CHAPTER 7

X.25 and LAPB Commands

Use the commands in this chapter to configure Link Access Procedure Balanced (LAPB), X.25, DDN X.25, and Blacker Front-end Encryption (BFE). X.25 provides remote terminal access; routing using the IP, DECnet, XNS, ISO CLNS, AppleTalk, Novell IPX, Banyan VINES, and Apollo Domain protocols; and bridging.

For X.25 and LAPB configuration information and examples, refer to the "Configuring X.25 and LAPB Commands" chapter of the *Router Products Configuration Guide*.

bfe

Use the **bfe** EXEC command to allow the router to participate in emergency mode or to end participation in emergency mode when the interface is configured for **x25 bfe-emergency decision** and **x25 bfe-decision ask**.

bfe {**enter** | **leave**} *interface-type number*

Syntax Description

enter	Causes the router to send a special address translation packet that includes an **enter emergency mode** command to the BFE if the emergency mode window is open. If the BFE is already in emergency mode, this command enables the sending of address translation information.
leave	Disables the sending of address translation information from the router to the BFE when the BFE is in emergency mode.
interface-type	The interface name.
number	The interface number.

Command Mode

EXEC

Example

The following example illustrates how to enable an interface to participate in BFE emergency mode:

```
router# bfe enter interface serial 0
```

Related Commands

encapsulation bfex25
x25 bfe-decision
x25 bfe-emergency

clear x25-vc

Use the **clear x25-vc** privileged EXEC command to clear switched virtual circuits (SVCs) and to reset permanent virtual circuits (PVCs). This command without any arguments clears all X.25 virtual circuits at once by RESTARTing the packet layer service.

clear x25-vc [*interface-type*] [*number*] [*lcn*]

Syntax Description

interface-type	The interface name.
number	The interface unit number.
lcn	(Optional.) A virtual circuit.

Command Mode

Privileged EXEC

Example

The following example illustrates how to clear all VCs on an interface:

```
router# clear x25-vc serial 1
```

Related Command

x25 idle

cmns enable

Use the **cmns enable** interface configuration command to enable Connection-Mode Network Service (CMNS) on a nonserial interface. Use the **no cmns enable** command to disable this capability.

cmns enable
no cmns enable

Syntax Description

This command has no arguments or keywords.

Default

The CMNS protocol is implicitly enabled whenever an X.25 encapsulation command is included with a serial interface configuration. A particular nonserial interface, however, must be explicitly configured to use CMNS

Command Mode

Interface configuration

Usage Guidelines

After processing this command on the LAN interfaces (Ethernet, FDDI, and Token Ring), all the X.25-related interface configuration commands are made available.

Example

The following example illustrates how to enable CMNS on interface Ethernet 0:

```
interface ethernet 0
cmns enable
```

Related Command

x25 map cmns

encapsulation bfex25

Use the **encapsulation bfex25** interface configuration command to configure BFE encapsulation on a router attached to a BFE device.

encapsulation bfex25

Syntax Description

This command has no arguments or keywords.

Default

The default serial encapsulation is HDLC. You must choose an X.25 encapsulation method.

Command Mode

Interface configuration

Usage Guidelines

This encapsulation operates to map between Class A IP addresses and the type of X.121 addresses expected by the BFE encryption device.

Example

The following example sets BFE encapsulation on interface serial 0:

```
interface serial 0
encapsulation bfex25
```

Related Commands

bfe
x25 remote-red

encapsulation ddnx25

A router using DDN X.25 Standard Service can act as either a DTE or a DCE device. Use the **encapsulation ddnx25** interface configuration command to set DTE DDN X.25 operation.

encapsulation ddnx25

Syntax Description

This command has no arguments or keywords.

Default

The default serial encapsulation is HDLC. You must choose an X.25 encapsulation method.

Command Mode

Interface configuration

Usage Guidelines

This encapsulation operates to map between IP addresses and X.121 addresses used by the Defense Data Network.

Example

The following example sets DTE DDN X.25 operation on interface serial 0:

```
interface serial 0
encapsulation ddnx25
```

encapsulation ddnx25-dce

A router using DDN X.25 Standard Service can act as either a DTE or a DCE device. Use the **encapsulation ddnx25-dce** interface configuration command to set DCE DDN X.25 operation.

encapsulation ddnx25-dce

Syntax Description

This command has no arguments or keywords.

Default

The default serial encapsulation is HDLC. You must choose an X.25 encapsulation method.

Command Mode

Interface configuration

Usage Guidelines

This encapsulation operates to map between IP addresses and X.121 addresses used by the Defense Data Network.

Example

The following example sets DCE DDN X.25 operation on interface serial 0:

```
interface serial 0
encapsulation ddnx25-dce
```

encapsulation lapb

Use the **encapsulation lapb** interface configuration command to exchange datagrams over a serial interface using LAPB encapsulation and operating as the DTE. One end of the link must be DTE and the other end must be DCE.

encapsulation lapb

Syntax Description

This command has no arguments or keywords.

Default

The default serial encapsulation is HDLC. You must choose a LAPB encapsulation method.

Command Mode

Interface configuration

Example

The following example sets LAPB DTE encapsulation on interface serial 3:

```
interface serial 3
encapsulation lapb
```

Related Command

lapb protocol

encapsulation lapb-dce

Use the **encapsulation lapb-dce** interface configuration command to exchange datagrams over a serial interface using LAPB encapsulation and operating as the DCE. One end of the link must be DTE and the other end must be DCE.

encapsulation lapb-dce

Syntax Description

This command has no arguments or keywords.

Default

The default serial encapsulation is HDLC. You must choose a LAPB encapsulation method.

Command Mode

Interface configuration

Example

The following example sets LAPB DCE encapsulation on interface serial 3:

```
interface serial 3
encapsulation lapb-dce
```

Related Command

lapb protocol

encapsulation multi-lapb

For DTE operation, use the **encapsulation multi-lapb** interface configuration command to use multiple local-area network (LAN) protocols on the same line at the same time.

encapsulation multi-lapb

Syntax Description

This command has no arguments or keywords.

Default

The default serial encapsulation is HDLC. You must choose a LAPB encapsulation method.

Command Mode

Interface configuration

Usage Guidelines

With the **encapsulation multi-lapb** command, you can use multiple protocols such as IP, DECnet, and XNS at the same time. Both ends of the line must use the multi-lapb encapsulation; one end of the link must be DCE and the other end DTE.

Example

The following example illustrates how to allow multiple protocols on a LAPB line operating as the DTE:

```
interface serial 0
encapsulation multi-lapb
```

encapsulation multi-lapb-dce

For DCE operation, use the **encapsulation multi-lapb-dce** interface configuration command to enable use of multiple LAN protocols on the same line at the same time.

encapsulation multi-lapb-dce

Syntax Description

This command has no arguments or keywords.

Default

The default serial encapsulation is HDLC. You must choose a LAPB encapsulation method.

Command Mode

Interface configuration

Usage Guidelines

With the **encapsulation multi-lapb-dce** command, you can use multiple protocols such as IP, DECnet, and XNS at the same time. Both ends of the line must use the multi-lapb encapsulation; one end of the link must be DCE and the other end DTE.

Example

The following example illustrates how to allow multiple protocols on a LAPB line operating as the DCE:

```
interface serial 0
encapsulation multi-lapb-dce
```

encapsulation x25

A router using X.25 Level 3 can act as a DTE or DCE device. Use the **encapsulation x25** interface configuration command to set X.25 DTE operation.

encapsulation x25

Syntax Description

This command has no arguments or keywords.

Default

The default serial encapsulation is HDLC. You must choose an X.25 encapsulation method.

Command Mode

Interface configuration

Example

The following example sets X.25 DTE operation on interface serial 0:

```
interface serial 0
encapsulation x25
```

encapsulation x25-dce

A router using X.25 Level 3 can act as a DTE or DCE device. Use the **encapsulation x25-dce** interface configuration command to set X.25 DCE operation.

encapsulation x25-dce

Syntax Description

This command has no arguments or keywords.

Default

The default serial encapsulation is HDLC. You must choose an X.25 encapsulation method.

Command Mode

Interface configuration

Example

The following example sets X.25 DCE operation on interface serial 0:

```
interface serial 0
encapsulation x25-dce
```

ip tcp header-compression

Use the **ip tcp header-compression** interface configuration command to implement TCP header compression. The header compression complies with the IETF RFC 1144 standard. The **no ip tcp header-compression** command disables this feature.

ip tcp header-compression [**passive**]
no ip tcp header-compression [**passive**]

Syntax Description

passive	(Optional.) Outgoing packets are compressed only if incoming TCP packets on the virtual circuit (VC) for a TCP header compression map are compressed. When the **passive** option is not set, all compressible traffic intended for the TCP header compression address map is compressed.

Default

Disabled

Command Mode

Interface configuration

Usage Guidelines

The implementation of compressed TCP over X.25 uses a single VC to pass the compressed packets distinct from any VCs used for noncompressed packets.

The header compression increases the speed of interactive TCP/IP sessions over serial lines running at 56/64 kilobits per second or slower by caching the 20 bytes or so of the constant part of the IP packet header.

Example

The following example allows TCP header compression on interface serial 4:

```
interface serial 4
ip address 131.108.2.1 255.255.255.0
ip tcp header compression
x25 map compressedtcp 131.08.2.5 000000010300 broadcast
```

Related Command

x25 map compressedtcp

lapb hold-queue

Use the **lapb hold-queue** interface configuration command to define the number of frames that can be held while LAPB is unable to send. Use the **no lapb hold-queue** command without an argument to remove this command from the configuration file and return to the default value.

lapb hold-queue *queue-size*
no lapb hold-queue [*queue-size*]

Syntax Description

queue-size	Defines the number of frames. A hold queue limit of 0 allows an unlimited number of frames in the hold queue. This argument is optional in the **no** form of the command.

Default

10 frames for LAPB encapsulation; X25 encapsulation may not set this parameter because proper operation requires that LAPB send all requested frames.

Command Mode

Interface configuration

Example

The following example illustrates how to set the LAPB hold queue limit to allow up to 25 frames:

```
interface serial 0
lapb hold-queue 25
```

lapb k

Use the **lapb k** interface configuration command to specify the maximum permissible number of outstanding frames, called the window size.

lapb k *window-size*

Syntax Description

window-size	A frame count from 1 to 7.

Default

7 frames

Command Mode

Interface configuration

Example

The following example changes the LAPB window size (the k parameter) to three packets:

```
interface serial 0
lapb k 3
```

lapb n1

Use the **lapb n1** interface configuration command to specify the maximum number of bits a frame can hold (the LAPB N1 parameter).

lapb n1 *bits*

Syntax Description

bits	Number of bits from 1088 through 32,832; it must be a multiple of eight.

Default

12056 bits (1507 bytes total, or 1503 bytes of user information)

Command Mode

Interface configuration

Usage Guidelines

It is not necessary to set N1 to an exact value to support a particular X.25 data packet size, although both ends of a connection should have the same N1 value. The N1 parameter serves to avoid processing of any huge frames that result from a "jabbering" interface, an unlikely event.

The Cisco N1 default value corresponds to the hardware interface buffer size. Any changes to this value must allow for an X.25 data packet and LAPB frame overhead.The software supports an X.25 data packet with a maximum packet size plus 3 or 4 bytes of overhead for modulo 8 or 128 operation, respectively, and LAPB frame overhead of 2 bytes of header for modulo 8 operation plus 2 bytes of CRC.

In addition, the various standards bodies specify that N1 be given in bits rather than bytes. While some equipment can be configured using bytes or by automatically adjusting for some of the overhead information present, Cisco devices are configured using the true value of N1.

Table 1-1 specifies the *minimum* N1 values needed to support a given X.25 data packet. Note that N1 cannot be set to a value less than what is required to support an X.25 data packet size of 128 bytes under modulo 128 operation. This is because all X.25 implementations must be able to support 128-byte data packets.

Table 1-1 Minimum LAPB N1 Values

Maximum data in X.25 packet	Minimum N1 value for X.25 modulo 8	Minimum N1 value for X.25 modulo 8
128	1088	1088
256	2104	2112
512	4152	4160
1024	8248	8256
2048	16440	16448
4096	32824	32832

Configuring N1 to be less than 2104 will generate a warning message that X.25 may have problems because some nondata packets can use up to 259 bytes.

The N1 parameter cannot be set to a value larger than the default without first increasing the hardware maximum transmission unit (MTU) size.

The X.25 software will accept default packet sizes and CALLs that specify maximum packet sizes greater than what the LAPB layer will support, but will negotiate the CALLs placed on the interface to the largest value that can be supported. For switched CALLs, the packet size negotiation takes place end-to-end through the Cisco router so the CALL will not have a maximum packet size that exceeds the capability of either of the two interfaces involved.

Example

The following example sets the N1 bits to 9600:

```
interface serial 0
lapb n1 9600
```

lapb n2

Use the **lapb n2** interface configuration command to specify the maximum number of times a data frame can be transmitted (the LAPB N2 parameter).

lapb n2 *tries*

Syntax Description

tries	Transmission count from 1 through 255.

Default

20 transmissions

Command Mode

Interface configuration

Example

The following example sets the N2 retries to 50:

```
interface serial 0
lapb n2 50
```

lapb protocol

Use the **lapb protocol** interface configuration command to configure the protocol carried on the LAPB line.

lapb protocol *protocol*

Syntax Description

protocol	Protocol choice: **ip**, **xns**, **decnet**, **appletalk**, **vines**, **clns** (ISO CLNS), **ipx** (Novell IPX), and **apollo**.

Default

IP; this command is not available when using a multiprotocol LAPB encapsulation.

Command Mode

Interface configuration

Usage Guidelines

This command is valid only if encapsulation commands are set first.

Example

The following example sets AppleTalk as the protocol on the LAPB line:

```
interface serial 1
lapb protocol appletalk
```

Related Commands

encapsulation lapb
encapsulation lapb-dce

lapb t1

Use the **lapb t1** interface configuration command to set the retransmission timer period (the LAPB T1 parameter).

lapb t1 *milliseconds*

Syntax Description

milliseconds	Number of milliseconds from 1 through 64,000.

Default

3000 milliseconds

Command Mode

Interface configuration

Usage Guidelines

The retransmission timer determines how long a transmitted frame can remain unacknowledged before the LAPB software polls for an acknowledgment. The design of the LAPB protocol specifies that a frame is presumed to be lost if it is not acknowledged within T1; a T1 value that is too small may result in duplicated control information, which can severely disrupt service.

To determine an optimal value for the retransmission timer, use the privileged EXEC command **ping** to measure the round-trip time of a maximum-sized frame on the link. Multiply this time by a safety factor that takes into account the speed of the link, the link quality, and the distance. A typical safety factor is 1.5. Choosing a larger safety factor can result in slower data transfer if the line is noisy. However, this disadvantage is minor compared to the excessive retransmissions and effective bandwidth reduction caused by a timer setting that is too small.

Example

The following example sets the T1 retransmission timer to 20,000 milliseconds:

```
interface serial 0
lapb t1 20000
```

show cmns

Use the **show cmns** EXEC command to display information pertaining to CMNS traffic activity. In particular, you can use this command to display X.25 Level 3 parameters for LAN interfaces (such as Ethernet or Token Ring).

show cmns [*interface-name*]

Syntax Description

interface-name	(Optional.) The interface to describe.

Command Mode

EXEC

Sample Display

The following is sample output from the **show cmns** command for an Ethernet interface:

```
router# show cmns
Ethernet1 is administratively down, line protocol is down
  Hardware address is 0000.0c02.5f4c, (bia 0000.0c2.5f4c), state R1
    Modulo 8, idle 0, timer 0, nvc 1
    Window size: input 2, output 2, Packet size: input 128, output 128
    Timer: TH 0
    Channels: Incoming-only none, Two-way 1-4095, Outgoing-only none
    RESTARTs 0/0 CALLs 0+0/0+0/0+0 DIAGs 0/0
```

Table 1-2 describes significant fields shown in the display.

Table 1-2 Show CMNS Field Descriptions

Field	Description
Ethernet1 is down	Interface is currently active and inserted into network (up) or inactive and not inserted (down), or disabled (administratively down).
line protocol is {up | down	Indicates whether the software processes that handle the line protocol believes the interface is usable.
Hardware address	MAC address for this interface.
bia	Burned-in address.
state R1	State of the interface. R1 is normal ready state (this should always be R1).
modulo 8	Modulo value; determines the packet sequence numbering scheme used.
idle 0	Number of minutes the router waits before closing idle virtual circuits.
timer 0	Value of the interface time; should always be zero.
nvc 1	Maximum number of simultaneous virtual circuits permitted to and from a single host for a particular protocol.
Window size:	Default window sizes (in packets) for the interface.(cmns can’t originate or terminate calls.)
input 2	Default input window size is two packets.
output 2	Default output window size is two packets.

Field	Description
Packet size:	Default packet sizes for the interface.(cmns can’t originate or terminate calls).
input 128	Default input maximum packet size is 128 bytes.
output 128	Default output maximum packet size is 128 bytes.
TH 0	X.25 delayed acknowledgment threshold. Should always be zero.
Channels: Incoming-only none Two-way 1-4095 Outgoing-only none	Virtual circuit ranges for this interface per LLC2 connection.
RESTARTs 0/0	Restarts sent/received.
CALLs 0+0/0+0/0+0	Successful calls + failed calls/calls sent + calls failed/calls received + calls failed.
DIAGs 0/0	Diagnostic messages sent+received.

Related Command

show interfaces serial

show interfaces serial

Use the **show interfaces serial** EXEC command to display information about a serial interface.

show interfaces serial *number*

Syntax Description

number	Specifies the interface port number.

Command Mode

EXEC

Sample Displays

The following is a partial sample output from the **show interfaces serial** command for a serial interface using LAPB encapsulation:

```
router# show interfaces serial 1

LAPB state is SABMSENT, T1 3000, N1 12056, N2 20, K7,
VS 0, VR 0, RCNT 0, Remote VR 0, Retransmissions 2
IFRAMEs 0/0 RNRs 0/0 REJs 0/0 SABMs 3/0 FRMRs 0/0 DISCs 0/0
LAPB state is DISCONNECT, T1 3000, N1 12000, N2 20, K7, TH 3000
Window is closed
IFRAMEs 12/28 RNRs 0/1 REJs 13/1 SABMs 1/13 FRMRs 3/0 DISCs 0/11
```

Table 1-3 shows the fields relevant to all LAPB connections.

Table 1-3 Show Interfaces Serial Fields and Descriptions when LAPB is Enabled

Parameter	Description
LAPB state is	State of the LAPB protocol.
T1 3000, N1 12056, ...	Current parameter settings.
VS	Modulo 8 frame number of the next outgoing I-frame.
VR	Modulo 8 frame number to give to the next I-frame expected to be received.
RCNT	Number of received I-frames that have not yet been acknowledged.
Remote VR	Number of the next I-frame the remote expects to receive.
Retransmissions	Count of I-frames that have been retransmitted.
Window is closed	No more frames can be transmitted until some outstanding frames have been acknowledged.
IFRAMEs	Count of Information frames in the form of sent/received.
RNRs	Count of Receiver Not Ready frames in the form of sent/received.
REJs	Count of Reject frames in the form of sent/received.
SABMs	Count of Set Asynchronous Balanced Mode commands in the form of sent/received.
FRMRs	Count of Frame Reject frames in the form of sent/received.
DISCs	Count of Disconnect commands in the form of sent/received.

The following is a partial sample output from the **show interfaces** command for a serial X.25 interface:

```
router# show interfaces serial 1

X25 address 000000010100, state R1, modulo 8, idle 0, timer 0, nvc 1
  Window size: input 2, output 2, Packet size: input 128, output 128
  Timers: T20 180, T21 200, T22 180, T23 180, TH 0
  Channels: Incoming-only none, Two-way 1-1024, Outgoing-only none
(configuration on RESTART: modulo 8,
  Window size: input 2 output 2, Packet size: input 128, output 128
  Channels: Incoming-only none, Two-way 5-1024, Outgoing-only none)
  RESTARTs 3/2 CALLs 1000+2/1294+190/0+0/ DIAGs 0/0
```

The stability of the X.25 protocol requires that some parameters not be changed without a RESTART of the protocol. Any change to these parameters will be held until a RESTART is sent or received. If any of these parameters will change, the configuration on RESTART information will be output as well as the values that are currently in effect.

Table 1-4 describes significant fields shown in the display.

Table 1-4 Show Interfaces X25 Field Descriptions

Field	Description
X25 address 000000010100	Address used to originate and accept calls.
state R1	State of the interface. Possible values are: • R1 is the normal ready state • R2 is the DTE RESTARTing state • R3 is the DCE RESTARTing state If the state is R2 or R3, the interface is awaiting acknowledgment of a Restart packet.
modulo 8	Modulo value; determines the packet sequence numbering scheme used.
idle 0	Number of minutes the router waits before closing idle virtual circuits that it originated or accepted.
timer 0	Value of the interface timer, which is zero unless the interface state is R2 or R3.
nvc 1	Default maximum number of simultaneous virtual circuits permitted to and from a single host for a particular protocol.
Window size: input 2, output 2	Default window sizes (in packets) for the interface. The **x25 facility** interface configuration command can be used to override these default values for the switched virtual circuits originated by the router.
Packet size: input 128, output 128	Default maximum packet sizes (in bytes) for the interface. The **x25 facility** interface configuration command can be used to override these default values for the switched virtual circuits originated by the router.
Timers: T20 180, T21 200, T22 180, T23 180	Values of the Request packet timers: • T10 through T13 for a DCE device • T20 through T23 for a DTE device
TH0	Packet acknowledgment threshold (in packets). This value determines how many packets are received before sending an explicit acknowledgment; the default value (0) sends an explicit acknowledgment only when the incoming window is full.
Channels: Incoming-only none Two-way 5-1024 Outgoing-only none	Displays the virtual circuit ranges for this interface.
RESTARTs 3/2	Shows RESTART packet statistics for the interface using the format Sent/Received.
CALLs 1000+2/1294+190/0+0	Shows CALL packet statistics for the interface using these formats: • Successful+Failed / • Sent+Failed sent / • Received+Failed received
DIAGs 0/0	Shows DIAG packet statistics for the interface using the format Forwarded+Failed forwarded.

Related Command

show cmns

show llc2

Use the **show llc2** EXEC command to display active LLC2 connections.

show llc2c

Syntax Description

This command has no arguments or keywords.

Command Mode

EXEC

Sample Display

The following is sample output from the **show llc2** command:

```
router# show llc2

TokenRing0 DTE=1000.5A59.04F9,400022224444 SAP=04/04, State=NORMAL
V(S)=5, V(R)=5, Last N(R)=5, Local Window=7, Remote Window=127
ack-max=3, n2=8, Next timer in 7768
xid-retry timer 0/60000 ack timer 0/1000
p timer 0/1000 idle timer 7768/10000
rej timer 0/3200 busy timer 0/9600
ack-delay timer 0/3200
CMNS Connections to:
 Address 1000.5A59.04F9 via Ethernet2
 Protocol is up
 Interface type X25-DCE RESTARTS 0/1
 Timers: T10 1 T11 1 T12 1 T13 1
```

The display includes a CMNS addendum, indicating that LLC2 is running with CMNS. When LLC2 is not running with CMNS, the **show llc2** command does not display a CMNS addendum.

Table 1-5 describes significant fields shown in the display.

Table 1-5 Show LLC2 Field Descriptions

Field	Description
TokenRing0	Name of interface on which the session is established.
DTE=1000.5A59.04F9, 400022224444	Address of the station to which the Cisco router is talking on this session. (The router's address is the MAC address of the interface on which the connection is established, except when Local Acknowledgment or SDLLC is used, in which case the address used by the router is shown as in this example, following the DTE address and separated by a comma.)
SAP=04/04	Other station's and router's (remote/local) Service Access Point for this connection. The SAP is analogous to a "port number" on the router and allows for multiple sessions between the same two stations.

Field	Description
State=	Current state of the LLC2 session which are any of the following:
ADM	Asynchronous Disconnect Mode—A connection is not established, and either end can begin one.
SETUP	Request to begin a connection has been sent to the remote station, and this station is waiting for a response to that request.
RESET	A previously open connection has been reset because of some error by this station, and this station is waiting for a response to that reset command.
D_CONN	This station has requested a normal, expected, end of communications with the remote, and is waiting for a response to that disconnect request.
ERROR	This station has detected an error in communications and has told the other station about it. This station is waiting for a reply to its posting of this error.
NORMAL	Connection between the two sides is fully established, and normal communication is occurring.
BUSY	Normal communication state exists, except busy conditions on this station make it such that this station cannot receive information frames from the other station at this time.
REJECT	Out-of-sequence frame has been detected on this station, and this station has requested that the other resend this information
AWAIT	Normal communication exists, but this station has had a timer expire, and is trying to recover from it (usually by resending the frame that started the timer).
AWAIT_BUSY	A combination of the AWAIT and BUSY states.
AWAIT_REJ	A combination of the AWAIT and REJECT states.
V(S)=5	Sequence number of the next information frame this station will send.
V(R)=5	Sequence number of the next information frame this station expects to receive from the other station.
Last N (R)=5	Last sequence number of this station's transmitted frames acknowledged by the remote station.
Local Window=7	Number of frames this station may send before requiring an acknowledgment from the remote station.
Remote Window=127	Number of frames this station can accept from the remote.
ack-max=3, n2=8	Value of these parameters, as given in the previous configuration section.

Field	Description
Next timer in 7768	Number of milliseconds before the next timer, for any reason, goes off.
xid-retry timer 0/60000	A series of timer values in the form of next-time/time-between, where "next-time" is the next time, in milliseconds, that the timer will wake, and "time-between" is the time, in milliseconds, between each timer wakeup. A "next-time" of zero indicates that the given timer is not enabled, and will never wake.
CMNS Connections to:	CMNS addendum when LLC2 is running with the CMNS protocol contains the following:
Address 1000.5A59.04F9 via Ethernet2	MAC address of remote station.
Protocol is up	Up indicates the LLC2 and X.25 protocols are in a state where incoming and outgoing Call Requests can be made on this LLC2 connection.
Interface type X25-DCE	One of the following: X25-DCE, X25-DTE, or X25-DXE (either DTE or DCE).
RESTARTS 0/1	Restarts sent/received on this LLC2 connection.
Timers:	T10, T11, T12, T13 (or T20, T21, T22, T23 for DTE); these are Request packet timers. These are similar in function to X.25 parameters of the same name.

show x25 map

Use the **show x25 map** EXEC command to display information about configured address maps.

show x25 map

Syntax Description

This command has no arguments or keywords.

Command Mode

EXEC

Sample Display

The following is sample output from the **show x25 map** command:

```
router# show x25 map

Serial0: IP 131.108.170.1 1311001 PERMANENT BROADCAST, 2 LCN: 3 4*
Serial0: appletalk 128.1 1311005 PERMANENT
Serial1: BRIDGE 1311006 PERMANENT
```

The display shows that three virtual circuits have been configured for the router, two for the Serial0 interface, and one for the Serial1 interface.

Table 1-6 describes significant fields shown in the first line of output in the display.

Table 1-6 Show X.25 Map Field Description

Field	Description
Serial0	Interface on which this X.25 virtual circuit is established.
IP	Type of higher-level address that has been configured for this virtual circuit using the **x25 map** command. The BRIDGE value in this field indicates that all bridged packets go to this X.121 address.
131.108.170.1	Higher-level address mapped for this virtual circuit.
1311001	X.121 addressmapped for this virtual circuit.
PERMANENT	Address-mapping type that has been configured for the interface in this entry. Possible values include: • CONSTRUCTED—Derived using the DDN or BFE address conversion scheme. • PERMANENT—Address was entered using the **x25 map** interface configuration command. • TEMPORARY—Address mapping was not entered using a configuration command, but was dynamically created instead.
BROADCAST	If broadcasts are enabled for an address mapping, the work BROADCAST also appears on the output line.
2 LCN:	If the number of logical circuit numbers (LCNs) is greater than zero, the line of output also includes the LCN numbers.
3 4	Indicates the LCN(s), if one or more exists.
*	An asterisk marks the current LCN.

show x25 remote-red

Use the **show x25 remote-red** EXEC command to display the one-to-one mapping of the host IP addresses and the remote BFE device's IP addresses.

show x25 remote-red

Syntax Description

This command has no arguments or keywords.

Command Mode

EXEC

Sample Display

The following is sample output from the **show x25 remote-red** command:

```
router# show x25 remote-red
Entry       REMOTE-RED     REMOTE-BLACK   INTERFACE
1           21.0.0.3       21.0.0.7       serial3
2           21.0.0.10      21.0.0.6       serial1
3           21.0.0.24      21.0.0.8       serial3
```

Table 1-7 describes significant fields shown in the display.

Table 1-7 Show X.25 Remote-Red Display Field Description

Field	Description
Entry	Address mapping entry.
REMOTE-RED	Host IP address.
REMOTE-BLACK	IP address of the remote BFE device.
INTERFACE	Name of interface through which communication with the remote BFE device will take place.

show x25 route

Use the **show x25 route** EXEC command to display the X.25 routing table.

show x25 route

Syntax Description

This command has no arguments or keywords.

Command Mode

EXEC

Sample Display

The following is sample output from the **show x25 route** command:

```
router# show x25 route

Number         X.121        CUD        Forward To
1              1311001                 Serial0, 0 uses
2              1311002                 131.108.170.10, 0 uses
3              1311003      00         alias Serial0, 2 uses
```

Table 1-8 describes significant fields shown in the display.

Table 1-8 Show X.25 Route Display Field Description

Field	Description
Number	Number identifying the entry in the X.25 routing table.
X.121 address	X.121 address pattern associated with this entry.
CUD	Call User Data, if any, that has been configured for this route.
Forward To	Router interface or IP address to which the router will forward a CALL destined for the X.121 address pattern in this entry. This field also includes the number of uses of this route.

Related Command

x25 route

show x25 vc

Use the **show x25 vc** EXEC command to display the parameters and statistics of the active X.25 virtual circuit. To examine a particular virtual circuit, add an LCN argument to the **show x25 vc** command.

show x25 vc [*lcn*]

Syntax Description

lcn	(Optional.) Logical channel number (LCN).

Command Mode

EXEC

Usage Guidelines

For PVCs, the syntax of the third and sometimes fourth line(s) of **show x25 vc** output varies depending on whether the PVC is in a connected or disconnected state, and whether the connection is locally switched, or remotely tunneled over a TCP connection.

If the PVC is locally switched and connected, the syntax for the third line of output follows:

```
Switched PVC to interface name PVC #, connected
```

If the PVC is locally switched and not connected, the syntax for the third line of output follows:

```
Switched PVC to interface name PVC #, not connected, PVC state string
```

If the PVC is remotely tunneled and connected, the syntax for the third and fourth lines of output follows:

```
Tunneled PVC to ip address interface name PVC #, connected
via TCP connection from ip address, port to ip address, port, D-bit allowed
```

If the PVC is remotely tunneled and not connected, the syntax for the third line of output follows:

```
Tunneled PVC to ip address interface name PVC #, not connected, PVC state string
```

The PVC state string represents the state of a PVC. Some of these strings only apply to PVCs that are remotely tunneled over a TCP connection. The %X25-3-PVCBAD system error message (as documented in the *System Error Messages* publication), and the **debug x25 all** command (as documented in the *Debug Command Reference* publication) also use these PVC state strings. These PVC state strings follow:

```
awaiting PVC-SETUP reply
can't support flow control values
connected
dest. disconnected
dest. interface is not up
dest. PVC configuration mismatch
mismatched flow control values
no such dest. interface
no such dest. PVC
non-X.25 dest. interface
PVC setup protocol error
PVC/TCP connect timed out
PVC/TCP connection refused
PVC/TCP routing error
trying to connect via TCP
waiting to connect
```

Sample Display

The following is sample output from **show x25 vc** command for an SVC that carries encapsulated IP diagrams:

```
router# show x25 vc

LC1: 1, State: D1, Interface: Serial0
Started 0:55:03, last input 0:54:56, output 0:54:56
Connected to IP [10.4.0.32] <–>000000320400 Precedent: 0
Window size input: 7, output: 7
Packet size input: 1024, output: 1024
PS: 2 PR: 6 Remote PR: 2 RCNT: 1 RNR: FALSE
Window is closed
Retransmits: 0   Timer (secs): 0  Reassembly (bytes): 0
Held Fragments/Packets: 0/0
Bytes 1111/588 Packets 18/22 Resets 0/0 RNRs 0/0 REJs 0/0 INTs 0/0
```

Table 1-9 describes significant fields shown in the output.

Table 1-9 Show X25 VC Field Descriptions

Field	Description
LCI	Virtual circuit number.
State	State of the virtual circuit (which is independent of the states of other virtual circuits); D1 is the normal ready state. (See the CCITT X.25 Recommendation for a description of virtual circuit states.)
Interface	Interface on which the virtual circuit is established.
Started	Time elapsed since the virtual circuit was created.
last input	Time of last input.
output	Shows time of last output.
Connected to	Network-protocol address, in brackets, and the X.121 address of the machine to which the router is locally connected.
Precedent	IP precedence (appears only if you have specified DDN encapsulation).

Field	Description
Window size	Window sizes for the virtual circuit.
Packet size	Maximum packet sizes for the virtual circuit.
PS	Current send sequence number.
PR	Current receive sequence number.
Remote	Last PR number received from the other end of the circuit.
RCNT	Count of unacknowledged input packets.
RNR	State of the Receiver Not Ready flag; this field is true if the network sends a receiver-not-ready packet.
Window is closed	Router cannot transmit any more packets until the remote end has acknowledged some outstanding packets.
Retransmits	Number of times a supervisory packet (RESET or CLEAR) has been retransmitted.
Timer	A nonzero time value if a packet has not been acknowledged or if virtual circuits are being timed for inactivity.
Reassembly	Number of bytes received for a partial packet (a packet in which the more data bit is set).
Held Fragments/Packets	Number of X.25 packets being held. (In this case, Fragments refers to the X.25 fragmentation of higher-level data packets.)
Bytes	Total number of bytes sent and received. The Packets, Resets, RNRs, REJs, and INTs fields show the total sent and received packet counts of the indicated types. (RNR is Receiver Not Ready, REJ is Reject, and INT is Interrupt).

Sample Display Showing CMNS Virtual Circuit Parameters and Statistics

When the protocol type used for the connection is CMNS, the display generated with **show x25 vc** differs slightly from the display outlined in the preceding description.

The following is sample output from the **show x25 vc** command for two complementary interfaces, both running CMNS, and transmitting CMNS traffic to each other:

```
router# show x25 vc

LCI: 1,  State: P4,  Interface: Serial1
Started 0:23:00, last input never, output never
Connected to CMNS [37.1111] <--> 313131 via Ethernet1 LCN 4095 to 0000.0c01.487d
Window size input: 6, output: 6
Packet size input: 1024, output: 1024
PS: 0  PR: 0  ACK: 0  Remote PR: 0  RCNT: 0  RNR: FALSE
Retransmits: 0  Timer (secs): 0  Reassembly (bytes): 0
Held Fragments/Packets: 0/0
Bytes 0/0 Packets 0/0 Resets 0/0 RNRs 0/0 REJs 0/0 INTs 0/0
--More--
LCI: 4095,  State: P4,  Interface: Ethernet1
Started 0:23:01, last input never, output never
Connected to CMNS [36.3030.3030.3030.30] <--> 0000.0c01.487d
via Serial1 LCN 1to 313131
Window size input: 6, output: 6
Packet size input: 1024, output: 1024
PS: 0  PR: 0  ACK: 0  Remote PR: 0  RCNT: 0  RNR: FALSE
Retransmits: 0  Timer (secs): 0  Reassembly (bytes): 0
Held Fragments/Packets: 0/0\
Bytes 0/0 Packets 0/0 Resets 0/0 RNRs 0/0 REJs 0/0 INTs 0/0
```

Table 1-10 describes significant fields shown in the display.

Table 1-10 Show X25 VC with CMNS Field Descriptions

Field	Description
LCI	Virtual circuit number; range is 1 through 4095.
State	State of the virtual circuit (which is independent of the states of other virtual circuits); P4 indicates the interface is in the data transfer state (See the CCITT X.25 recommendation for a description of virtual circuit states.)
Interface	Interface used for the virtual circuit. With CMNS, this can indicate Ethernet, Token Ring, and FDDI interfaces, as well as Serial.
Connected to	NSAP address, in brackets, for the device at the indicated X.121 address.
Ethernet1	Logical Channel Number (LCN) used (1 through 4095) and the MAC address of the node to which the interface is connected.

x25 accept-reverse

Use the **x25 accept-reverse** interface configuration command to instruct the router to accept all reverse charge calls. The **no x25 accept-reverse** command disables this facility.

x25 accept-reverse
no x25 accept-reverse

Syntax Description

This command has no arguments or keywords.

Default

Disabled

Command Mode

Interface configuration

Usage Guidelines

This command causes the interface to accept reverse charge calls by default. This behavior also can be configured on a per-peer basis using the **x25 map** interface configuration command.

Example

The following example illustrates how to set acceptance of reverse charge calls:

```
interface serial 0
x25 accept-reverse
```

Related Command

x25 map

x25 address

Use the **x25 address** interface configuration command to set the X.121 address of a particular network interface.

x25 address *X.121-address*

Syntax Description

X.121-address	Variable-length X.121 address. The address is assigned by the X.25 network service provider.

Default

DDN and BFE encapsulations have a default interface address generated from the interface IP address. Standard X.25 encapsulations do not have a default

Command Mode

Interface configuration

Example

The following example sets the X.121 address for the interface:

```
interface serial 0
x25 address 00000123005
```

The address must match that assigned by the X.25 network service provider.

x25 bfe-decision

Use the **x25 bfe-decision** interface configuration command to direct how a router configured for **x25 bfe-emergency decision** will participate in emergency mode.

x25 bfe-decision {**no** | **yes** | **ask**}

Syntax Description

no Prevents the router from participating in emergency mode and from sending address translation information to the BFE device.

yes Allows the router to participate in emergency mode and to send address translation information to the BFE when the BFE enters emergency mode. The router obtains this information from the table created by the **x25 remote-red** command.

ask Configures the router to display an onscreen request to enter the **bfe** EXEC command.

Default

no

Command Mode

Interface configuration

Example

The following example shows how to configure interface Serial 0 to require an EXEC command from the administrator before it participates in emergency mode. The host IP address is 21.0.0.12, and the address of the remote BFE unit is 21.0.0.1. When the BFE enters emergency mode, the router will prompt the administrator for EXEC command **bfe enter** to direct the router to participate in emergency mode.

```
interface serial 0
x25 bfe-emergency decision
x25 remote-red 21.0.0.12 remote-black 21.0.0.1
x25 bfe-decision ask
```

Related Commands

bfe
x25 bfe-emergency
x25 remote-red

x25 bfe-emergency

Use the **x25 bfe-emergency** interface configuration command to configure the circumstances under which the router participates in emergency mode.

x25 bfe-emergency {**never** | **always** | **decision**}

Syntax Description

never Prevents the router from sending address translation information to the BFE. If it does not receive address translation information, the BFE cannot open a new connection for which it does not know the address.

always Allows the router to pass address translations to the BFE when it enters emergency mode and an address translation table has been created.

decision Directs the router to wait until it receives a diagnostic packet from the BFE device indicating that the emergency mode window is open. The window is only open when a condition exists that allows the BFE is to enter emergency mode. When the diagnostic packet is received, the router's participation in emergency mode depends on how it is configured using the **x25 bfe-decision** command.

Default

never

Command Mode

Interface configuration

Example

The following example shows how to configure interface Serial 0 to require an EXEC command from the administrator before it participates in emergency mode. The host IP address is 21.0.0.12, and the address of the remote BFE unit is 21.0.0.1. When the BFE enters emergency mode, the router will prompt the administrator for EXEC command **bfe enter** to direct the router to participate in emergency mode.

```
interface serial 0
x25 bfe-emergency decision
x25 remote-red 21.0.0.12 remote-black 21.0.0.1
x25 bfe-decision ask
```

Related Commands

bfe
x25 bfe-decision

x25 default

Use the **x25 default** interface configuration command to set a default protocol. Use the **no x25 default** command to remove the protocol specified.

x25 default *protocol*
no x25 default *protocol*

Syntax Description

protocol Specifies the protocol; can only be IP, specified by the **ip** keyword.

Default

None

Command Mode

Interface configuration

Usage Guidelines

This command specifies the protocol assumed by the router to interpret incoming calls with unknown Call User Data. If you do not use the **x25 default** interface configuration command, the router clears any incoming calls with unknown Call User Data.

Example

The following example illustrates how to establish IP as the default protocol for X.25 calls:

```
interface serial 0
x25 default IP
```

Related Command

x25 map

x25 facility

Use the **x25 facility** interface configuration command to force facilities on a per-call basis for calls originated by the router. Use the **no x25 facility** command to disable a facility.

x25 facility *facility-keyword value*
no x25 facility *facility-keyword value*

Syntax Description

facility-keyword User facility.

value Facility value; see Table 1-11 for a list of supported facilities and their values.

Table 1-11 X.25 User Facilities

Option	Description
cug *number*	Specifies a closed user group (CUG) number; CUGs 1 to 99 are allowed. CUGs can be used by a public data network to create a virtual private network within the larger network and to restrict access.
packetsize *in-size out-size*	Proposes input maximum packet size (*in-size*) and output maximum packet size (*out-size*) for flow control parameter negotiation. Both values must be one of the following values: 16, 32, 64, 128, 256, 512, 1024, 2048, or 4096.
windowsize *in-size out-size*	Proposes the packet count for input windows (*in-size*) and output windows (*out-size*) for flow control parameter negotiation. Both values must be in the range 1 to 127 and must not be greater than or equal to the value set for the **x25 modulo** command.
reverse	Specifies reverses charging on all calls originated by the interface.
throughput *in out*	Sets the requested throughput class negotiation values for input (*in*) and output (*out*) throughput across the network. Values for *in* and *out* are in bits per second (bps) and range from 75 to 48,000 bps.
t**ransit-delay** *value*	Specifies a network transit delay for the duration of outgoing calls for networks that support transit delay. The transit delay value can be between 0 and 65534 milliseconds.
rpoa *name*	Specifies the name defined by the **x25 rpoa** command for a list of transit Recognized Private Operation Agencies (RPOAs) to use in outgoing Call Request packets.

Default

No facility sent

Command Mode

Interface configuration

Examples

The following example illustrates how to specify a transit delay value in an X.25 configuration:

```
interface serial 0
x25 facility transit-delay 24000
```

The following example illustrates how to set an RPOA name and then send the list via the X.25 user facilities:

```
x25 rpoa green_list 23 35 36
interface serial 0
x25 facility rpoa green_list
```

Related Command

x25 rpoa

x25 hic

Use the **x25 hic** interface configuration command to set the highest incoming-only virtual circuit number.

x25 hic *circuit-number*

Syntax Description

circuit-number	Virtual circuit number from 1 through 4095, or 0 if there is no incoming-only virtual circuit range.

Default

0

Command Mode

Interface configuration

Usage Guidelines

This command is applicable only if you have the X.25 switch configured for an incoming only virtual circuit range. Incoming is from the perspective of the X.25 DTE. If you do not want any outgoing calls from your DTE, configure both ends to disable the two-way range (set tc and htc to 0) and configure an incoming-only range. Any incoming-only range must come before (that is, must be numerically less than) any two-way range. Any two-way range must come before any outgoing-only range.

Example

The following example illustrates how to set a valid incoming-only virtual circuit range of 1 to 5:

```
interface serial 0
x25 lic 1
x25 hic 5
x25 ltc 6
```

Related Command

x25 lic

x25 hoc

Use the **x25 hoc** interface configuration command to set the highest outgoing-only virtual circuit number.

x25 hoc *circuit-number*

Syntax Description

circuit-number	Virtual circuit number from 1 through 4095, or 0 if there is no outgoing-only virtual circuit range.

Default

0

Command Mode

Interface configuration

Usage Guidelines

This command is applicable only if you have the X.25 switch configured for an outgoing only virtual circuit range. Outgoing is from the perspective of the X.25 DTE. If you do not want any incoming calls on your DTE, disable the two-way range (set tc and htc to 0) and configure an outgoing-only range. Any outgoing-only range must come after (that is, be numerically greater than) any other range.

Example

The following example illustrates how to set a valid outgoing-only virtual circuit range of 2000 to 2005:

```
interface serial 0
x25 loc 2000
x25 hoc 2005
```

Related Command

x25 loc

x25 hold-queue

Use the **x25 hold-queue** interface configuration command to modify the maximum number of packets that can be held until a virtual circuit is able to transmit. Use the **no x25 hold-queue** command without an argument to remove this command from the configuration file and restore the default value.

x25 hold-queue *queue-size*
no x25 hold-queue [*queue-size*]

Syntax Description

queue-size	Defines the number of packets. A hold queue value of 0 allows an unlimited number of packets in the hold queue. This argument is optional for the no form of this command.

Default

10 packets

Command Mode

Interface configuration

Usage Guidelines

If you set the *queue-size* to 0 when using the **no x25 hold-queue** command, there will be no hold queue limit. While this will prevent drops until the router runs out of memory, it is only rarely appropriate. A virtual circuit hold queue value is determined when it is created; changing this parameter will not affect the hold queue limits of the existing VCs.

Example

The following example illustrates how to set the X.25 hold queue to hold 25 packets:

```
interface serial 0
x25 hold-queue 25
```

Related Commands

A dagger (†) indicates that the command is documented in another chapter.

ip mtu †
x25 ips
x25 ops

x25 hold-vc-timer

Use the **x25 hold-vc-timer** interface configuration command to prevent overruns on some X.25 switches caused by Call Request packets. This command starts the hold-vc-timer to prevent additional calls to a destination for a given period of time. The **no x25 hold-vc-timer** command restores the default value for the timer.

x25 hold-vc-timer *minutes*
no x25 hold-vc-timer

Syntax Description

minutes	Number of minutes to prevent calls from going to a previously failed destination. Incoming calls still will be accepted.

Default

0

Command Mode

Interface configuration

Usage Guidelines

Only Call Requests that the router originates will be held down; routed X.25 Call Requests are not affected by this parameter.

Upon receiving a Clear Request for an outstanding Call Request, the X.25 support code immediately tries another Call Request if it has more traffic to send, and this action might cause overrun problems.

The failed VC(s) may be observed with the show x25 vc command; they are renumbered to the illegal value 4096 and have the non-standard state X1.

Example

The following example illustrates how to set the hold-vc-timer to 3 minutes:

```
interface serial 0
x25 hold-vc-timer 3
```

x25 host

Use the **x25 host** global configuration command to define a static host name-to-address mapping. Use the **no x25 host** command to remove the host name.

x25 host *name X.121-address* [**cud** *call-user-data*]
no x25 host *name*

Syntax Description

name	Host name.
X.121-address	The X.121 address.
cud *call-user-data*	(Optional.) Specifies the Call User Data (CUD) field in the X.25 Call Request packet.

Default

None

Command Mode

Global configuration

Examples

The following example illustrates how to specify a static address mapping:

```
x25 host Willard 4085551212
```

The following example illustrates how to remove a static address mapping:

```
no x25 host Willard
```

x25 htc

Use the **x25 htc** interface configuration command to set the highest two-way virtual circuit number.

x25 htc *circuit-number*

Syntax Description

circuit-number	Virtual circuit number from 1 through 4095, or 0 if there is no two-way virtual circuit range.

Default

1024 for X.25 network service interfaces; 4095 for CMNS network service interfaces.

Command Mode

Interface configuration

Usage Guidelines

This command is applicable if you have the X.25 switch configured for a two-way virtual circuit range. Any two-way virtual circuit range must come after (that is, be numerically larger than) any incoming-only range, and must come before any outgoing-only range.

Example

The following example illustrates how to set a valid two-way virtual circuit range of 5 to 25:

```
interface serial 0
x25 ltc 5
x25 htc 25
```

Related Commands

cmns enable
x25 ltc

x25 idle

The router can clear a switched virtual circuit (SVC) after a period of inactivity. Use the **x25 idle** interface configuration command to set this period.

x25 idle *minutes*

Syntax Description

minutes	Number of minutes in the idle period.

Default

0 (causes the router to keep the SVC open indefinitely)

Command Mode

Interface configuration

Usage Guidelines

Both calls originated and terminated by the router are cleared; switched virtual circuits are not cleared. To clear one or all virtual circuits at once, use the privileged EXEC command **clear x25-vc**.

Example

The following example illustrates how to set a 5-minute wait period before an idle circuit is cleared:

```
interface serial 2
x25 idle 5
```

Related Command

clear x25-vc

x25 ip-precedence

Use the **x25 ip-precedence** interface configuration command to enable the ability to open a new virtual circuit based on the IP precedence value. The command **no x25 ip-precedence** causes the precedence value to be ignored when opening virtual circuits.

x25 ip-precedence
no x25 ip-precedence

Syntax Description

This command has no arguments or keywords.

Default

The routers open one virtual circuit for all types of service.

Command Mode

Interface configuration

Usage Guidelines

There is a problem associated with this feature in that some hosts send nonstandard data in the IP TOS field, thus causing multiple, wasteful virtual circuits to be created.

Four VCs may be opened based on IP precedence to encapsulate routine, priority, immediate, and all higher precedences.

The nvc limit specified for the map or the interface default nvc limit still applies.

Although an originated VC will be restricted to traffic of a particular precedence, VCs that are received and accepted have no precedence associated.

Example

The following example illustrates how to allow new IP encapsulation virtual circuits based on the IP precedence:

```
interface serial 3
x25 ip-precedence
```

x25 ips

Use the **x25 ips** interface configuration command to set the interface default maximum input packet size to match that of the network.

x25 ips *bytes*

Syntax Description

bytes	Byte count that is one of the following: 16, 32, 64, 128, 256, 512, 1024, 2048, or 4096.

Default

128 bytes

Command Mode

Interface configuration

Usage Guidelines

X.25 network connections have a default maximum input packet size set by the network administrator. Larger packet sizes require less overhead processing. To send a packet larger than the X.25 packet size over an X.25 virtual circuit, a router must break the packet into two or more X.25 packets with the M-bit ("more data" bit) set. The receiving device collects all packets with the M-bit set and reassembles them.

Note Set the **x25 ips** and **x25 ops** commands to the same value unless your network supports asymmetric input and output packet sizes.

Example

The following example shows how to set the default maximum packet sizes to 512:

```
interface serial 1
x25 ips 512
x25 ops 512
```

Related Command

x25 ops

x25 lic

Use the **x25 lic** interface configuration command to set the lowest incoming-only virtual circuit number.

x25 lic *circuit-number*

Syntax Description

circuit-number	Virtual circuit number from 1 through 4095, or 0 if there is no incoming-only virtual circuit range.

Default

0

Command Mode

Interface configuration

Usage Guidelines

This command is applicable only if you have the X.25 switch configured for an outgoing only virtual circuit range. Outgoing is from the perspective of the X.25 DTE. If you do not want any incoming calls on your DTE, disable the two-way range (set tc and htc to 0) and configure an outgoing-only range. Any outgoing-only range must come after (that is, be numerically greater than) any other range.

Usage Guidelines

This command is applicable if you have the X.25 switch configured for two way virtual circuit range.

Example

The following example shows how to set a valid incoming-only virtual circuit range of 1 to 5:

```
interface serial 0
x25 lic 1
x25 hic 5
x25 ltc 6
```

Related Command

x25 hic

x25 linkrestart

Use the **x25 linkrestart** interface configuration command to force a packet-level restart when the link level resets. This command restarts X.25 Level 3 when errors occur in Level 2 (LAPB). The **no x25 linkrestart** command disables this function.

x25 linkrestart
no x25 linkrestart

Syntax Description

This command has no arguments or keywords.

Default

Forcing packet-level restarts is the default and is necessary for networks that expect this behavior.

Command Mode

Interface configuration

Example

The following example illustrates how to disable the link level restart:

```
interface serial 3
no x25 linkrestart
```

x25 loc

Use the **x25 loc** interface configuration command to set the lowest outgoing-only virtual circuit number.

x25 loc *circuit-number*

Syntax Description

circuit-number	Virtual circuit number from 1 through 4095, or 0 if there is no outgoing-only virtual circuit range.

Default

0

Command Mode

Interface configuration

Usage Guidelines

This command is applicable only if you have the X.25 switch configured for outgoing only. Outgoing is from the perspective of the X.25 DTE. If you do not want any incoming calls from your DTE, configure the loc and hoc values and set the ltc and htc values to 0.

Example

The following example illustrates how to set a valid outgoing-only virtual circuit range of 2000 to 2005:

```
interface serial 0
x25 loc 2000
x25 hoc 2005
```

Related Command

x25 hoc

x25 ltc

Use the **x25 ltc** interface configuration command to set the lowest two-way virtual circuit number.

x25 ltc *circuit-number*

Syntax Description

circuit-number	Virtual circuit number from 1 through 4095, or 0 if there is no two-way virtual circuit range.

Default

1

Command Mode

Interface configuration

Usage Guidelines

This command is applicable if you have the X.25 switch configured for a two-way virtual circuit range. Any two-way virtual circuit range must come after (that is, be numerically larger than) any incoming-only range, and must come before any outgoing-only range.

Example

The following example illustrates how to set a valid two-way virtual circuit range of 5 to 25:

```
interface serial 0
x25 ltc 5
x25 htc 25
```

Related Command

x25 htc

x25 map

Use the **x25 map** interface configuration command to set up the LAN protocol-to-X.121 address mapping for the host. Because no defined protocol can dynamically determine such mappings, you must enter a mapping for each host with which the router will exchange traffic. Use the **no x25 map** command with the appropriate network protocol and X.121 address arguments to retract a network protocol-to-X.121 mapping.

x25 map *protocol-keyword protocol-address X.121-address* [*option*]
no x25 map *protocol-keyword protocol-address X.121-address*

Syntax Description

protocol-keyword	Selects the protocol type. Supported protocol keywords are listed in Table 1-12.
protocol-address	Specifies the protocol address.
X.121-address	Specifies the X.121 address. Both addresses specify the network protocol-to-X.121 mapping.
option	(Optional.) Provides additional functionality or the X.25 essential user facilities to the mapping specified. Can be any of the options listed in Table 1-13).

Table 1-12 Protocols Supported by X.25

Keyword	Protocol
ip	IP
decnet	DECnet
xns	XNS
novell	Novell IPX
appletalk	AppleTalk
vines	VINES
apollo	Apollo Domain
bridge	Bridging
clns	OSI Connectionless Network Service
cmns	OSI Connection-Mode Network Service
compressedtcp	TCP header compression

Table 1-13 X.25 Map Options

Option	Description
reverse	Specifies reverse charging for outgoing calls.
accept-reverse	Causes the router to accept incoming reverse-charged calls. If this option is not present, the router clears reverse charged calls unless the interface accepts all reverse charged calls.
broadcast	Causes the router to direct any broadcasts sent through this interface to the specified X.121 address. This option also simplifies the configuration of OSPF; see "Usage Guidelines" for more detail.
cug *number*	Specifies a closed user group number (from 1 to 99) for the mapping in an outgoing call.
nvc *count*	Sets the number of virtual circuits (VCs) for this map/host. The default *count* is the **x25 nvc** setting of the interface. A maximum number of eight VCs can be configured for each single map/host. Compressed TCP may only use 1 VC.
packetsize *in-size out-size*	Proposes maximum input packet size (*in-size*) and maximum output packet size (*out-size*) for an outgoing call. Both values must be one of the following values: 16, 32, 64, 128, 256, 512, 1024, 2048, or 4096.
windowsize *in-size out-size*	Proposes the packet count for input window (*in-size*) and output window (*out-size*) for an outgoing call. Both values should be the same, must be in the range 1 to 127, and must not be greater than or equal to the value set by the **x25 modulo** command.
throughput *in out*	Sets the requested throughput class values for input (*in*) and output (*out*) throughput across the network for an outgoing call. Values for *in* and *out* are in bits per second (bps) and range from 75 to 48,000 bps.
transit-delay *number*	Specifies the transit delay value in milliseconds (0 to 65534) for an outgoing call, for networks that support transit delay.
nuid *username password*	Specifies that a network ID facility be sent in the outgoing call with the specified TACACS username and password (format determined by Cisco). The combined length of the username and password should not exceed 127 characters.
nudata *string*	Specifies the network user identification in a format determined by the network administrator (as per CCITT recommendation). The string should not exceed 130 characters and must be enclosed in quotation marks (" ") if there are any spaces present.
rpoa *name*	Specifies the name defined by the **x25 rpoa** command for a list of transit RPOAs to use in outgoing Call Request packets.

Note These options cannot be configured with the **x25 map cmns** version of the **x25 map** command.

Default

None

Command Mode

Interface configuration

Usage Guidelines

The **broadcast** keyword simplifies the configuration of OSPF for nonbroadcast networks that will use X.25.

OSPF treats a nonbroadcast, multiaccess network such as X.25 much the same way it treats a broadcast network in that it requires selection of a designated router. In previous releases, this required manual assignment in the OSPF configuration using the **neighbor interface** router configuration command. When the **x25 map** command is included in the configuration with the **broadcast** keyword, there is no need to configure any neighbors manually. OSPF will now automatically run over the Frame Relay network as a broadcast network.

Note The OSPF broadcast mechanism assumes that IP class D addresses are never used for regular traffic over X.25.

Examples

The **broadcast** keyword directs any broadcasts sent through this interface to the specified X.121 address. The following example illustrates how to map IP address 131.08.2.5 to X.121 address 000000010300:

```
interface serial 0
x25 map ip 131.08.2.5 000000010300 broadcast
```

The following example illustrates how to set an RPOA name for use in the connection:

```
x25 rpoa green_list 23 35 36
interface serial 0
x25 facility rpoa green_list
x25 map ip 131.108.170.26 10 rpoa green_list
```

The following example shows how to add a network user identifier (NUI) to the address map:

```
interface serial 0
x25 map IP 131.108.174.32 2 nudata “Network User ID 35”
```

Strings can be quoted, but quotes are not required unless embedded blanks are present.

Related Commands

x25 map bridge
x25 map cmns
x25 map compressedtcp

x25 map bridge

Use the **x25 map bridge** interface configuration command to configure bridging over X.25. The command specifies Internet-to-X.121 address mapping.

x25 map bridge *X.121-address* **broadcast** [*options-keywords*]

Syntax Description

X.121-address	The X.121 address.
broadcast	Required keyword for bridging X.25 frames.
options-keywords	(Optional.) Services that can be added to this map; see Table 1-13 earlier in this chapter for a list of supported services.

Default

None

Command Mode

Interface configuration

Example

The following example illustrates how to configure bridging of X.25 frames using a maximum of six VCs:

```
interface serial 1
x25 map bridge 000000010300 broadcast nvc 6
```

Related Command

x25 map

x25 map cmns

Use the **x25 map cmns** interface configuration command to map NSAP addresses to either MAC-layer addresses or X.121 addresses after enabling CMNS on a nonserial interface. To retract a mapping, use the **no x25 map cmns** command with the appropriate address arguments.

x25 map cmns *nsap mac-address*
no x25 map cmns *nsap mac-address*

x25 map cmns *nsap* [*X.121-address*]
no x25 map cmns *nsap* [*X.121-address*]

Syntax Description

nsap	NSAP address. The NSAP can be either the actual DTE NSAP address or the prefix of the NSAP address. The NSAP prefix is sufficient for a best match to route a call.
mac-address	MAC-level address.
X.121-address	(Optional.) X.121 address.

Default

None

Command Mode

Interface configuration

Usage Guidelines

The address arguments specify the NSAP address-to-MAC address or NSAP address-to-X.121 address mappings. A mapping to a MAC address is only valid on a non-serial interface. A mapping to an X.121 address is only valid on a serial interface.

Example

The following example shows how to switch traffic intended for any NSAP address with prefix 38.8261.17 to MAC address 000.0C02.5F56 over interface Ethernet 0:

```
interface ethernet 0
cmns enable
x25 map cmns 38.8261.17 000.0C02.5F56.
```

Related Commands

cmns enable
x25 map

x25 map compressedtcp

Use the **x25 map compressedtcp** interface configuration command to map compressed TCP traffic to X.121 addresses. The **no x25 map compressedtcp** command deletes a TCP header compression map for the link.

x25 map compressedtcp *ip-address X.121-address* [*options*]
no x25 map compressedtcp *ip-address X.121-address*

Syntax Description

ip-address	The IP address.
X.121-address	The X.121 address.
options	(Optional.) The same options as those for the **x25 map** command described in Table 1-13.

Default

None

Command Mode

Interface configuration

Usage Guidelines

TCP header compression is supported over X.25 links. The implementation of compressed TCP over X.25 uses a virtual circuit (VC) to pass the compressed packets. The noncompressed packets use separate VCs. The NVC map option cannot be used for TCP header compression, as only one VC can carry compressed TCP header traffic to a given host.

Example

The following example establishes packet compression on interface serial 4:

```
interface serial 4
ip tcp header-compression
x25 map compressedtcp 131.108.2.5 000000010300
```

Related Commands

ip tcp header-compression
x25 map

x25 modulo

Use the **x25 modulo** interface configuration command to set the window modulus).

x25 modulo *modulus*

Syntax Description

modulus	Either 8 or 128. The value of the modulo parameter must agree with that of the device on the other end of the X.25 link.

Default

8

Command Mode

Interface configuration

Usage Guidelines

X.25 supports flow control with a sliding window sequence count. The window counter restarts at zero upon reaching the upper limit, which is called the *window modulus*. Modulo 128 operation is also referred to as extended packet sequence numbering, which allows larger packet windows.

Example

The following example illustrates how to set the window modulus to 128:

```
interface serial 0
x25 modulo 128
```

Related Commands

x25 win
x25 wout
x25 facility windowsize

x25 nvc

Use the **x25 nvc** interface configuration command to specify the maximum number of switched virtual circuits (SVCs) that a protocol can have open simultaneously to one host. To increase throughput across networks, you can establish up to eight switched virtual circuits to a host protocol.

x25 nvc *count*

Syntax Description

count	Circuit count from 1 to 8. A maximum of eight VCs can be configured for each protocol/host pair. Protocols that do not tolerate out-of-order delivery, such as encapsulated TCP header compression, will only use one virtual circuit despite this value.

Default

1

Command Mode

Interface configuration

Usage Guidelines

When the windows and output queues of all existing connections to a host are full, a new virtual circuit will be opened to the designated circuit count. If a new connection cannot be opened, the data is dropped.

Note The *count* value specified for **x25 nvc** affects the default value for the number of SVCs. It does not affect the **nvc** option for any **x25 map** commands that are configured.

Example

The following example illustrates how to set the default maximum number of switched virtual circuits that can be open simultaneously to 4:

```
interface serial 0
x25 nvc 4
```

x25 ops

Use the **x25 ops** interface configuration command to set the interface default maximum output packet size to match that of the network.

x25 ops *bytes*

Syntax Description

bytes	Byte count that is one of the following: 16, 32, 64, 128, 256, 512, 1024, 2048, or 4096.

Default

128 bytes

Command Mode

Interface configuration

Usage Guidelines

X.25 networks use maximum output packet sizes set by the network administration. Larger packet sizes are better because smaller packets require more overhead processing. To send a packet larger than the X.25 packet size over an X.25 virtual circuit, a router must break the packet into two or more X.25 packets with the M-bit ("more data" bit) set. The receiving device collects all packets with the M-bit set and reassembles them.

Note Set the **x25 ips** and **x25 ops** commands to the same value unless your network supports asymmetry between input and output packets.

Example

The following example shows how to set the default maximum packet sizes to 512:

```
interface serial 1
x25 ips 512
x25 ops 512
```

Related Command

x25 ips

x25 pvc (encapsulating)

Use the encapsulating version of the **x25 pvc** interface configuration command to establish an encapsulation permanent virtual circuit (PVC). To delete the PVC, use the **no x25 pvc** command with the appropriate channel number, protocol keyword, and protocol address.

x25 pvc *circuit protocol-keyword protocol-address* [*option*]
no x25 pvc *circuit protocol-keyword protocol-address*

Syntax Description

circuit	Virtual-circuit channel number which must be less than the virtual circuits assigned to the switched virtual circuits (SVCs).
protocol-keyword	Protocol type. Supported protocols are listed in Table 1-14.
protocol-address	Address of the host at the other end of the PVC.
option	(Optional.) PVC's flow control parameters if they differ from the interface defaults. The *option* arguments add certain features to the mapping specified and can be either of the options listed in Table 1-15.

Table 1-14 Protocols Supported by X.25 PVCs

Keyword	Protocol
ip	IP
decnet	DECnet
xns	XNS
novell	Novell IPX
appletalk	AppleTalk
vines	VINES
apollo	Apollo Domain
bridge	Bridging
clns	OSI Connectionless Network Service
compressedtcp	TCP header compression

Table 1-15 PVC Options

Option	Description
packetsize *in-size out-size*	Maximum input packet size (*in-size*) and output packet size (*out-size*) for the PVC. Both values must be one of the following values: 16, 32, 64, 128, 256, 512, 1024, 2048, or 4096.
windowsize *in-size out-size*	Packet count for input window (*in-size*) and output window (*out-size*) for the PVC. Both values should be the same, must be in the range 1 to 127, and must not be greater than or equal to the value set for the **x25 modulo** command.

Default

None; the PVC window and maximum packet sizes default to the map values or the interface default values.

Command Mode

Interface configuration

Usage Guidelines

PVCs are not supported for ISO CMNS.

You must specify the required network protocol-to-X.121 address mapping with an **x25 map** command before you can set up a PVC.

Note When configuring X.25 to use a PVC, you must ensure that no traffic is sent toward a remote terminal server between the time the **x25 map** command is issued and the time that **x25 pvc** command is issued. Otherwise, the local system will create a switched virtual circuit (SVC), and then the **x25 pvc** command will not be allowed.

Map entries with the **broadcast** attribute are particularly likely to get traffic, due to routing protocol traffic. The simplest way to ensure that traffic is not sent while configuring an interface to use a PVC is to shut down the interface while configuring it for PVC support.

Example

The following example shows how to establish a PVC on a channel with a VINES host attached:

```
interface serial 0
x25 map vines 60002A2D:0001 11110001
x25 pvc 2 vines 60002A2D:0001
```

Related Command

x25 map

x25 pvc (switched)

Use the switched version of the **x25 pvc** interface configuration command to configure a switched permanent virtual circuit (PVC) for a given interface.

x25 pvc *pvc-number1* **interface** *interface-name* **pvc** *pvc-number2* [*option*]

Syntax Description

pvc-number1	PVC number that will be used on the local interface (as defined by the primary interface command).
interface	Required keyword to specify an interface.
interface-name	Remote interface type and unit number (serial 0, for example).
pvc	Required keyword to specify a switched PVC.
pvc-number2	Number that will be used on the remote interface.
option	(Optional.) Adds certain features to the mapping specified; can be either option listed in Table 1-16.

Table 1-16 Switched PVC Options

Option	Description
packetsize *in-size out-size*	Maximum input packet size (*in-size*) and output packet size (*out-size*) for the PVC. Both values must be one of the following values: 16, 32, 64, 128, 256, 512, 1024, 2048, or 4096.
windowsize *in-size out-size*	Packet count for input window (*in-size*) and output window (*out-size*) for the PVC. Both values should be the same, must be in the range 1 to 127, and must not be greater than the value set for the **x25 modulo** command.

Default

None; the PVC window and maximum packet sizes default to the interface default values.

Command Mode

Interface configuration

Usage Guidelines

You can configure X.25 PVCs in the X.25 switching software. This means that DTEs that require permanent circuits can be connected to the router acting as an X.25 switch and have a properly functioning connection. X.25 RESETs will be sent to indicate when the circuit comes up or goes down.

PVC circuit numbers must come before (that is, be numerically smaller than the circuit numbers allocated to any SVC range.

Example

The following example configures a PVC connected between two serial interfaces on the same router. In this type of interconnection configuration, the alternate interface must be specified along with the PVC number on that interface. To make a working PVC connection, two commands must be specified, each pointing to the other as this example illustrates.

```
interface serial 0
encapsulation x25
x25 ltc 5
x25 pvc 1 interface serial 1 pvc 1
interface serial 1
encapsulation x25
x25 ltc 5
x25 pvc 1 interface serial 0 pvc 1
```

x25 pvc (tunnel)

Use the tunnel version of the **x25 pvc** interface configuration command to connect two PVCs across a TCP/IP LAN.

x25 pvc *pvc-number1* **tunnel** *ip-address* **interface serial** *string* **pvc** *pvc-number2* [*option*s]

Syntax Description

pvc-number1	PVC number of the connecting device.
tunnel	Indicates two PVCs will be connected across a TCP/IP LAN.
ip-address	IP address of the router to which you are connecting.
interface serial	Indicates the interface is serial.
string	Serial interface specification that accepts either a number or a string in model 7000 format (number/number) to denote the serial interface.
pvc	Indicates a PVC.
pvc-number2	Remote PVC number on the target interface.
options	(Optional.) Adds certain features for the connection; can be either option listed in Table 1-17.

Table 1-17 X.25 PVC Tunnel Options

Option	Description
packetsize *in-size out-size*	Maximum input packet size (*in-size*) and output packet size (*out-size*) for the PVC. Both values must be one of the following values: 16, 32, 64, 128, 256, 512, 1024, 2048, or 4096.
windowsize *in-size out-size*	Packet count for input window (*in-size*) and output window (*out-size*) for the PVC. Both values should be the same, must be in the range 1 to 127, and must not be greater than or equal to the value set for the **x25 modulo** command.

Default

None; the PVC window and packet sizes default to the interface default values.

Command Mode

Interface configuration

Usage Guidelines

Use the PVC tunnel commands to tell the router to what the far end of the PVC is connected. The incoming and outgoing packet sizes and window sizes must match the remote PVC outgoing and incoming sizes.

Example

The following example illustrates how to enter the parameters for one side of a connection destined for a router platform other than the model 7000:

```
interface serial 0
x25 pvc 1 tunnel 131.108.1.2 interface serial 1 pvc 2
```

The following example illustrates how to enter the parameters for one side of a connection destined for a model 7000:

```
interface serial 0
x25 pvc 1 tunnel 131.108.1.2 interface serial 1/1 pvc 2
```

See the section "LAPB and X.25 Configuration Examples" in the *Router Products Configuration Guide* for more complete configuration examples.

x25 remote-red

Use the **x25 remote-red** interface configuration command to set up the table that lists the BFE nodes (host or gateways) to which the router will send packets.

x25 remote-red *host-ip-address* **remote-black** *blacker-ip-address*

Syntax Description

host-ip-address	IP address of the host or a router that the packets are being sent to.
remote-black	Delimits the addresses for the table being built.
blacker-ip-address	IP address of the remote BFE device in front of the host to which the packet is being sent.

Default

None

Command Mode

Interface configuration

Usage Guidelines

The table that results from this command provides the address translation information the router sends to the BFE when it is in emergency mode.

Example

The following example sets up a short table of BFE nodes for interface serial 0:

```
interface serial 0
x25 remote-red 131.108.9.3 remote-black 131.108.9.13
x25 remote-red 192.108.15.1 remote-black 192.108.15.26
```

Related Commands

x25 bfe-decision
show x25 remote-red

x25 route

Use the **x25 route** global configuration command to create an entry in the X.25 routing table. Enter the **no x25 route** command with the appropriate arguments and keywords to remove an entry from the table.

x25 route [**#** *position*] *X.121-address* [**cud** *pattern*] **interface** *interface number*
no x25 route [**#** *position*] *X.121-address* [**cud** *pattern*] **interface** *interface number*

x25 route [**#** *position*] *X.121-address* [**cud** *pattern*] **ip** *ip-address* [*ip-address2 ... ip-address6*]
no x25 route [**#** *position*] *X.121-address* [**cud** *pattern*] **ip** *ip-address*

x25 route [**#** *position*] *X.121-address* [**cud** *pattern*] **alias** *interface number*
no x25 route [**#** *position*] *X.121-address* [**cud** *pattern*] **alias** *interface number*

x25 route [*# position*] *X.121-address* [**substitute-source** *rewrite-pattern*]
[**substitute-dest** *rewrite-pattern*] [**cud** *pattern*] **interface** *interface number*
no x25 route [*# position*] *X.121-pattern* [**substitute-source** *rewrite-pattern*]
[**substitute-dest** *rewrite-pattern*] [**cud** *pattern*] **interface** *interface number*

Note For typographical reasons, the last two commands are shown on two lines. When using the optional keywords in this variation of the **x25 route** command, the **substitute-source** keyword must precede the **substitute-dest** keyword, and both must precede the **cud** keyword. The entire command must be on one line.

Syntax Description

# position	(Optional.) A pound sign (#) followed by a number to designate a positional parameter at which to insert the new entry. If no *position* parameter is given, the entry is appended to the end of the routing table.
X.121-address	The called X.121 address pattern. This argument can be either an actual X.121 destination address or a regular expression such as 1111*, representing a group of X.121 addresses.
cud *pattern*	(Optional.) Call User Data pattern which is specified as a printable ASCII string. The Call User Data field may be present in a call packet and is commonly 4 bytes long.
interface *interface number*	Specifies the destination interface (type followed by the unit or port number); for example, **interface** Ethernet 0.
ip *ip-address*	Specifies an IP address of the network interface or DTE for connections routed through a LAN. Optionally, up to five alternate IP addresses can be listed and each in turn will be tried in the event that the first destination fails, thus allowing alternate routes and decreasing the likelihood of failure.

alias *interface number*	Configures an interface alias. Specify the interface type followed by the unit or port number of the interface. Encapsulation calls are normally accepted when the destination address is that of the interface (or the zero-length X.121 address). Aliases allow the specified interface to accept calls with other destination addresses.
substitute-source *rewrite-pattern*	(Optional.) Specifies the calling X.121 address to replace in locally routed X.25 calls. The backslash (\) character is treated specially in the argument *rewrite-pattern*; it indicates that the digit immediately following it selects a portion of the original called address to be inserted in the new called address. The characters \0 are replaced with the entire original address. The characters \1 through \9 are replaced with the strings that matched the first through ninth parenthesized parts of *X.121-pattern.* See Table 1-18 and Table 1-19 for summaries of pattern and character matching, respectively.
substitute-dest *rewrite-pattern*	(Optional.) Specifies the called X.121 address to replace in locally routed X.25 calls. (For backwards compatibility, the **substitute** keyword will be accepted as **substitute-dest** and written to nonvolatile memory in the new format.) The backslash (\) character is treated specially in the argument *rewrite-pattern*; it indicates that the digit immediately following it selects a portion of the original called address to be inserted in the new called address. The characters \0 are replaced with the entire original address. The characters \1 through \9 are replaced with the strings that matched the first through ninth parenthesized parts of *X.121-pattern.* See Table 1-18 and Table 1-19 for summaries of pattern and character matching, respectively.

Default

None

Command Mode

Global configuration

Usage Guidelines

The X.25 routing table is consulted when an incoming call is received that should be forwarded to its destination. Two fields are used to determine the route: the called X.121 network interface address (or destination host address), and the X.25 packet's Called User Data (CUD) field. When the destination address and the CUD of the incoming packet fit the X.121 and CUD patterns in the routing table, the call is forwarded.

The order in which X.25 routing table entries are specified is significant; the list is scanned for the first match. The optional argument *# position* (# followed by a number) designates the line number at which to insert the new router. If no *position* parameter is given, the entry is appended to the end of the routing table.

The argument *X.121-address* can be either an actual X.121 destination address or a regular expression such as 1111*, representing a group of X.121 addresses.

The optional Call User Data pattern can be specified as a printable ASCII string. Both the X.121 address and Call User Data can be written using UNIX-style, regular expressions. The Call User Data field is matched against any data in the call, which is commonly 4 bytes long.

X.121 address and Call User Data are used to find a matching routing table entry. The list is scanned from the beginning to the end and each entry is pattern-matched with the incoming X.121 address and Call User Data to the X.121 and Call User Data in the routing table entry. If the pattern match for both entries succeeds, then that route is used. If the incoming call does not have any Call User Data, then only the X.121 address pattern match need succeed with an entry that only contains an X.121 pattern. If Call User Data is present, and while scanning, a route is found that matches the X.121 address but does not have a Call User Data pattern, then that route is used when an exact match cannot be found. Regular expressions are used to allow pattern-matching operations on the X.121 addresses and Call User Data. A common operation is to do prefix matching on the X.121 DNIC field and route accordingly. For example, the pattern ^3306 will match all X.121 addresses with a DNIC of 3306. The caret (^) is a special regular expression character that anchors the match at the beginning of the pattern.

If a matching route is found, the incoming call is forwarded to the *next hop* depending on the routing entry. If no match is found, the call is cleared. If the route specifies a serial interface running X.25, the router will attempt to forward the call over that interface. If the interface is not operational the remaining routes will be checked for forwarding to an operational interface. If the interface is operational but out of available virtual circuits, the call will be cleared. Otherwise, the expected Clear Request or Call Accepted message will be forwarded back toward the originator. The “null 0” interface can be used as the destination to refuse calls to specific locations. A call cannot be forwarded out the interface it arrived on.

If the matching route specifies an IP address, a TCP connection will be established to port 1998 at the specified IP address, which must be another Cisco router. The Call Request packet will be forwarded to the remote router, where it will be processed in a similar fashion. If a routing table entry is not present or the serial interface is down or out of virtual circuits, a Clear Request will be sent back and the TCP connection will be closed. Otherwise, the call will be forwarded over the serial interface and the expected Clear Request or Call Accepted packet will be returned. Incoming calls received via TCP connections that match a routing entry specifying an IP address will be cleared. This restriction prevents Cisco routers from establishing a TCP connection to another router that would establish yet another TCP connection. A router must always connect to the remote router with the destination DTE directly attached.

See Table 1-18 and Table 1-19 for summaries of pattern and character matching. A more complete description of the pattern-matching characters is found in Appendix C.

Note that address substitution is only performed on routes to an interface. When running X.25 over IP, address substitution can be performed on the destination IP system if the destination system is configured with the appropriate X.25 routing commands.

Use the **show x25 route** command to display the X.25 routing table. The interface routes will show up after any routes used for translation commands. Because the interface routes are expected to be less specific, they should come last. This is done automatically.

Table 1-18 Pattern Matching

Pattern	Description
\0	Replaces the entire original address.
\1...9	Replaces strings that match the first through ninth parenthesized part of the X.121 address.
*	Matches 0 or more sequences of the regular expressions.
+	Matches 1 or more sequences of the regular expressions.
?	Matches the regular expression of the null string.

Table 1-19 Character Matching

Character	Description
^	Matches the null string at the beginning of the input string.
$	Matches the null string at the end of the input string.
char	Matches *char*.
.	Matches any single character.

Examples

The following example illustrates how to use regular expression pattern matching characters to match just the initial portion of the complete X.25 address:

```
x25 route ^3107 interface serial 0
```

In the following example, if a call comes in on interface serial 0 and matches any X.121-address pattern, the call will be accepted for encapsulating traffic configured for the interface using x25 map commands:

```
x25 route .* alias serial 0
```

In the following example, a call will be accepted if destined for either the VAX X.121 address or the address given in the **x25 address** interface command:

```
x25 route vax-x121-address alias serial 0
```

The following example illustrates how to configure alternate IP addresses for the routing table. In the event the first address listed is not available, the next address is tried, and so on until a connection is made:

```
x25 route ^3106 ip 131.08.2.5  131.08.7.10  131.08.7.9
```

Related Command

show x25 route

x25 routing

Use the **x25 routing** global configuration command to enable X.25 switching or tunneling. The command **no x25 routing** disables the forwarding of X.25 calls.

x25 routing [USE-TCP-IF-DEFS]
no x25 routing

Syntax Description

USE-TCP-IF-DEFS	(Optional.) May be used to modify the acceptance of calls received over TCP.

Default

Disabled

Command Mode

Global configuration

Usage Guidelines

The **x25 routing** command enables local switching or tunneling, which is used for remote switching to allow routing X.25 traffic through a LAN. X.25 calls will not be forwarded until this command is issued. The **USE-TCP-IF-DEFS** flag may be needed when receiving remotely routed calls from Cisco routers using older software versions. Normally calls received over a TCP connection (remote routing reception) will have the flow control parameters (window sizes and maximum packet sizes) indicated, because proper operation of routed X.25 requires that these values match at both ends of the connection. Some previous versions of our software, however, do not ensure that these values are present in al calls. In this case the router normally forces universally acceptable flow control values (window sizes of 2 and maximum packet of 128) on the connection. Because some equipment disallows modification of the flow control values in the call confirm, the **USE-TCP-IF-DEFS** will cause the router to use the default flow control values of the outgoing interface and indicate the resulting values in the call confirm. This modified behavior may allow easier migration to newer versions of the router code.

Example

The following example illustrates how to enable X.25 switching:

```
x25 routing
```

x25 rpoa

Use the **x25 rpoa** global configuration command to specify a sequence of packet network carriers. The **no x25 rpoa** command removes the specified name.

x25 rpoa *name number*
no x25 rpoa *name*

Syntax Description

name	Recognized Private Operating Agency (RPOA), which must be unique with respect to all other RPOA names. It is used in the **x25 facility** and **x25 map** interface configuration commands.
number	A sequence of 1 or more numbers used to describe an RPOA; up to 10 numbers are accepted.

Default

None

Command Mode

Global configuration

Usage Guidelines

This command specifies a list of transit RPOAs to use, referenced by name.

Example

The following example illustrates how to set an RPOA name and then send the list via the X.25 user facilities:

```
x25 rpoa green_list 23 35 36
interface serial 0
x25 facility rpoa green_list
x25 map ip 131.108.170.26 10 rpoa green_list
```

Related Commands

x25 facility
x25 map

x25 suppress-called-address

Use the **x25 suppress-called-address** interface configuration command to omit the destination address in outgoing calls. Use the **no x25 suppress-called-address** command to reset this command to the default state.

x25 suppress-called-address
no x25 suppress-called-address

Syntax Description

This command has no arguments or keywords.

Default

The called address is sent by default.

Command Mode

Interface configuration

Usage Guidelines

This command omits the called (destination) X.121 address in Call Request packets and is required for networks that expect only subaddresses in the called address field.

Example

The following example illustrates how to suppress or omit the called address in Call Request packets:

```
interface serial 0
x25 suppress-called-address
```

x25 suppress-calling-address

Use the **x25 suppress-calling-address** interface configuration command to omit the source address in outgoing calls. Use the **no x25 suppress-calling-address** command to reset this command to the default state.

x25 suppress-calling-address
no x25 suppress-calling-address

Syntax Description

This command has no arguments or keywords.

Default

The calling address is sent by default.

Command Mode

Interface configuration

Usage Guidelines

This command omits the calling (source) X.121 address in Call Request packets and is required for networks that expect only subaddresses in the calling address field.

Example

The following example illustrates how to suppress or omit the calling address in Call Request packets:

```
interface serial 0
x25 suppress-calling-address
```

x25 t10

Use the **x25 t10** interface configuration command to set the value of the Restart Indication retransmission timer (T10) on DCE devices.

x25 t10 *seconds*

Syntax Description

seconds	Amount of time in seconds.

Default

60 seconds

Command Mode

Interface configuration

Example

The following example sets the T10 timer to 30 seconds:

```
interface serial 0
x25 t10 30
```

x25 t11

Use the **x25 t11** interface configuration command to set the value of the Incoming Call timer (T11) on DCE devices.

x25 t11 *seconds*

Syntax Description

seconds	Amount of time in seconds.

Default

180 seconds

Command Mode

Interface configuration

Example

The following example sets the T11 timer to 90 seconds:

```
interface serial 0
x25 t11 90
```

x25 t12

Use the **x25 t12** interface configuration command to set the value of the Reset Indication retransmission timer (T12) on DCE devices.

x25 t12 *seconds*

Syntax Description

seconds	Amount of time in seconds.

Default

60 seconds

Command Mode

Interface configuration

Example

The following example sets the T12 timer to 30 seconds:

```
interface serial 0
x25 t12 30
```

x25 t13

Use the **x25 t13** interface configuration command to set the value of the Clear Indication retransmission timer (T13) on DCE devices.

x25 t13 *seconds*

Syntax Description

seconds	Amount of time in seconds.

Default

60 seconds

Command Mode

Interface configuration

Example

The following example sets the T13 timer to 30 seconds:

```
interface serial 0
x25 t13 30
```

x25 t20

Use the **x25 t20** interface configuration command to set the value of the Restart Request retransmission timer (T20) on DTE devices.

x25 t20 *seconds*

Syntax Description

seconds	Amount of time in seconds.

Default

180 seconds

Command Mode

Interface configuration

Example

The following example sets the T20 timer to 90 seconds:

```
interface serial 0
x25 t20 90
```

x25 t21

Use the **x25 t21** interface configuration command to set the value of the Call Request timer (T21) on DTE devices.

x25 t21 *seconds*

Syntax Description

seconds	Amount of time in seconds.

Default

200 seconds

Command Mode

Interface configuration

Example

The following example sets the T21 timer to 100 seconds:

```
interface serial 0
x25 t21 100
```

x25 t22

Use the **x25 t22** interface configuration command to set the value of the Reset Request retransmission timer (T22) on DTE devices.

x25 t22 *seconds*

Syntax Description

seconds	Amount of time in seconds.

Default

180 seconds

Command Mode

Interface configuration

Example

The following example sets the T22 timer to 90 seconds:

```
interface serial 0
x25 t22 90
```

x25 t23

Use the **x25 t23** interface configuration command to set the value of the Clear Request retransmission timer (T23) on DTE devices.

x25 t23 *seconds*

Syntax Description

seconds	Amount of time in seconds.

Default

180 seconds

Command Mode

Interface configuration

Example

The following example sets the T23 timer to 90 seconds:

```
interface serial 0
x25 t23 90
```

x25 th

Use the **x25 th** interface configuration command to set the data packet acknowledgment threshold. When set, this parameter will instruct the router to send acknowledgment packets when it is not busy sending other packets, even if the number of input packets has not reached the input window size count. This command improves line responsiveness at the expense of bandwidth.

x25 th *delay-count*

Syntax Description

delay-count	Value between zero and the input window size. A value of 1 sends one Receiver Ready acknowledgment per packet at all times.

Default

0 (which disables the acknowledgment threshold)

Command Mode

Interface configuration

Usage Guidelines

The router sends an acknowledgment packet when the number of input packets reaches the count you specify, providing there are no other packets to send. For example, if you specify a count of 1, the router will send an acknowledgment per input packet if unable to "piggyback" the acknowledgment of an outgoing data packet.

Example

The following example sends an explicit Receiver Ready acknowledgment when it has received five data packets that it has not acknowledged:

```
interface serial 1
x25 th 5
```

Related Commands

x25 win
x25 wout

x25 use-source-address

Use the **x25 use-source-address** interface configuration command to over-ride the X.121 addresses of outgoing calls forwarded over a specific interface. Use the **no x25 use-source-address** command to prevent updating the source addresses of outgoing calls.

x25 use-source-address
no x25 use-source-address

Syntax Description

This command has no arguments or keywords.

Default

Disabled

Command Mode

Interface configuration

Usage Guidelines

Some X.25 calls, when forwarded by the X.25 switching support, need the calling (source) X.121 address updated to that of the outgoing interface. This is necessary when forwarding calls from private data networks to public data networks.

Example

The following example shows how to prevent updating the source addresses of outgoing X.25 calls on interface serial 0 once calls have been forwarded:

```
interface serial 0
no x25 use-source-address
```

x25 win

Use the **x25 win** interface configuration command to change the default incoming window size to match that of the network.

x25 win *packets*

Syntax Description

packets	Packet count that can range from 1 to one less than the window modulus.

Default

2 packets

Command Mode

Interface configuration

Usage Guidelines

This command determines the default number of packets a VC can receive before sending an X.25 acknowledgment. To maintain high bandwidth utilization, assign this limit the largest number that the network allows.

Note Set **x25 win** and **x25 wout** to the same value unless your network supports asymmetric input and output window sizes.

Example

The following example specifies that five packets may be received before sending an X.25 acknowledgment:

```
interface serial 1
x25 win 5
```

Related Commands

x25 modulo
x25 th
x25 wout

x25 wout

Use the **x25 wout** interface configuration command to change the default outgoing window size to match that of the network.

x25 wout *packets*

Syntax Description

packets	Packet count that can range from 1 to the window modulus.

Default

2 packets

Command Mode

Interface configuration

Usage Guidelines

This command determines the default number of packets a VC can send before waiting for an X.25 acknowledgment. To maintain high bandwidth utilization, assign this limit the largest number that the network allows.

Note Set **x25 win** and **x25 wout** to the same value unless your network supports asymmetric input and output window sizes.

Example

The following example specifies a default limit of five for the number of outstanding unacknowledged packets for VCs:

```
interface serial 1
x25 wout 5
```

Related Commands

x25 modulo
x25 th
x25 win