is now possible to configure the links to be dial-up, i.e. the link is provided by a mechanism which means that it is not physically established until it is required to carry packet traffic. Examples are links provided by synchronous V.32 dial-up modems or via ISDN Terminal Adapters (TAs). Figure D-1 shows a possible configuration where a remote 8160 is connected into the network via a modem link.

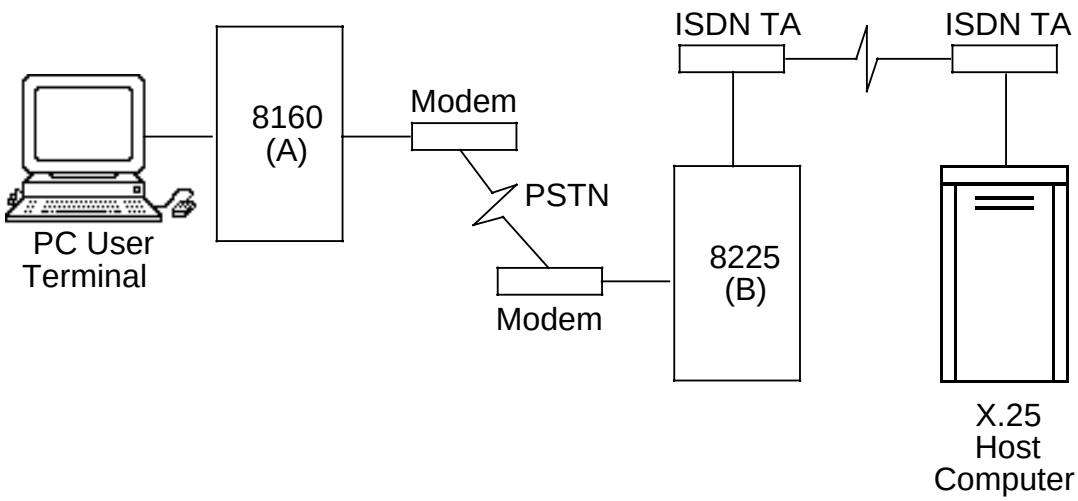



**Figure D-1 Example of Dial-up Link Usage**

In Figure D-1 the 8160 is connected via a V.24 dial-up modem link. In normal operation, with no X.25 calls present on the dial-up links, DTR will be low on the modem ports hence the physical link will not be active and the X.25 links will be down.

If the User Terminal 8160 makes an X.25 call, the 8160 raises DTR to its local modem which then dials the phone number of the modem attached to

8225. This modem starts pulsing Ring Indicator and the 8225 will raise DTR on the dial-up port to instruct the modem to answer the phone call. The modem answers, trains up and X.25 levels 2 and 3 come up between the 8160 and 8225. The X.25 call is then forwarded across the link from 8160 to 8225.

The 8225 routing software will hold on to the X.25 call and will raise DTR (or Control) to the ISDN TA which then dials the ISDN number of the TA attached to the X.25 host computer. The TA answers, trains up and X.25 levels 2 and 3 come up between the 8225 and the X.25 host. The X.25 call is then forwarded across the link from the 8225 to the X.25 host.

If the user (or the X.25 host computer) clears the call, the modem links will also be broken by the software after a delay once it has decided the modem links are no longer required.

# D.2 Operation and Signalling

## D.2.1 General

The dial-up software uses the V.24 or V.11 circuits defined below to control the attached device.

When making a dial-up call, the software will hold onto the X.25 call that initiated the dialling sequence, plus any others which follow, for a user-definable length of time (the dial-up timeout) after which the call attempt will be abandoned and the X.25 call(s) will be cleared back.

## D.2.2 V.24 Interface Circuits

The signalling used to drive a V.24 dial-up interface is based on V.25*bis* control signals as detailed below.

**DTR** (Pin 20, circuit 108.1 – Connect Data Set to Line)

Raised by the 8225 to signal that the attached DCE should dial a pre-defined number to establish a connection. Dropped by the 8225 to signal that the connection should be dropped.

**RI** (Pin 22, circuit 125 – Ring Indicator)

Pulsed by the DCE to indicate an incoming call to the X.25 port. The port responds to RI by raising DTR at the end of the first ring (i.e. on a negative transition of RI). Note that RI must stay low for at least 0.75 seconds. This mechanism is optional as the DCE may signal an incoming call by raising DCD (see below).

**DCD** (Pin 8, circuit 109 – Data Carrier Detect)

The DCE raises DCD to indicate:

- An incoming call (an optional alternative to RI).
- Successful establishment of an outgoing call, i.e. raised in response to DTR after training sequence is completed.

DCD is dropped by the DCE to indicate circuit failure or call cleared by the remote end.

Note that the dial-up software does not rely on DCD going high to detect a link establishment, this it does by detecting the level 2 SABM/UA and level 3 Restart/Confirm exchange on the link. However the software does

act on DCD going low treating this as a link failure and will drop DTR in response.

### D.2.3 V.11 Interface Circuits

The signalling used to drive a V.11 dial-up interface is based on X.21 control signals as follows:

**C** (Pins 3 and 10, Control)

C is raised by the 8225 to signal that the attached DCE should dial a pre-defined number to establish a connection and is dropped by the 8225 to signal that the connection should be dropped.

Note that when the connection is not required the 8225 will signal Control off and transmit a continuous stream of ones, i.e. it will be signalling Ready. When the circuit is required, Control will be raised and HDLC flags transmitted, i.e. the interface will switch from Ready to Data Transfer. In order to clear the circuit the 8225 will drop Control and revert to transmitting all ones thus switching from Data Transfer back to Ready.

**I** (Pins 5 and 12, Indicate)

I is raised by the DCE to indicate:

- An incoming call.
- Successful establishment of an outgoing call, i.e. raised in response to Control after connection sequence is completed.

Dropped by the DCE to indicate circuit failure or call cleared by the remote end.

Note that the dial-up software does not rely on Indicate going high to detect a link establishment, this it does by detecting the level 2 SABM/UA and level 3 Restart/Confirm exchange on the link. However, the software does act on Indicate going low treating this as a link failure and will drop Control in response.

# Appendix E Network Service and User Facilities

## E.1 X.2 (CCITT 1980)

In the following X.2 tables 'TR' is used to denote that the facility is not acted upon by the 8225 but may be passed transparently.

| X.2 INDEX NUMBER | X.2 (1980) USER FACILITY | X.25 CLASS | | 8225 SUPPORT |
|---|---|---|---|---|
| | | SVC | PVC | |
| 1.1 | Extended packet sequence numbering (mod 128) | A | A | NO |
| 1.2 | Non-standard default packet level window sizes | A | A | YES |
| 1.3 | Non-standard default packet sizes | A | A | YES |
| 1.4 | Default throughput class assignment | A | A | TR |
| 1.5 | Flow control parameter negotiation | E | - | YES |
| 1.6 | Throughput class negotiation | E | - | TR |
| 1.7 | Packet retransmission | A | A | YES |
| 1.8 | Incoming calls barred | E | - | YES |
| 1.9 | Outgoing calls barred | E | - | YES |
| 1.10 | One way logical channels outgoing | E | - | YES |
| 1.11 | One way logical channels incoming | A | - | YES |
| 1.12 | Closed user group (CUG) | E | - | TR |
| 1.3-14 | CUG outgoing/incoming access | A | - | TR |
| 1.15-16 | Incoming/outgoing calls barred within a CUG | A | | TR |
| 1.17 | Bilateral CUG | A | - | TR |
| 1.18 | Bilateral CUG with outgoing access | A | - | TR |
| 1.19 | Reverse charging acceptance | A | - | YES |
| 1.20 | Fast select acceptance | A | - | YES |
| 1.21 | Datagram queue length selection | - | - | NO |
| 1.22 | Datagram service signal logical channel | - | - | NO |
| 1.23 | Datagram nondelivery indication | - | - | NO |
| 1.24 | Datagram delivery confirmation | - | - | NO |
| 1.25 | Multiple circuits to the same DTE | A | A | YES |
| 1.26 | Charging information | F | - | TR |
| 1.27 | Direct call | F | - | NO |
| 1.28 | Multiple terminals with the same data number | F | - | YES |
| 1.29 | On-line facility registration | A | - | NO |
| 1.30 | D-bit modification | A | A | TR |

| X.2 INDEX NUMBER | X.2 (1980) USER FACILITY | X.25 CLASS | | 8225 SUPPORT |
|---|---|---|---|---|
| | | SVC | PVC | |
| 2.1 | Closed user group selection | E | - | TR |
| 2.2 | Bilateral CUG selection | A | - | TR |
| 2.3 | Reverse charging | A | - | YES |
| 2.4 | RPOA selection | A | - | TR |
| 2.5 | Flow control parameter negotiation | E | - | YES |
| 2.6 | Fast select | A | - | YES |
| 2.7 | Throughput class negotiation | E | - | TR |
| 2.8 | Abbreviated address calling | F | - | YES |
| 2.9 | Datagram nondelivery indication | - | - | NO |
| 2.10 | Datagram delivery indication | - | - | NO |
| 2.11 | Multi-address calling | A | - | YES |
| 2.12 | Charging information | F | | TR |

# E.2 X.2 (CCITT 1984)

| X.2 INDEX NUMBER | X.2 (1984) USER FACILITY | X.25 CLASS | | 8225 SUPPORT |
|---|---|---|---|---|
| | | SVC | PVC | |
| 1.1 | Extended packet sequence numbering (mod 128) | A | A | NO |
| 1.2 | Non-standard default packet level window sizes | A | A | YES |
| 1.3 | Non-standard default packet sizes | A | A | YES |
| 1.4 | Default throughput class assignment | A | A | TR |
| 1.5 | Flow control parameter negotiation | E | - | YES |
| 1.6 | Throughput class negotiation | E | - | TR |
| 1.7 | Packet retransmission | A | A | YES |
| 1.8 | Incoming calls barred | E | - | YES |
| 1.9 | Outgoing calls barred | E | - | YES |
| 1.10 | One way logical channels outgoing | E | - | YES |
| 1.11 | One way logical channels incoming | A | - | YES |
| 1.12 | Closed user group (CUG) | E | - | TR |
| 1.3-14 | CUG outgoing/incoming access | A | - | TR |
| 1.15-16 | Incoming/outgoing calls barred within a CUG | A | - | TR |
| 1.17 | Bilateral CUG | A | - | TR |
| 1.18 | Bilateral CUG with outgoing access | A | - | TR |
| 1.19 | Reverse charging acceptance | A | - | YES |
| 1.20 | Fast select acceptance | E | - | YES |
| 1.21 | Multilink procedure support | A | A | NO |
| 1.22 | Charging information | A | - | TR |
| 1.23 | Direct call | F | - | NO |
| 1.24 | Hunt groups | A | - | NO |
| 1.25 | On-line facility registration | A | - | NO |
| 1.26 | D-bit modification | A | A | TR |
| 1.27 | Local charging prevention | A | - | NO |
| 1.28 | Call redirection | A | - | NO |
| 1.29 | Network User Identifier (NUI) | A | - | TR |
| 1.30 | Extended frame sequence numbering | A | A | NO |
| 1.31 | RPOA subscription | A | - | TR |

| X.2 INDEX NUMBER | X.2 (1984) USER FACILITY | X.25 CLASS | | 8225 SUPPORT |
|---|---|---|---|---|
| | | SVC | PVC | |
| 2.1 | Closed user group selection | E | - | TR |
| 2.2 | Bilateral CUG selection | A | - | TR |
| 2.3 | Reverse charging | A | - | YES |
| 2.4 | RPOA selection | A | - | TR |
| 2.5 | Flow control parameter negotiation | E | - | YES |
| 2.6 | Fast select | E | - | YES |
| 2.7 | Throughput class negotiation | E | - | TR |
| 2.8 | Abbreviated address calling | F | - | YES |
| 2.9 | Charging information | A | - | TR |
| 2.10 | Transit delay selection and indication | E | - | TR |
| 2.11 | Call redirection notification | A | - | TR |
| 2.12 | Called line address modified notification (CLAMN) | A | - | TR |
| 2.13 | Network user Identification (NUI) | A | - | TR |
| 2.14 | CUG with outgoing access selection | A | - | TR |

# E.3 X.2 (CCITT 1988)

| X.2 INDEX NUMBER | X.2 (1984) USER FACILITY | X.25 CLASS | | 8225 SUPPORT |
|---|---|---|---|---|
| | | SVC | PVC | |
| 1.1 | Extended frame sequence numbering | A | A | YES |
| 1.2 | Multilink procedure | A | A | NO |
| 1.3 | On-line facility registration | A | - | NO |
| 1.4 | Extended packet sequence numbering (modulo 128) | A | A | YES |
| 1.5 | D-bit modification | A | A | TR |
| 1.6 | Packet retransmission | A | A | YES |
| 1.7 | Incoming calls barred | E | - | YES |
| 1.8 | Outgoing calls barred | E | - | YES |
| 1.9 | One way logical channels outgoing | E | - | YES |
| 1.10 | One way logical channels incoming | A | - | YES |
| 1.11 | Nonstandard default packet sizes 16, 32, 64, 256 | | - | |
| | 512, 1024, 2048, 4096 | A | A | YES |
| 1.12 | Nonstandard default window sizes | A | A | YES |
| 1.13 | Default throughput classes assignment | A | A | TR |
| 1.14 | Flow control parameter negotiation | E | - | YES |
| 1.15 | Throughput class negotiation | E | - | TR |
| 1.16 | Closed user group | E | - | TR |
| 1.17 | Closed user group with outgoing access | A | - | TR |
| 1.18 | Clsoed user group with incoming access | A | - | TR |
| 1.19 | Incoming call barred within a closed user group | A | - | TR |
| 1.20 | Outgoing call barred within a closed user group | A | - | TR |
| 1.21 | Bilateral closed user group | A | - | TR |
| 1.22 | Bilateral closed user group with outgoing access | A | - | TR |
| 1.23 | Fast select acceptance | E | - | YES |
| 1.24 | Reverse charging acceptance | A | - | YES |
| 1.25 | Local charging prevention | A | - | NO |
| 1.26 | NUI subscription | A | - | TR |
| 1.27 | NUI override | A | - | TR |
| 1.28 | Charging information | A | - | TR |
| 1.29 | RPOA subscription | A | - | TR |
| 1.30 | Hunt group | A | - | NO |
| 1.31 | Call redirection | A | - | NO |
| 1.32 | Call deflection subscription | A | - | NO |
| 1.33 | TOA/NPI address subscription | FS | - | NO |
| 1.34 | Direct call | FS | - | NO |

| X.2 INDEX NUMBER | X.2 (1984) USER FACILITY | X.25 CLASS | | 8225 SUPPORT |
|---|---|---|---|---|
| | | SVC | PVC | |
| 2.1 | Flow control parameter negotiation | E | - | YES |
| 2.2 | Throughput class negotiation | E | - | TR |
| 2.3 | Closed user group selection | E | - | TR |
| 2.4 | Closed user group with outgoing access selection | A | - | TR |
| 2.5 | Bilateral closed user group selection | A | - | TR |
| 2.6 | Reverse charging | A | - | YES |
| 2.7 | Fast select | E | - | YES |
| 2.8 | NUI selection | A | - | TR |
| 2.9 | Charging information | A | - | TR |
| 2.10 | RPOA selection | A | - | TR |
| 2.11 | Call deflection selection | A | - | TR |
| 2.12 | Call redirection or call deflection notification | A | - | TR |
| 2.13 | Called line address modified notification | A | - | TR |
| 2.14 | Transit delay selection and indication | E | - | TR |
| 2.15 | Abbreviated address calling | FS | - | YES |