X.25 and LAPB Commands

Use the commands in this chapter to configure Link Access Procedure, Balanced (LAPB), X.25 services (X.25, XOT and CMNS), Defense Data Network (DDN) X.25, and the Blacker Front End (BFE). X.25 provides remote terminal access; encapsulation for the IP, DECnet, XNS, ISO CLNS, AppleTalk, Novell IPX, Banyan VINES, and Apollo Domain protocols; and bridging.

X.25 virtual circuits can also be switched as follows:

- Between interfaces—for local routing
- Between two routers—for remote routing using X.25-over-TCP (XOT)
- Over nonserial media—for Connection-Mode Network Service (CMNS).

To translate between X.25 and another protocol, refer to the "Protocol Translation Commands" chapter in the *Dial Solutions Command Reference*.

For X.25 and LAPB configuration information and examples, refer to the "Configuring X.25 and LAPB" chapter in the *Wide-Area Networking Configuration Guide*.

access-class

To configure an incoming access class on virtual terminals, use the **access-class** line configuration command.

access-class *access-list-number* **in**

Syntax Description

access-list-number	An integer between 1 and 199 that you select for the access list.
in	Restricts incoming connections between a particular access server and the addresses in the access list.

Default

No incoming access class is defined.

Command Mode

Line configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.3.

The access list number is used for both incoming Transmission Control Protocol (TCP) access and incoming packet assembler/disassembler (PAD) access.

In the case of TCP access, the access server uses the Internet Protocol (IP) access list defined with the **access-list** command.

For incoming PAD connections, the same numbered X.29 access list is referenced. If you only want to have access restrictions on one of the protocols, you can create an access list that permits all addresses for the other protocol.

Example

The following example configures an incoming access class on virtual terminal line 4:

```
line vty 4
 access-class 4 in
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

access-list
line vty
x29 access-list

bfe

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**, use the **bfe** EXEC command.

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

Syntax Description

enter	Causes the Cisco IOS software to send a special address translation packet that includes an **enter emergency mode** command to the Blacker Front End (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 Cisco IOS software to the BFE when the BFE is in emergency mode.
type	Interface type.
number	Interface number.

Command Mode

EXEC

Usage Guidelines

This command first appeared in Cisco IOS Release 10.3.

Example

The following example enables an interface to participate in BFE emergency mode:

```
bfe enter serial 0
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

encapsulation x25 bfe
x25 bfe-decision
x25 bfe-emergency

clear x25

Use the **clear x25** privileged EXEC command to restart an X.25 or CMNS service, to clear an SVC, or to reset a PVC.

clear x25 {**serial** *number* | *cmns-interface mac-address*} [*vc-number*]

Syntax Description

serial *number*	Local serial interface being used for X.25 service.
cmns-interface mac-address	Local CMNS interface (an Ethernet, Token Ring, or FDDI interface) and MAC address of the remote device; this information identifies a CMNS service.
vc-number	(Optional) SVC or PVC number, in the range 1 to 4095. If specified, the SVC is cleared or the PVC is reset. If not specified, the X.25 or CMNS service is restarted.

Command Mode

Privileged EXEC

Usage Guidelines

This command first appeared in Cisco IOS Release 11.2 F. (This command replaces the **clear x25-vc** command, which first appeared in Cisco IOS Release 8.3.)

This command form is used to disrupt service forcibly on an individual circuit or on all circuits using a specific X.25 service or CMNS service.

If this command is used without the *vc-number* value, a restart event is initiated, which implicitly clears all SVCs and resets all PVCs.

Examples

The following command clears the SVC or resets the PVC specified:

```
clear x25 serial 0 1
```

The following command forces an X.25 restart, which implicitly clears all SVCs and resets all PVCs using the interface:

```
clear x25 serial 0
```

The following command restarts the specified CMNS service (if active), which implicitly clears all SVCs using the service:

```
clear x25 ethernet 0 0001.0002.0003
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

clear xot
show x25 services

clear x25-vc

This command is replaced by the **clear x25** command.

clear xot

To clear an XOT SVC or reset an XOT PVC, use the **clear xot** EXEC command.

clear xot remote *ip-address port* **local** *ip-address port*

Syntax Description

remote *ip-address port*	Remote IP address and port number of an XOT connection ID.
local *ip-address port*	Local IP address and port number of an XOT connection ID.

Command Mode

EXEC

Usage Guidelines

This command first appeared in Cisco IOS Release 11.2 F.

Each SVC or PVC supported by the XOT service uses a TCP connection to communicate X.25 packets. A TCP connection is uniquely identified by the data quartet: remote IP address, remote TCP port, local IP address, and local TCP port. This command form is used to forcibly disrupt service on an individual XOT circuit.

XOT connections are sent to TCP port 1998, so XOT connections originated by the router will have that remote port number, and connections received by the router will have that local port number.

Example

The following command will clear or reset, respectively, the SVC or PVC using the TCP connection identified:

```
clear xot remote 1.1.1.1 1998 local 2.2.2.2 2000
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

show x25 services

cmns enable

To enable the Connection-Mode Network Service (CMNS) on a nonserial interface, use the **cmns enable** interface configuration command. To disable this capability, use the **no** form of this command.

cmns enable
no cmns enable

Syntax Description

This command has no arguments or keywords.

Default

Each nonserial interface must be explicitly configured to use CMNS.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

After this command is processed on the LAN interfaces—Ethernet, Fiber Distributed Data Interface (FDDI), and Token Ring—all the X.25-related interface configuration commands are made available.

Example

The following example enables CMNS on Ethernet interface 0:

```
interface ethernet 0
 cmns enable
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 route

encapsulation lapb

To exchange datagrams over a serial interface using LAPB encapsulation, use the **encapsulation lapb** interface configuration command.

encapsulation lapb [**dte** | **dce**] [**multi** | *protocol*]

Syntax Description

dte	(Optional) Specifies operation as a data terminal equipment (DTE) device. This is the default LAPB mode.
dce	(Optional) Specifies operation as a data communications equipment (DCE) device.
multi	(Optional) Specifies use of multiple local-area network (LAN) protocols to be carried on the LAPB line.
protocol	(Optional) A single protocol to be carried on the LAPB line. A single protocol can be one of the following: **apollo**, **appletalk**, **clns** (ISO CLNS), **decnet**, **ip**, **ipx** (Novell IPX), **vines**, and **xns**. IP is the default protocol.

Defaults

The default serial encapsulation is High-Level Data Link Control (HDLC). You must explicitly configure a LAPB encapsulation method.

DTE operation is the default LAPB mode. IP is the default protocol.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.
The **dte**, **dce**, **multi** and *protocol* argument forms first appeared in Cisco IOS Release 10.3

LAPB encapsulations are appropriate only for private connections, where you have complete control over both ends of the link. Connections to X.25 networks should use an X.25 encapsulation configuration, which operates the X.25 Layer 3 protocol above a LAPB Layer 2.

One end of the link must be a logical DCE, and the other end a logical DTE. (This assignment is independent of the interface's hardware DTE or DCE identity.)

Both ends of the LAPB link must specify the same protocol encapsulation.

LAPB encapsulation is supported on serial lines configured for dial-on-demand routing (DDR). It can be configured on DDR synchronous serial and Integrated Services Digital Network (ISDN) interfaces and on DDR dialer rotary groups. It is not supported on asynchronous dialer interfaces.

A single-protocol LAPB encapsulation exchanges datagrams of the given protocol, each in a separate LAPB information frame. You must configure the interface with the protocol-specific parameters needed—for example, a link that carries IP traffic will have an IP address defined for the interface.

A multiprotocol LAPB encapsulation can exchange any or all of the protocols allowed for a LAPB interface. It exchanges datagrams, each in a separate LAPB information frame. Two bytes of protocol identification data precede the protocol data. You need to configure the interface with all the protocol-specific parameters needed for each protocol carried.

Beginning with Cisco IOS Release 11.0, *multiprotocol* LAPB encapsulation supports transparent bridging. This feature requires use of the **encapsulation lapb multi** command followed by the **bridge-group** command, which identifies the bridge group associated with multiprotocol LAPB encapsulation. This feature does *not* support use of the **encapsulation lapb** *protocol* command with a **bridge** keyword.

Beginning with Release 10.3, LAPB encapsulation supports the priority and custom queueing features.

Example

The following example sets the operating mode as DTE and specifies that AppleTalk protocol traffic will be carried on the LAPB line:

```
interface serial 1
 encapsulation lapb dte appletalk
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

bridge-group

encapsulation x25

To specify a serial interface's operation as an X.25 device, use the **encapsulation x25** interface configuration command.

encapsulation x25 [**dte** | **dce**] [**ddn** | **bfe**] | [**ietf**]

Syntax Description

dte	(Optional) Specifies operation as a DTE. This is the default X.25 mode.
dce	(Optional) Specifies operation as a DCE.
ddn	(Optional) Specifies DDN encapsulation on an interface using DDN X.25 Standard Service.
bfe	(Optional) Specifies BFE encapsulation on an interface attached to a BFE device.
ietf	(Optional) Specifies that the interface's datagram encapsulation defaults to use of the Internet Engineering Task Force (IETF) standard method, as defined by RFC 1356.

Defaults

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

DTE operation is the default X.25 mode. Cisco's traditional X.25 encapsulation method is the default.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0. The **dte**, **dce**, **ddn**, **bfe** and **ietf** keywords first appeared in Cisco IOS Release 10.3

One end of an X.25 link must be a logical DCE and the other end a logical DTE. (This assignment is independent of the interface's hardware DTE or DCE identity.) Typically, when connecting to a public data network (PDN), the customer equipment acts as the DTE and the PDN attachment acts as the DCE.

Cisco has long supported the encapsulation of a number of datagram protocols, using a standard means when available and a proprietary means when necessary. More recently the IETF adopted a standard, RFC 1356, for encapsulating most types of datagram traffic over X.25. X.25 interfaces use Cisco's traditional method unless explicitly configured for IETF operation; if the **ietf** keyword is specified, that standard is used unless Cisco's traditional method is explicitly configured. For details see the **x25 map** command.

You can configure a router attaching to the Defense Data Network (DDN) or to a Blacker Front End (BFE) device to use their respective algorithms to convert between IP and X.121 addresses by using the **ddn** or **bfe** option, respectively. An IP address must be assigned to the interface, from which the algorithm will generate the interface's X.121 address. For proper operation, this X.121 address must not be modified.

A router DDN attachment can operate as either a DTE or a DCE device. A BFE attachment can operate only as a DTE device. The **ietf** option is not available if either the **ddn** or **bfe** option is selected.

Example

The following example configures the interface for connection to a BFE device:

```
interface serial 0
 encapsulation x25 bfe
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 map

lapb interface-outage

To specify a period during which a link will remain connected, even if a brief hardware outage occurs, use the **lapb interface-outage** interface configuration command.

lapb interface-outage *milliseconds*

Syntax Description

milliseconds	Number of milliseconds a hardware outage can last without having the protocol disconnect the service. The default is 0 ms, which disables this feature.

Default

0 ms, which disables this feature.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

If a hardware outage lasts longer than the LAPB hardware outage period you select, normal protocol operations will occur. The link will be declared down and, when it is restored, a link setup will be initiated.

Example

The following example sets the interface outage period to 100 ms. The link remains connected for outages equal to or shorter than that period.

```
encapsulation lapb dte ip
lapb interface-outage 100
```

lapb k

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

lapb k *window-size*

Syntax Description

window-size	Frame count. It can be a value from 1 to the modulo size minus 1 (the maximum is 7 if the modulo size is 8; it is 127 if the modulo size is 128). The default is 7 frames.

Default

7 frames

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

If the window size is changed while the protocol is up, the new value takes effect only when the protocol is reset. You will be informed that the new value will not take effect immediately.

When using the LAPB modulo 128 mode (extended mode), you must increase the window parameter k to send a larger number of frames before acknowledgment is required. This increase is the basis for the router's ability to achieve greater throughput on high-speed links that have a low error rate.

This configured value must match the value configured in the peer X.25 switch. Nonmatching values will cause repeated LAPB reject (REJ) frames.

Example

The following example sets the LAPB window size (the k parameter) to 10 frames:

```
interface serial 0
 lapb modulo
 lapb k 10
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

lapb modulo

lapb modulo

To specify the LAPB basic (modulo 8) or extended (modulo 128) protocol mode, use the **lapb modulo** interface configuration command.

lapb modulo *modulus*

Syntax Description

modulus	Either 8 or 128. The value 8 specifies LAPB's basic mode; the value 128 specifies LAPB's extended mode. The default is 8.

Default

Modulo 8

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

The modulo parameter determines which of LAPB's two modes is to be used. The modulo values derive from the fact that basic mode numbers information frames between 0 and 7, whereas extended mode numbers them between 0 and 127. Basic mode is widely available and is sufficient for most links. Extended mode is an optional LAPB feature that may achieve greater throughput on high-speed links that have a low error rate.

The LAPB operating mode may be set on X.25 links as well as LAPB links. The X.25 modulo is independent of the LAPB layer modulo. Both ends of a link must use the same LAPB mode.

When using modulo 128 mode, you must increase the window parameter k to send a larger number of frames before acknowledgment is required. This increase is the basis for the router's ability to achieve greater throughput on high-speed links that have a low error rate.

If the modulo value is changed while the protocol is up, the new value takes effect only when the protocol is reset. You will be informed that the new value will not take effect immediately.

Example

The following example configures a high-speed X.25 link to use LAPB's extended mode:

```
interface serial 1
 encapsulation x25
 lapb modulo 128
 lapb k 40
 clock rate 2000000
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

lapb k

lapb n1

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

lapb n1 *bits*

Syntax Description

bits	Maximum number of bits in multiples of eight. The minimum and maximum range is dynamically set. Use the question mark (**?**) to view the range.

Defaults

The largest (maximum) value available for the particular interface is the default. The Cisco IOS software dynamically calculates N1 whenever you change the maximum transmission unit (MTU), the L2/L3 modulo, or compression on a LAPB interface.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Caution The LAPB N1 parameter provides little benefit beyond the interface MTU and can easily cause link failures if misconfigured. Cisco recommends that this parameter be left at its default value.

The Cisco IOS software uses the following formula to determine the minimum N1 value:

*(128 (default packet size) + LAPB overhead + X.25 overhead + 2 bytes of CRC) * 8*

The Cisco IOS software uses the following formula to determine for the maximum N1 value:

*(hardware MTU + LAPB overhead + X.25 overhead + 2 bytes of CRC) * 8*

LAPB overhead is 2 bytes for modulo 8 and 3 bytes for modulo 128.

X.25 overhead is 3 bytes for modulo 8 and 4 bytes for modulo 128.

You need not set N1 to an exact value to support a particular X.25 data packet size. The N1 parameter prevents the processing of any huge frames that result from a “jabbering” interface, an unlikely event.

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

You cannot set the N1 parameter to a value less than that required to support an X.25 data packet size of 128 bytes. All X.25 implementations must be able to support 128-byte data packets. Moreover, if you configure N1 to be less than 2104 bits, you receive a warning message that X.25 might have problems because some nondata packets can use up to 259 bytes.

You cannot set the N1 parameter to a value larger than the default unless the hardware MTU size is first increased.

The X.25 software accepts default packet sizes and calls that specify maximum packet sizes greater than those the LAPB layer supports, but negotiates 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 router so the call will not have a maximum packet size that exceeds the capability of either of the two interfaces involved.

Examples

The following example shows how to use the question mark (**?**) command to display the minimum and maximum N1 value. In this example, X.25 encapsulation has both the LAPB and X.25 modulo set to 8. Any violation of this N1 range results in an "Invalid input" error message.

```
router# interface serial 1
router(config)# lapb n1 ?

<1080-12056> LAPB N1 parameter (bits; multiple of 8)
```

The following example sets the N1 bits to 16440:

```
interface serial 0
 lapb n1 16440
 mtu 2048
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

mtu

lapb n2

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

lapb n2 *tries*

Syntax Description

tries	Transmission count. It can be a value from 1 to 255. The default is 20 transmissions**.**

Default

20 transmissions

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Example

The following example sets the N2 tries to 50:

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

lapb protocol

This command is obsolete. It has been replaced by the [*protocol* | **multi**] option of the **encapsulation lapb** command.

lapb t1

To set the retransmission timer period (the LAPB T1 parameter), use the **lapb t1** interface configuration command.

lapb t1 *milliseconds*

Syntax Description

milliseconds	Time in milliseconds. It can be a value from 1 to 64000. The default is 3000 ms.

Default

3000 ms

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

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 2000 ms:

```
interface serial 0
 lapb t1 2000
```

lapb t4

To set the T4 idle timer, after which the Cisco IOS software sends out a Poll packet to determine whether the link has suffered an unsignaled failure, use the **lapb t4** interface configuration command.

lapb t4 *seconds*

Syntax Description

seconds	Number of seconds between reception of the last frame and the transmission of the outgoing Poll. The default value is 0 seconds, which disables the T4 timer feature.

Default

0 seconds, which disables the T4 timer feature.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

Any nonzero T4 duration must be greater than T1, the LAPB retransmission timer period.

Example

The following example will poll the other end of an active link if it has been 10 seconds since the last frame was received. If the far host has failed, the service will be declared down after **n2** tries are timed out.

```
interface serial0
 encapsulation x25
 lapb t4 10
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

lapb n2
lapb t1

service pad

To enable all packet assembler/disassembler (PAD) commands and connections between PAD devices and access servers, use the **service pad** global configuration command. Use the **no** form of this command to disable this service.

service pad [**cmns**]
no service pad [**cmns**]

Syntax Description

cmns	(Optional) Specifies sending and receiving of PAD calls over CMNS.

Default

All PAD commands and associated connections are enabled. PAD services over XOT or CMNS are not enabled.

Command Mode

Global configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0. The **cmns** option first appeared in Cisco IOS Release 11.3.

Examples

If **service pad** is disabled, the EXEC **pad** command and all PAD related configurations, such as X.29, are unrecognized, as shown in the following example:

```
Router(config)# no service pad
Router(config)# x29 ?
% Unrecognized command
Router(config)# exit
Router# pad ?
% Unrecognized command
```

If **service pad** is enabled, the EXEC **pad** command and access to an X.29 configuration is granted as shown in the following example:

```
Router# config terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# service pad
Router(config)# x29 ?
access-list       Define an X.29 access list
inviteclear-time  Wait for response to X.29 Invite Clear message
profile           Create an X.3 profile
Router# pad ?
WORD   X121 address or name of a remote system
```

In the following example, PAD services over CMNS are enabled:

```
! Enable CMNS on a nonserial interface
interface ethernet0
 cmns enable
!
!Enable inbound and outbound PAD over CMNS service
service pad cmns
!
! Specify an X.25 route entry pointing to an interface's CMNS destination MAC address
x25 route ^2193330 interface Ethernet0 mac 00e0.b0e3.0d62

Router# show x25 vc

SVC 1,  State: D1,  Interface: Ethernet0
     Started 00:00:08, last input 00:00:08, output 00:00:08

     Line: 0   con 0    Location: console Host: 2193330
      connected to 2193330 PAD <--> CMNS Ethernet0 00e0.b0e3.0d62

     Window size input: 2, output: 2
     Packet size input: 128, output: 128
     PS: 2  PR: 3  ACK: 3  Remote PR: 2  RCNT: 0  RNR: no
     P/D state timeouts: 0  timer (secs): 0
     data bytes 54/19 packets 2/3 Resets 0/0 RNRs 0/0 REJs 0/0 INTs 0/0
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

cmns enable
show x25 vc
x29 access-list
x29 profile

service pad from-xot

To permit incoming XOT Calls to be accepted as a PAD session, use the **service pad from-xot** global configuration command. Use the **no** form of this command to disable this service.

service pad from-xot
no service pad from-xot

Syntax Description

This command has no arguments or keywords.

Default

Incoming XOT connections are ignored.

Command Mode

Global configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 11.2 F.

If **service pad from-xot** is enabled, the Calls received using the XOT service may be accepted for processing a PAD session.

Example

The following example prevents incoming XOT Calls from being accepted as a PAD session:

```
no service pad from-xot
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x29 access-list
x29 profile
x25 route

service pad to-xot

To permit outgoing PAD sessions to use routes to an XOT destination, use the **service pad to-xot** global configuration command. Use the **no** form of this command to disable this service.

service pad to-xot
no service pad to-xot

Syntax Description

This command has no arguments or keywords.

Default

XOT routes pointing to XOT are not considered.

Command Mode

Global configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 11.2 F.

Example

If **service pad to-xot** is enabled, the configured routes to XOT destinations may be used when the router determines where to send a PAD Call, as show in the following example:

```
service pad to-xot
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x29 access-list
x29 profile
x25 route

show cmns

To display X.25 Level 3 parameters for LAN interfaces (such as Ethernet or Token Ring) and other information pertaining to Connection-Mode Network Service (CMNS) traffic activity, use the **show cmns** EXEC command.

show cmns [*type number*]

Syntax Description

type	(Optional) Interface type.
number	(Optional) Interface number.

Command Mode

EXEC

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

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 25 describes significant fields shown in the display.

Table 25 Show CMNS Field Descriptions

Field	Description
Ethernet1 is administratively 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 recognize the interface as usable.
Hardware address	Media access control (MAC) address for this interface.
bia	Burned-in address.
state R1	State of the interface. R1 is normal ready state. (The state should always be R1.)
Modulo 8	Modulo value; determines the packet sequence numbering scheme used.
idle 0	Number of minutes the Cisco IOS software waits before closing idle virtual circuits.
timer 0	Value of the interface time; should always be zero.

Table 25 Show CMNS Field Descriptions (Continued)

Field	Description
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 cannot originate or terminate calls.)
input 2	Default input window size is two packets.
output 2	Default output window size is two packets.
Packet size:	Default packet sizes for the interface. (CMNS cannot 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 Logical Link Control, type 2 (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 and received.

Related Commands

You can use the master indexes or search online to find documentation of related commands.

show interfaces serial

show interfaces serial

To display information about a serial interface, use the **show interfaces serial** EXEC command.

show interfaces serial *number*

Syntax Description

number	Interface port number.

Command Mode

EXEC

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

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,Protocol ip
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
```

Table 26 shows the fields relevant to all LAPB connections.

Table 26 Show Interfaces Serial Fields Descriptions when LAPB Is Enabled

Field	Description
LAPB state is	State of the LAPB protocol.
T1 3000, N1 12056,...	Current parameter settings.
Protocol	Protocol encapsulated on a LAPB link; this field is not present on interfaces configured for multiprotocol LAPB or X.25 encapsulations.
VS	Modulo 8 frame number of the next outgoing information frame.
VR	Modulo 8 frame number of the next information frame expected to be received.
RCNT	Number of received information frames that have not yet been acknowledged.
Remote VR	Number of the next information frame the remote device expects to receive.
Retransmissions	Count of current retransmissions due to expiration of T1.
Window is closed	No more frames can be transmitted until some outstanding frames have been acknowledged. This message should be displayed only temporarily.
IFRAMEs	Count of information frames in the form of sent/received.

Table 26 Show Interfaces Serial Fields Descriptions when LAPB Is Enabled (Continued)

Field	Description
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 are held until a restart is sent or received. If any of these parameters changes, the configuration on restart information will be output as well as the values that are currently in effect.

Table 27 describes significant fields shown in the display.

Table 27 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 Cisco IOS software 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.

Table 27 Show Interfaces X25 Field Descriptions (Continued)

Field	Description
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 X.25 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 an explicit acknowledgment is sent. 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	Successful calls sent + failed calls/calls received + calls failed/calls forwarded + calls failed. Calls forwarded are counted as calls sent.
DIAGs 0/0	Diagnostic messages sent and received.

Related Commands

You can use the master indexes or search online to find documentation of related commands.

show cmns

show llc2

To display active Logical Link Control, type 2 (LLC2) connections, use the **show llc2** EXEC command.

show llc2c

Syntax Description

This command has no arguments or keywords.

Command Mode

EXEC

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

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 28 describes significant fields shown in the display.

Table 28 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 router is transmitting on this session. (The 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 (SAP) for this connection. The SAP is analogous to a "port number" on the router and allows for multiple sessions between the same two stations.

Table 28 Show LLC2 Field Descriptions (Continued)

Field	Description
State=	Current state of the LLC2 session, which can be 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 station, 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 that busy conditions on this station prevent this station from receiving 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 station.
ack-max=3, n2=8	Value of these parameters, as given in the previous configuration section.
Next timer in 7768	Number of milliseconds before the next timer, for any reason, goes off.

Table 28 Show LLC2 Field Descriptions (Continued)

Field	Description
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 in which 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 and are similar in function to X.25 parameters of the same name.

show x25 interface

To display information about VCs that use an X.25 interface and, optionally, about a specified virtual circuit, use the **show x25 interface** EXEC command.

show x25 interface [**serial** *number* | *cmns-interface* **mac** *mac-address*]

Syntax Description

serial *number*	(Optional) Keyword **serial** and number of the serial interface used for X.25.
cmns-interface **mac** *mac-address*	(Optional) Local CMNS interface type and number, plus the MAC address of the remote device. CMNS interface types are Ethernet, Token Ring, or FDDI. The interface numbering scheme depends on the router interface hardware.

Command Mode

EXEC

Usage Guidelines

This command first appeared in Cisco IOS Release 11.2 F.

Sample Display

The following **show x25 interface** sample output displays X.25 information about VCs on serial interface 0:

```
Router# show x25 interface serial 0

SVC 1,  State: D1,  Interface: Serial0
  Started 00:13:52, last input 00:00:05, output never
  Connects 3334 <-> ip 3.3.3.4
  Call PID ietf, Data PID none
  Window size input: 7, output: 7
  Packet size input: 512, output: 512
  PS: 0  PR: 6  ACK: 1  Remote PR: 0  RCNT: 5  RNR: no
  P/D state timeouts: 0  timer (secs): 0
  data bytes 0/2508 packets 0/54 Resets 0/0 RNRs 0/0 REJs 0/0 INTs 0/0
SVC 32,  State: D1,  Interface: Serial0.11
  Started 00:16:53, last input 00:00:37, output 00:00:28
  Connects 3334 <-> clns
  Call PID cisco, Data PID none
  Window size input: 7, output: 7
  Packet size input: 512, output: 512
  PS: 5  PR: 4  ACK: 4  Remote PR: 4  RCNT: 0  RNR: no
  P/D state timeouts: 0  timer (secs): 0
  data bytes 378/360 packets 21/20 Resets 0/0 RNRs 0/0 REJs 0/0 INTs 0/0
```

show x25 map

To display information about configured address maps, use the **show x25 map** EXEC command.

show x25 map

Syntax Description

This command has no arguments or keywords.

Command Mode

EXEC

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

The **show x25 map** command shows information about the following:

- Configured maps (defined by the **x25 map** command)
- Maps implicitly defined by encapsulation PVCs (defined by the **x25 pvc** command)
- Dynamic maps (from the X.25 DDN or BFE operations)
- Temporary maps (from unconfigured CMNS endpoints)

Sample Display

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

```
Router# show x25 map

Serial0: X.121 1311001 <--> ip 172.20.170.1
  PERMANENT, BROADCAST, 2 VCS: 3 4*
Serial0: X.121 1311005 <--> appletalk 128.1
  PERMANENT
Serial1: X.121 2194441 cud hello <--> pad
  PERMANENT, windowsize 5 5, accept-reverse, idle 5
Serial1: X.121 1311005 <--> bridge
  PERMANENT, BROADCAST
Serial2: X.121 001003 <--> apollo 1.3,
         appletalk 1.3,
         ip 172.20.1.3,
         decnet 1.3,
         novell 1.0000.0c04.35df,
         vines 00000001:0003,
         xns 1.0000.0c04.35df,
         clns
  PERMANENT, NVC 8, 1 VC: 1024
```

The display shows that four maps have been configured for a router: two for serial interface 0, one for serial interface 1, and one for the serial interface 2 (which maps eight protocols to the host).

Table 29 describes fields shown in the display.

Table 29 Show X25 Map Field Descriptions

Field	Description
Serial0	Interface on which this map is configured.
X.121 1311001	X.121 address of the mapped encapsulation host.
ip 172.20.170.1	Type and address of the higher-level protocol(s) mapped to the remote host. Bridge maps do not have a higher-level address; all bridge datagrams are sent to the mapped X.121 address. CLNS maps refer to a configured neighbor as identified by the X.121 address.
PERMANENT	Address-mapping type that has been configured for the interface in this entry. Possible values include the following: • CONSTRUCTED—Derived with the DDN or BFE address conversion scheme. • PERMANENT—Map was entered with the **x25 map** interface configuration command. • PVC—Map was configured with the **x25 pvc** interface command. • TEMPORARY—A temporary map was created for an incoming unconfigured CMNS connection.
BROADCAST	If any options are configured for an address mapping, they are listed; the example shows a map that is configured to forward datagram broadcasts to the mapped host.
2 VCs:	If the map has any active virtual circuits, they are identified.
3 4*	Identifies the circuit number of the active virtual circuits. The asterisk (*) marks the virtual circuit last used to send data. Note that a single protocol virtual circuit can be associated with a multiprotocol map.

show x25 remote-red

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

show x25 remote-red

Syntax Description

This command has no arguments or keywords.

Command Mode

EXEC

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

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 30 describes significant fields shown in the display.

Table 30 Show X25 Remote-Red Display Field Descriptions

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

To display the X.25 routing table, use the **show x25 route** EXEC command.

show x25 route

Syntax Description

This command has no arguments or keywords.

Command Mode

EXEC

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

Sample Display

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

```
Router# show x25 route

# Match                     Substitute              Route To
1 ^1311001$                                         Serial0, 0 uses
2 ^1311002$                                         xot 172.20.170.10
```

Table 31 describes significant fields shown in the display.

Table 31 Show X25 Route Display Field Descriptions

Field	Description
#	Number identifying the entry in the X.25 routing table.
Match	The match criteria and patterns associated with this entry.
Route To	Destination to which the router will forward a Call; X.25 destinations identify an interface, CMNS destinations identify an interface and host MAC address, XOT destinations identify one (or more) IP addresses.

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 route

show x25 services

To display information pertaining to the X.25 services, use the **show x25 services** EXEC command.

show x25 services

Syntax Description

This command has no arguments and keywords.

Command Mode

EXEC

Usage Guidelines

This command first appeared in Cisco IOS Release 11.2 F.

This command is the default form of the **show x25** command.

Sample Display

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

```
Router# show x25 services

X.25 software, Version 3.0.0.
  3 configurations supporting 3 active contexts
  VCs allocated, freed and in use: 7 - 0 = 7
  VCs active and idle: 4, 3
XOT software, Version 2.0.0.
  VCs allocated, freed and in use: 2 - 1 = 1
  connections in-progress: 0 outgoing and 0 incoming
  active VCs: 1, connected to 1 remote hosts
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

show x25 interface
show x25 map
show x25 route
show x25 vc

show x25 vc

To display information about active switched virtual circuits (SVCs) and permanent virtual circuits (PVCs), use the **show x25 vc** EXEC command.

show x25 vc [*lcn*]

Syntax Description

lcn	(Optional) Logical channel number (LCN).

Command Mode

EXEC

Usage Guidelines

This command first appeared prior to Cisco IOS Release 8.3.

To examine a particular virtual circuit number, add an LCN argument to the **show x25 vc** command.

This command displays information about virtual circuits. Virtual circuits may be used for a number of purposes, such as the following:

- Encapsulation traffic
- Traffic switched between X.25 services (X.25, CMNS and XOT)
- PAD traffic
- QLLC traffic

The connectivity information displayed will vary according to the traffic carried by the virtual circuit. For multiprotocol circuits, the output varies depending on the number and identity of the protocols mapped to the X.121 address and the encapsulation method selected for the circuit.

Sample Display for Encapsulated Traffic

The following is sample output from the **show x25 vc** command used on an encapsulated traffic circuit:

```
Router# show x25 vc 1024

SVC 1024, State: D1, Interface: Serial0
 Started 0:00:31, last input 0:00:31, output 0:00:31
 Connects 170090 <-->
    compressedtcp 172.20.170.90
    ip 172.20.170.90
 Call PID multi, Data PID ietf
 Reverse charged
 Window size input: 2, output: 2
 Packet size input: 128, output: 128
 PS: 5 PR: 5 ACK: 4 Remote PR: 5 RCNT: 1 RNR: FALSE
 Window is closed
 P/D state timeouts: 0 Timer (secs): 0
 data bytes 505/505 packets 5/5 Resets 0/0 RNRs 0/0 REJs 0/0 INTs 0/0
```

Table 32 describes the fields shown in the sample output that are typical for virtual circuits.

Table 32 Show X25 VC Typical Field Descriptions

Field	Description
SVC *n* or PVC *n*	Identifies the type of virtual circuit (switched or permanent) and its LCN (also called its "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 International Telecommunication Union Telecommunication Standardization Sector (ITU-T)[1] X.25 Recommendation for a description of virtual circuit states.
Interface	Interface or subinterface 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.
Connects...<-->...	Describes the traffic-specific connection information. See Table 33, Table 34, Table 35 and Table 36 for more information.
D-bit permitted	Indicates that the X.25 D-bit (Delivery Confirmation) may be used on this circuit (displayed as needed).
Fast select VC	Indicates that the Fast Select facility was present on the incoming call (displayed as needed).
Reverse charged	Indicates reverse charged virtual circuit (displayed as needed).
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.
ACK	Last acknowledged incoming packet.
Remote PR	Last receive sequence 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	This line appears if the router cannot transmit any more packets until the X.25 Layer 3 peer has acknowledged some outstanding packets.
P/D state timeouts	Number of times a supervisory packet (Reset or Clear) has been retransmitted.
Timer	A nonzero time value indicates that a control packet has not been acknowledged yet or that the virtual circuit is being timed for inactivity.
Reassembly	Number of bytes received and held for reassembly. Packets with the M-bit set are reassembled into datagrams for encapsulation virtual circuits; switched X.25 traffic is not reassembled (displayed only when values are non-zero).
Held Fragments/Packets	Number of X.25 data fragments to transmit to complete an outgoing datagram, and the number of datagram packets waiting for transmission (displayed only when values are non-zero).
data bytes *m*/*n* packets *p*/*q*	Total number of data bytes sent (m), data bytes received (n), data packets sent (p), and data packets received (q) since the circuit was established.

Table 32 Show X25 VC Typical Field Descriptions (Continued)

Field	Description
Resets *t*/*r*	Total number of Reset packets transmitted/received since the circuit was established.
RNRs *t*/*r*	Total number of Receiver Not Ready packets transmitted/received since the circuit was established.
REJs *t*/*r*	Total number of Reject packets transmitted/received since the circuit was established.
INTs *t*/*r*	Total number of Interrupt packets transmitted/received since the circuit was established.

1. The ITU-T carries out the functions of the former Consultative Committee for International Telegraph and Telephone (CCITT).

Table 33 describes the connection fields specific for encapsulation traffic.

Table 33 Show X25 VC Encapsulation Traffic Field Descriptions

Field	Description
170090	The X.121 address of the remote host.
ip 172.20.170.90	The higher-level protocol and address values that are mapped to the virtual circuit.
Call PID	Identifies the method used for the protocol identification (PID) in the Call User Data (CUD) field. Because PVCs are not set up using a Call packet, this field is not displayed for encapsulation PVCs. The available methods are as follows: • cisco—Cisco's traditional method was used to set up a single protocol virtual circuit. • ietf—The IETF's standard RFC 1356 method was used to set up a single protocol virtual circuit. • snap—The IETF's Subnetwork Access Protocol (SNAP) method for IP encapsulation was used. • multi—the IETF's multiprotocol encapsulation method was used.
Data PID	Identifies the method used for protocol identification (PID) when sending datagrams. The available methods are as follows: • none—The virtual circuit is a single-protocol virtual circuit; no PID is used. • ietf—The IETF's standard RFC 1356 method for identifying the protocol is used. • snap—The IETF's SNAP method for identifying IP datagrams is used.

Sample Display for Locally Switched X.25 Traffic

The following is sample output from the **show x25 vc** command used on a virtual circuit carrying locally switched X.25 traffic:

```
Router# show x25 vc

PVC 1, State: D1, Interface: Serial2
  Started 0:01:26, last input never, output never
  PVC <--> Serial1 PVC 1, connected
  Window size input: 2, output: 2
  Packet size input: 128, output: 128
  PS: 0 PR: 0 ACK: 0 Remote PR: 0 RCNT: 0 RNR: FALSE
  P/D state timeouts: 0 Timer (secs): 0
  data bytes 0/0 packets 0/0 Resets 0/0 RNRs 0/0 REJs 0/0 INTs 0/0

SVC 5, State: D1, Interface: Serial2
  Started 0:00:16, last input 0:00:15, output 0:00:15
  Connects 170093 <--> 170090 from Serial1 VC 5
  Window size input: 2, output: 2
  Packet size input: 128, output: 128
  PS: 5 PR: 5 ACK: 4 Remote PR: 5 RCNT: 1 RNR: FALSE
  P/D state timeouts: 0 Timer (secs): 0
  data bytes 505/505 packets 5/5 Resets 0/0 RNRs 0/0 REJs 0/0 INTs 0/0
```

Table 34 describes the connection fields for virtual circuits carrying locally switched X.25 traffic.

Table 34 Show X25 VC Local Traffic Field Descriptions

Field	Description
PVC <-->	Indicates a switched connection between two PVCs.
Serial1 PVC 1	Identifies the other half of a local PVC connection.
connected	Identifies connection status for a switched connection between two PVCs. See Table 37 for PVC status messages.
170093	Identifies the Calling (source) Address of the connection. If a Calling Address Extension was encoded in the call facilities, it is also displayed. If the source host is a CMNS host, its MAC address is also displayed.
170090	Identifies the Called (destination) Address of the connection. If a Called Address Extension was encoded in the call facilities, it is also displayed. If the destination host is a CMNS host, its MAC address is also displayed.
from Serial1	Indicates the direction of the call and the connecting interface.
VC 5	Identifies the circuit type and LCN for the connecting interface. VC indicates an SVC, and PVC indicates a PVC. If the connecting host is a CMNS host, its MAC address is also displayed.

Sample Display for Locally Switched X.25 Traffic between PVCs and SVCs

The following is sample output from the **show x25 vc** command used on a virtual circuit carrying locally switched PVC to SVC X.25 traffic:

```
Router# show x25 vc

PVC 5,  State: D1,  Interface: Serial0
  Started 4d21h, last input 00:00:14, output 00:00:14
  Connects 101600 <--> 201700 from Serial2 VC 700
  D-bit permitted
  Window size input: 2, output: 2
  Packet size input: 128, output: 128
  PS: 5  PR: 5  ACK: 4  Remote PR: 5  RCNT: 1  RNR: no
  P/D state timeouts: 0  timer (secs): 0
  data bytes 1000/1000 packets 10/10 Resets 1/0 RNRs 0/0 REJs 0/0 INTs 0/0

SVC 700,  State: D1,  Interface: Serial2
  Started 00:00:16, last input 00:00:16, output 00:00:16
  Connects 101600 <--> 201700 from Serial0 PVC 5
  Window size input: 2, output: 2
  Packet size input: 128, output: 128
  PS: 5  PR: 5  ACK: 5  Remote PR: 4  RCNT: 0  RNR: no
  P/D state timeouts: 0  timer (secs): 103
  data bytes 500/500 packets 5/5 Resets 0/0 RNRs 0/0 REJs 0/0 INTs 0/0
```

Table 35 describes the connection fields for virtual circuits carrying locally switched X.25 traffic between PVCs and SVCs.

Table 35 Show X25 VC Locally Switched PVC to SVC Traffic Field Descriptions

Field	Description
101600	Identifies the Calling (source) Address of the connection. If a Calling Address Extension was encoded in the call facilities, it is also displayed. If the source host is a CMNS host, its MAC address is also displayed.
201700	Identifies the Called (destination) Address of the connection. If a Called Address Extension was encoded in the call facilities, it is also displayed. If the destination host is a CMNS host, its MAC address is also displayed.
from Serial2	Indicates the direction of the call and the connecting interface.
VC 700	Identifies the circuit type and LCN for the connecting interface. VC indicates an SVC and PVC indicates a PVC. If the remote host is a CMNS host, its MAC address is also displayed.

Sample Display for Remotely Switched X.25 Traffic

The following is sample output from the **show x25 vc** command used on a virtual circuit carrying remotely switched X.25 traffic:

```
Router# show x25 vc

PVC 2, State: D1, Interface: Serial2
 Started 0:01:25, last input never, output never
 PVC <--> [172.20.165.92] Serial2/0 PVC 1 connected
 XOT between 171.20.165.91, 1998 and 172.20.165.92, 27801
 Window size input: 2, output: 2
 Packet size input: 128, output: 128
 PS: 0 PR: 0 ACK: 0 Remote PR: 0 RCNT: 0 RNR: FALSE
 P/D state timeouts: 0 Timer (secs): 0 Reassembly (bytes): 0
 Held Fragments/Packets: 0/0
 data bytes 0/0 packets 0/0 Resets 0/0 RNRs 0/0 REJs 0/0 INTs 0/0

SVC 6, State: D1, Interface: Serial2
 Started 0:00:04, last input 0:00:04, output 0:00:04
 Connects 170093 <--> 170090 from
 XOT between 172.20.165.91, 1998 and 172.20.165.92, 27896
 Window size input: 2, output: 2
 Packet size input: 128, output: 128
 PS: 5 PR: 5 ACK: 4 Remote PR: 5 RCNT: 1 RNR: FALSE
 P/D state timeouts: 0 Timer (secs): 0 Reassembly (bytes): 0
 Held Fragments/Packets: 0/0
 data bytes 505/505 packets 5/5 Resets 0/0 RNRs 0/0 REJs 0/0 INTs 0/0
```

Table 36 describes the connection fields for virtual circuits carrying remotely switched X.25 traffic.

Table 36 Show X25 VC Remote X.25 Traffic Field Descriptions

Field	Description
PVC	Flags PVC information.
[172.20.165.92]	Indicates the IP address of the router remotely connecting the PVC.
Serial 2/0 PVC 1	Identifies the remote interface and PVC number.
connected	Identifies connection status for a switched connection between two PVCs. See Table 37 for PVC status messages.
170093	Identifies the Calling (source) Address of the connection. If a Calling Address Extension was encoded in the call facilities, it is also displayed.
170090	Identifies the Called (destination) Address of the connection. If a Called Address Extension was encoded in the call facilities, it is also displayed.
from	Indicates the direction of the call.
XOT between...	Identifies the IP addresses and port numbers of the X.25-over-TCP (XOT) connection.

Table 37 lists the PVC states that can be reported. These states are also reported by the **debug x25** command in PVC-SETUP packets (for remote PVCs only) as well as in the PVCBAD system error message. Some states apply only to remotely switched PVCs.

Table 37 X.25 PVC States

Status Message	Description
awaiting PVC-SETUP reply	A remote PVC has initiated an XOT TCP connection and is waiting for a reply to the setup message.
can't support flow control values	The window sizes or packet sizes of the PVC cannot be supported by one of its two interfaces.
connected	The PVC is up.
dest. disconnected	The other end disconnected the PVC.
dest interface is not up	The target interface's X.25 service is down.
dest PVC config mismatch	The targeted PVC is already connected.
mismatched flow control values	The configured flow control values do not match.
no such dest. interface	The remote destination interface was reported to be in error by the remote router.
no such dest. PVC	The targeted PVC does not exist.
non-X.25 dest. interface	The target interface is not configured for X.25.
PVC/TCP connect timed out	A remote PVC XOT TCP connection attempt timed out.
PVC/TCP connection refused	A remote PVC XOT TCP connection was tried and refused.
PVC/TCP routing error	A remote PVC XOT TCP connection routing error was reported.
trying to connect via TCP	A remote PVC XOT TCP connection is established and is in the process of connecting.
waiting to connect	The PVC is waiting to be processed for connecting.

show x25 xot

To display information for all XOT virtual circuits that match a given criterion, use the **show x25 xot** EXEC command.

show x25 xot [**local** *ip-address* [**port** *port*]] [**remote** *ip-address* [**port** *port*]]

Syntax Description

local *ip-address* [**port** *port*]	Local IP address and optional port number.
remote *ip-address* [**port** *port*]	Remote IP address and optional port number.

Command Mode

EXEC

Usage Guidelines

This command first appeared in Cisco IOS Release 11.2 F.

Sample Display

The following **show x25 xot** sample output displays information about all XOT virtual circuits:

```
Router> show x25 xot

SVC 11,  State: D1,  Interface: [2.2.2.2,1998/2.2.2.1,11002]
  Started 00:00:08, last input 00:00:08, output 00:00:08

  Line: 0   con 0    Location:  Host: 5678
  111 connected to 5678 PAD <--> XOT 2.2.2.2,1998

  Window size input: 2, output: 2
  Packet size input: 128, output: 128
  PS: 2  PR: 3  ACK: 3  Remote PR: 2  RCNT: 0  RNR: no
  P/D state timeouts: 0  timer (secs): 0
  data bytes 54/18 packets 2/3 Resets 0/0 RNRs 0/0 REJs 0/0 INTs 0/0
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

show x25 interface
show x25 services

x25 accept-reverse

To configure the Cisco IOS software to accept all reverse charge calls, use the **x25 accept-reverse** interface configuration command. To disable this facility, use the **no** form of this command.

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 first appeared prior to Cisco IOS Release 10.0.

This command causes the interface to accept reverse charge calls by default. You can also configure this behavior for each peer with the **x25 map** interface configuration command.

Example

The following example sets acceptance of reverse charge calls:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 map

x25 address

To set the X.121 address of a particular network interface, use the **x25 address** interface configuration command.

x25 address *x121-address*

Syntax Description

x121-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; for proper DDN or BFE operation, this generated X.121 address must not be changed. Standard X.25 encapsulations do not have a default.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

When you are connecting to a public data network (PDN), the PDN administrator will assign the X.121 address to be used. Other applications (for example, a private X.25 service), may assign arbitrary X.121 addresses as required by the network and service design. X.25 interfaces that engage in X.25 switching only do not need to assign an X.121 address.

Example

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

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

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

x25 alias

To configure an interface alias address that will allow this interface to accept calls with other destination addresses, use the **x25 alias** interface configuration command.

x25 alias *destination-pattern* [**cud** *cud-pattern*]

Syntax Description

destination-pattern	Regular expression used to match against the destination address of a received call.
cud *cud-pattern*	(Optional) Call user data (CUD) pattern, a regular expression of ASCII text. The CUD field might be present in a call packet. The first few bytes (commonly 4 bytes long) identify a protocol; the specified pattern is applied to any user data after the protocol identification.

Default

No alias is configured.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 11.2 F. It replaces the functionality that was provided by the **alias** keyword of the **x25 route** command.

Encapsulation, PAD, and QLLC calls are normally accepted when the destination address is that of the interface (or the zero-length address). Those calls will also be accepted when the destination address matches a configured alias.

Example

An X.25 call may be addressed to the receiving interface; calls addressed to the receiving interface are eligible for acceptance as a datagram encapsulation, PAD or QLLC connection, and may not be routed. In the following example, serial interface 0 is configured with a native address of 0000123 and a destination alias for any address that starts with 1111123. That is, serial interface 0 can accept its own calls and calls for any destination that starts with 1111123.

```
interface serial 0
 encapsulation x25
 x25 address 0000123
 x25 alias ^1111123.*
```

x25 bfe-decision

To specify how a router configured for **x25 bfe-emergency decision** will participate in emergency mode, use the **x25 bfe-decision** interface configuration command.

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. This information is obtained from the table created by the **x25 remote-red** command.
ask	Configures the Cisco IOS software to prompt you to enter the **bfe** EXEC command.

Default

The router does not participate in emergency mode.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

Example

The following example configures serial interface 0 to require an EXEC command from you 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 Cisco IOS software prompts you for the 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

You can use the master indexes or search online to find documentation of related commands.

bfe
x25 bfe-emergency
x25 remote-red

x25 bfe-emergency

To configure the circumstances under which the router participates in emergency mode, use the **x25 bfe-emergency** interface configuration command.

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

Syntax Description

never	Prevents the router from sending address translation information to the Blacker Front End (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 to enter emergency mode. When the diagnostic packet is received, the participation in emergency mode depends on how the router is configured with the **x25 bfe-decision** command.

Default

No address translation information is sent to the BFE.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

Example

The following example configures serial interface 0 to require an EXEC command from you 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 Cisco IOS software prompts you for the 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

To set a default protocol, use the **x25 default** interface configuration command. To remove the default protocol specified, use the **no** form of this command.

x25 default *protocol*
no x25 default *protocol*

Syntax Description

protocol	Specifies the protocol to assume; may be **ip** or **pad**.

Default

No default protocol is set.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

This command specifies the protocol assumed by the Cisco IOS software for incoming calls with unknown or missing protocol identifier in the call user data (CUD). If you do not use the **x25 default** interface configuration command, the software clears any incoming calls with unrecognized CUD.

Example

The following example establishes IP as the default protocol for X.25 calls:

```
interface serial 0
 x25 default ip
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 map

x25 facility

To force facilities on a per-call basis for calls originated by the router (switched calls are not affected), use the **x25 facility** interface configuration command. To disable a facility, use the **no** form of this command.

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

Syntax Description

facility-keyword	User facility.
value	Facility value; see Table 38 for a list of supported facilities and their values.

Default

No facility is sent.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Table 38 lists X.25 user facilities.

Table 38 X.25 User Facilities

User Facility	Description
cug *number*	Specifies a closed user group (CUG) number; CUGs 1 to 9999 are allowed. CUGs can be used by a public data network (PDN) 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 64000 bps.

Table 38 X.25 User Facilities (Continued)

User Facility	Description
transit-delay *value*	Specifies a network transit delay to request for the duration of outgoing calls for networks that support transit delay. The transit delay value can be between 0 and 65534 milliseconds.
roa *name*	Specifies the name defined by the **x25 roa** command for a list of transit Recognized Operation Agencies (ROAs) to use in outgoing Call Request packets.

Examples

The following example specifies a transit delay value in an X.25 configuration:

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

The following example sets an ROA name and then sends the list via the X.25 user facilities:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 roa

x25 hic

To set the highest incoming-only virtual circuit number, use the **x25 hic** interface configuration command.

x25 hic *circuit-number*

Syntax Description

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

Default

0

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

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 the values of **x25 ltc** and **x25 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 sets a valid incoming-only virtual circuit range of 1 to 5:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 lic

x25 hoc

To set the highest outgoing-only virtual circuit number, use the **x25 hoc** interface configuration command.

x25 hoc *circuit-number*

Syntax Description

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

Default

0

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

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 the values of **x25 ltc** and **x25 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 sets a valid outgoing-only virtual circuit range of 2000 to 2005:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 loc

x25 hold-queue

To set the maximum number of packets to hold until a virtual circuit is able to transmit, use the **x25 hold-queue** interface configuration command. To remove this command from the configuration file and restore the default value, use the **no** form of this command without an argument.

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

Syntax Description

packets	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. The default is 10 packets.

Default

10 packets

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

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 setting 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 virtual circuits.

Example

The following example sets the X.25 hold queue to hold 25 packets:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

ip mtu
x25 ips
x25 ops

x25 hold-vc-timer

To start the timer that prevents additional calls to a destination for a given period of time (thus preventing overruns on some X.25 switches caused by Call Request packets), use the **x25 hold-vc-timer** interface configuration command. To restore the default value for the timer, use the **no** form of this command.

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 are still accepted. The default is 0 minutes.

Default

0 minutes

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Only Call Requests that the router originates are 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.

Example

The following example sets this timer to 3 minutes:

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

x25 host

To define a static host name-to-address mapping, use the **x25 host** global configuration command. Use the **no** form of the command to remove the host name.

x25 host *name x121-address* [**cud** *call-user-data*]
no x25 host *name*

Syntax Description

name	Host name.
x121-address	The X.121 address.
cud *call-user-data*	(Optional) Sets the Call User Data (CUD) field in the X.25 Call Request packet.

Default

No static host name-to-address mapping is defined.

Command Mode

Global configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Examples

The following example specifies a static address mapping:

```
x25 host Willard 4085551212
```

The following example removes a static address mapping:

```
no x25 host Willard
```

x25 htc

To set the highest two-way virtual circuit number, use the **x25 htc** interface configuration command.

x25 htc *circuit-number*

Syntax Description

circuit-number	Virtual circuit number from 1 to 4095, or 0 if there is no two-way virtual circuit range. The default is 1024 for X.25 network service interfaces; 4095 for CMNS network service interfaces.

Defaults

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

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

This command is applicable if the X.25 switch is 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 sets a valid two-way virtual circuit range of 5 to 25:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

cmns enable
x25 ltc

x25 idle

To define the period of inactivity after which the router can clear a switched virtual circuit (SVC), use the **x25 idle** interface configuration command.

x25 idle *minutes*

Syntax Description

minutes	Idle period in minutes. The default is 0, which causes the router to keep the SVC open indefinitely.

Default

0 (the SVC is kept open indefinitely)

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

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

Example

The following example sets a 5-minute wait period before an idle circuit is cleared:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

clear x25

x25 ip-precedence

To enable the Cisco IOS software to use the IP precedence value when it opens a new virtual circuit, use the **x25 ip-precedence** interface configuration command. To cause the Cisco IOS software to ignore the precedence value when opening virtual circuits, use the **no** form of this command.

x25 ip-precedence
no x25 ip-precedence

Syntax Description

This command has no arguments or keywords.

Default

The router opens one virtual circuit for all types of service.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

This feature is useful only for DDN or BFE encapsulations, because only these methods have an IP precedence facility defined to allow the source and destination devices to both use the virtual circuit for traffic of the given IP priority.

Verify that your host does not send nonstandard data in the IP type of service (TOS) field because it can cause multiple wasteful virtual circuits to be created.

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

The **x25 map nvc** limit or the default **x25 nvc** limit still applies.

Example

The following example allows new IP encapsulation virtual circuits based on the IP precedence:

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

x25 ips

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

x25 ips *bytes*

Syntax Description

bytes	Byte count. It can be one of the following values: 16, 32, 64, 128, 256, 512, 1024, 2048, or 4096. The default is 128 bytes.

Default

128 bytes

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

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, the Cisco IOS software must break the packet into two or more X.25 packets with the more data bit (M-bit) set. The receiving device collects all packets with the M-bit set and reassembles the original packet.

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 sets the default maximum packet sizes to 512:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 facility
x25 ops

x25 lic

To set the lowest incoming-only virtual circuit number, use the **x25 lic** interface configuration command.

x25 lic *circuit-number*

Syntax Description

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

Default

0

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

This command is applicable only if you have the X.25 switch configured for an incoming-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 the values of **x25 ltc** and **x25 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.

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

Example

The following example sets a valid incoming-only virtual circuit range of 1 to 5 and sets the lowest two-way virtual circuit number:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 hic

x25 linkrestart

To force X.25 Level 3 (packet level) to restart when Level 2 (LAPB, the link level) resets, use the **x25 linkrestart** interface configuration command. To disable this function, use the **no** form of this command.

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

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Example

The following example disables the link-level restart:

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

x25 loc

To set the lowest outgoing-only virtual circuit number, use the **x25 loc** interface configuration command.

x25 loc *circuit-number*

Syntax Description

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

Default

0

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

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 from your DTE, configure the values of **x25 loc** and **x25 hoc** and set the values of **x25 ltc** and **x25 htc** to 0.

Example

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

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 hoc

x25 ltc

To set the lowest two-way virtual circuit number, use the **x25 ltc** interface configuration command.

x25 ltc *circuit-number*

Syntax Description

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

Default

1

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

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 sets a valid two-way virtual circuit range of 5 to 25:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 htc

x25 map

To set up the LAN protocols-to-remote host mapping, use the **x25 map** interface configuration command. To retract a prior mapping, use the **no** form of this command with the appropriate network protocol(s) and X.121 address argument.

x25 map *protocol address* [*protocol2 address2*[...[*protocol9 address9*]]] *x121-address* [*option*]
no x25 map *protocol address x121-address*

Syntax Description

protocol	Protocol type, entered by keyword. Supported protocols are entered by keyword, as listed in Table 39. As many as nine protocol and address pairs can be specified in one command line.
address	Protocol address.
x121-address	X.121 address of the remote host.
option	(Optional) Additional functionality that can be specified for originated calls. Can be any of the options listed in Table 40.

Default

No LAN protocol-to-remote host mapping is set up.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Because no defined protocol can dynamically determine LAN protocol-to-remote host mappings, you must enter all the information for each host with which the router may exchange X.25 encapsulation traffic.

Two methods are available to encapsulate traffic, Cisco's long-available encapsulation method and the IETF's standard method (defined in RFC 1356); the latter allows hosts to exchange several protocols over a single virtual circuit. Cisco's encapsulation method is the default (for backward compatibility) unless the interface configuration command specifies **ietf**.

When you configure multiprotocol maps, you can specify a maximum of nine protocol and address pairs in an **x25 map** command. However, you can specify a protocol only once. For example, you can specify the IP protocol and an IP address, but you cannot specify another IP address. If **compressedtcp** and **ip** are both specified, the same IP address must be used.

Bridging is supported only if you are using Cisco's traditional encapsulation method. For correct operation, bridging maps must specify the **broadcast** option.

Since most datagram routing protocols rely on broadcasts or multicasts to send routing information to their neighbors, the **broadcast** keyword is needed to run such routing protocols over X.25.

Encapsulation maps might also specify that traffic between the two hosts should be compressed, thus increasing the effective bandwidth between them at the expense of memory and computation time. Because each compression virtual circuit requires memory and computation resources, compression must be used with care and monitored to maintain acceptable resource usage and overall performance.

OSPF treats a nonbroadcast, multiaccess network such as X.25 in much the same way as it treats a broadcast network by requiring the selection of a designated router. In previous releases, this required manual assignment in the OSPF configuration using the **neighbor** router configuration command. When the **x25 map** command is included in the configuration with the broadcast, and the **ip ospf network** command (with the **broadcast** keyword) is configured, there is no need to configure any neighbors manually. OSPF will now run over the X.25 network as a broadcast network. (Refer to the **ip ospf network** interface configuration command for more detail.)

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

You can modify the options of an **x25 map** command by restating the complete set of protocols and addresses specified for the map, followed by the desired options. To delete a map command, you must also specify the complete set of protocols and addresses; the options can be omitted when deleting a map.

Once defined, a map's protocols and addresses cannot be changed. This requirement exists because the Cisco IOS software cannot determine whether you want to add to, delete from, or modify an existing map's protocol and address specification, or simply mistyped the command. To change a map's protocol and address specification, you must delete it and create a new map.

A given protocol-address pair cannot be used in more than one map on the same interface.

Table 39 lists the protocols supported by X.25.

Table 39 Protocols Supported by X.25

Keyword	Protocol
apollo	Apollo Domain
appletalk	AppleTalk
bridge	Bridging[1]
clns	ISO Connectionless Network Service
compressedtcp	TCP/IP header compression
decnet	DECnet
ip	IP
ipx	Novell IPX
pad	PAD links[2]

Table 39 Protocols Supported by X.25 (Continued)

Keyword	Protocol
qllc	System Network Architecture (SNA) encapsulation in X.25[3]
vines	Banyan VINES
xns	XNS

1. Bridging traffic is supported only for Cisco's traditional encapsulation method, so a bridge map cannot specify other protocols.
2. Packet Assembly/Disassembly (PAD) maps are used to configure session and protocol translation access, therefore, this protocol is not available for multiprotocol encapsulation.
3. Qualified Logical Link Control (QLLC) is not available for multiprotocol encapsulation.

The CMNS map form is obsolete; its function is replaced by the enhanced **x25 route** command.

Table 40 lists the map options supported by X.25.

Table 40 X.25 Map Options

Option	Description
compress	Specifies that X.25 payload compression be used for mapping the traffic to this host. Each virtual circuit established for compressed traffic uses a significant amount of memory (for a table of learned data patterns) and for computation (for compression and decompression of all data). Cisco recommends that compression be used with careful consideration to its impact on overall performance.
method {**cisco** | **ietf** | **snap** | **multi**}	Specifies the encapsulation method. The choices are as follows: • **cisco**—Cisco's proprietary encapsulation; not available if more than one protocol is to be carried. • **ietf**—Default RFC 1356 operation: protocol identification of single-protocol virtual circuits and protocol identification within multiprotocol virtual circuits use the standard encoding, which is compatible with RFC 877. Multiprotocol virtual circuits are used only if needed. • **snap**—RFC 1356 operation where IP is identified with SNAP rather than the standard IETF method (the standard method is compatible with RFC 877). • **multi**—Forces a map that specifies a single protocol to set up a multiprotocol virtual circuit when a call is originated; also forces a single-protocol PVC to use multiprotocol data identification methods for all datagrams sent and received.
no-incoming	Use the map only to originate calls.
no-outgoing	Do not originate calls when using the map.
idle *minutes*	Specifies an idle timeout for calls other than the interface default; 0 minutes disables the idle timeout.
reverse	Specifies reverse charging for outgoing calls.
accept-reverse	Causes the Cisco IOS software to accept incoming reverse-charged calls. If this option is not present, the Cisco IOS software clears reverse-charged calls unless the interface accepts all reverse-charged calls.

Table 40 X.25 Map Options (Continued)

Option	Description
broadcast	Causes the Cisco IOS software 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 *group-number*	Specifies a closed user group number (from 1 to 9999) for the mapping in an outgoing call.
nvc *count*	Sets the maximum number of virtual circuits for this map or host. The default *count* is the **x25 nvc** setting of the interface. A maximum number of eight virtual circuits can be configured for each map. Compressed TCP may use only 1 virtual circuit.
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 typically are the same and 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 typically are the same, must be in the range 1 to 127, and must be less than 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 48000 bps.
transit-delay *milliseconds*	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 user ID (NUID) facility be sent in the outgoing call with the specified Terminal Access Controller Access Control System (TACACS) username and password (in a format defined by Cisco). This option should be used only when connecting to another Cisco router. The combined length of the username and password should not exceed 127 characters. This option only works if the router is configured as an X.25 DTE.
nudata *string*	Specifies the network user identification in a format determined by the network administrator (as allowed by the standards). This option is provided for connecting to non-Cisco equipment that requires an NUID facility. The string should not exceed 130 characters and must be enclosed in quotation marks ("") if there are any spaces present. This option only works if the router is configured as an X.25 DTE.
roa *name*	Specifies the name defined by the **x25 roa** command for a list of transit Recognized Operating Agencies (ROAs, formerly called Recognized Private Operating Agencies, or RPOAs) to use in outgoing Call Request packets.
passive	Specifies that the X.25 interface should send compressed outgoing TCP datagrams only if they were already compressed when they were received. This option is available only for compressed TCP maps.

Examples

The following example maps IP address 172.20.2.5 to X.121 address 000000010300. The **broadcast** keyword directs any broadcasts sent through this interface to the specified X.121 address.

```
interface serial 0
 x25 map ip 171.20.2.5 000000010300 broadcast
```

The following example specifies an ROA name to be used for originating connections:

```
x25 roa green_list 23 35 36
interface serial 0
 x25 map ip 172.20.170.26 10 roa green_list
```

The following example specifies a network user ID (NUID) facility to send on calls originated for the address map:

```
interface serial 0
 x25 map ip 172.20.174.32 2 nudata "Network User ID 35"
```

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

ip ospf network
show x25 map
x25 facility
x25 map bridge
x25 map compressedtcp
x25 map pad
x25 route
x25 roa

x25 map bridge

To configure an Internet-to-X.121 address mapping for bridging over X.25, use the **x25 map bridge** interface configuration command.

x25 map bridge *x121-address* **broadcast** [*option*]

Syntax Description

x121-address	The X.121 address.
broadcast	Required keyword for bridging over X.25.
option	(Optional) Services that can be added to this map; the same options as the **x25 map** command; see Table 40 earlier in this chapter.

Default

No bridging over X.25 is configured.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Example

The following example configures transparent bridging over X.25 between two Cisco routers using a maximum of six virtual circuits:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 map

x25 map cmns

The enhanced **x25 route** command replaces the **x25 map cmns** command. Refer to the description of the **x25 route** command for more information.

x25 map compressedtcp

To map compressed TCP traffic to an X.121 address, use the **x25 map compressedtcp** interface configuration command. To delete a TCP/IP header compression map for the link, use the **no** form of this command.

x25 map compressedtcp *ip-address* [*protocol2 address2* [...[*protocol9 address9*]]] *x121-address* [*option*]
no x25 map compressedtcp *address* [*protocol2 address2* [...[*protocol9 address9*]]] *x121-address*

Syntax Description

ip-address	IP address.
protocol	(Optional) Protocol type, entered by keyword. Supported protocols are entered by keyword, as listed in Table 39. As many as nine protocol and address pairs can be specified in one command line.
address	(Optional) Protocol address.
x121-address	X.121 address.
option	(Optional) The same options as those for the **x25 map** command; see Table 40 earlier in this chapter.

Default

No mapping is configured.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Cisco supports RFC 1144 TCP/IP header compression (THC) on serial lines using HDLC and X.25 encapsulation. THC encapsulation is only slightly different from other encapsulation traffic, but these differences are worth noting. The implementation of compressed TCP over X.25 uses one virtual circuit to pass the compressed packets. Any IP traffic (including standard TCP) is separate from TCH traffic; it is carried over separate IP encapsulation virtual circuits or identified separately in a multiprotocol virtual circuit.

Note If you specify both **ip** and **compressedtcp** in the same **x25 map compressedtcp** command, they must both specify the same IP address.

The **nvc** map option cannot be used for TCP/IP header compression, because only one virtual circuit can carry compressed TCP/IP header traffic to a given host.

Example

The following example establishes a map for TCP/IP header compression on serial interface 4:

```
interface serial 4
 ip tcp header-compression
 x25 map compressedtcp 172.20.2.5 000000010300
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 map

x25 map pad

To configure an X.121 address mapping for packet assembler/disassembler (PAD) access over X.25, use the **x25 map pad** interface configuration command.

x25 map pad *x121-address* [*option*]

Syntax Description

x121-address	X.121 address of the interface.
option	(Optional) Services that can be added to this map—the same options as the **x25 map** command (see Table 40 earlier in this chapter).

Default

No specific options are used for PAD access.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.2.

Use a PAD map to configure optional X.25 facility use for PAD access. When used with the **x25 pad-access** interface configuration command, the **x25 map pad** command restricts incoming PAD access to those statically mapped hosts.

Example

The following example configures an X.25 interface to restrict incoming PAD access to the single mapped host. This example requires that both incoming and outgoing PAD access use the network user identification (NUID) user authentication.

```
interface serial 1
 x25 pad-access
 x25 map pad 000000010300 nuid johndoe secret
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 map
x25 pad-access

x25 modulo

To set the window modulus, use the **x25 modulo** interface configuration command.

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. The default is 8.

Default

8

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

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 sets the window modulus to 128:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 facility
x25 win
x25 wout

x25 nvc

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

x25 nvc *count*

Syntax Description

count	Circuit count from 1 to 8. A maximum of eight virtual circuits can be configured for each protocol-host pair. Protocols that do not tolerate out-of-order delivery, such as encapsulated TCP/IP header compression, will use only one virtual circuit despite this value. The default is 1. Permitting more than one VC may help throughput on slow networks.

Default

1

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

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 VCs. It does not affect the **nvc** option for any **x25 map** commands that are configured.

Example

The following example sets the default maximum number of VCs that each map can have open simultaneously to 4:

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

x25 ops

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

x25 ops *bytes*

Syntax Description

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

Default

128 bytes

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

X.25 networks use maximum output packet sizes set by the network administrator. 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, the Cisco IOS software must break the packet into two or more X.25 packets with the more data bit (M-bit) set. The receiving device collects all packets with the M-bit set and reassembles the original packet.

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 sets the default maximum packet sizes to 512:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 ips

x25 pad-access

Use the **x25 pad-access** interface configuration command to cause the packet assembler/disassembler (PAD) software to accept PAD connections only from statically mapped X.25 hosts. To disable checking maps on PAD connections, use the **no** form of this command.

x25 pad-access
no x25 pad-access

Syntax Description

This command has no arguments or keywords.

Default

Accept PAD connections from any host.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.2.

By default, all PAD connection attempts are processed for session creation or protocol translation, subject to the configuration of those functions. If you use the **x25 pad-access** command, PAD connections are processed only for incoming calls with a source address that matches a statically mapped address configured with the **x25 map pad** interface configuration command. PAD connections are refused for any incoming calls with a source address that has not been statically mapped.

Example

The following example restricts incoming PAD access on the interface to attempts from the host with the X.121 address 000000010300:

```
interface serial 1
 x25 pad-access
 x25 map pad 000000010300
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

service pad
x25 map pad
x29 access-list
x29 profile

x25 pvc (encapsulating)

To establish an encapsulation permanent virtual circuit (PVC), use the encapsulating version of the **x25 pvc** interface configuration command. To delete the PVC, use the **no** form of this command with the appropriate channel number.

x25 pvc *circuit protocol address* [*protocol2 address2*[...[*protocol9 address9*]]] *x121-address* [*option*]
no x25 pvc *circuit*

Syntax Description

circuit	Virtual-circuit channel number, which must be less than the virtual circuits assigned to the switched virtual circuits (SVCs).
protocol	Protocol type, entered by keyword. Supported protocols are listed in Table 41. As many as nine protocol and address pairs can be specified in one command line.
address	Protocol address of the host at the other end of the PVC.
x121-address	X.121 address.
option	(Optional) Provides additional functionality or allows X.25 parameters to be specified for the PVC. Can be any of the options listed in Table 42.

Default

No encapsulation PVC is established. The PVC window and maximum packet sizes default to the interface default values.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

PVCs are not supported for ISO CMNS.

You no longer need to specify a datagram protocol-to-address mapping before you can set up a PVC; a map is implied from the PVC configuration. Configurations generated by the router will no longer specify a map for encapsulating PVCs.

When configuring a PVC to carry CLNS traffic, use the X.121 address as the subnetwork point of attachment (SNPA) to associate the PVC with a CLNS neighbor configuration. When configuring a PVC to carry transparent bridge traffic, the X.121 address is required to identify the remote host to the bridging function. Other encapsulation PVCs do not require an X.121 address.

Table 41 lists supported protocols.

Table 41 Protocols Supported by X.25 PVCs

Keyword	Protocol
apollo	Apollo Domain
appletalk	AppleTalk
bridge	Bridging[1]
clns	OSI Connectionless Network Service
compressedtcp	TCP/IP header compression
decnet	DECnet
ip	IP
ipx	Novell IPX
qllc	SNA encapsulation in X.25[2]
vines	Banyan VINES
xns	XNS

1. Bridging traffic is supported only for Cisco's traditional encapsulation method, so a bridge PVC cannot specify other protocols.
2. QLLC is not available for multiprotocol encapsulation.

Table 42 lists supported X.25 PVC options.

Table 42 X.25 PVC Options

Option	Description
broadcast	Causes the Cisco IOS software to direct any broadcasts sent through this interface to this PVC. This option also simplifies the configuration of OSPF.
method {**cisco** | **ietf** | **snap** | **multi**}	Specifies the encapsulation method. The choices are as follows: • **cisco**—Single protocol encapsulation; not available if more than one protocol is carried. • **ietf**—Default RFC 1356 operation; single-protocol encapsulation unless more than one protocol is carried, and protocol identification when more than one protocol is carried. • **snap**—RFC 1356 operation where IP is identified when more than one protocol is carried using the SNAP encoding. • **multi**—Multiprotocol encapsulation used on the PVC.
packetsize *in-size out-size*	Maximum input packet size (*in-size*) and output packet size (*out-size*) for the PVC. Both values are typically the same and must be one of the following values: 16, 32, 64, 128, 256, 512, 1024, 2048, or 4096.
passive	Specifies that transmitted TCP datagrams will be compressed only if they were received compressed. This option is available only for PVCs carrying compressed TCP/IP header traffic.
windowsize *in-size out-size*	Packet count for input window (*in-size*) and output window (*out-size*) for the PVC. Both values are typically the same, must be in the range 1 to 127, and must be less than the value set for the **x25 modulo** command.

Example

The following example establishes a PVC on channel 2 to encapsulate VINES and IP with the far host:

```
interface serial 0
 x25 ltc 5
 x25 pvc 2 vines 60002A2D:0001 ip 172.20.170.91 11110001
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 map

x25 pvc (switched)

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

x25 pvc *number1* **interface** *type number* **pvc** *number2* [*option*]

Syntax Description

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.
type	Remote interface type.
number	Remote interface number.
pvc	Required keyword to specify a switched PVC.
number2	PVC 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 43.

Default

No switched PVC is configured. The PVC window and maximum packet sizes default to the interface default values.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

You can configure X.25 PVCs in the X.25 switching software. As a result, 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.

Table 43 lists the switched PVC options supported by X.25.

Table 43 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.

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 (switched pvc to svc)

To configure a switched PVC to SVC circuit for a given interface, use the switched version of the **x25 pvc** interface configuration command.

x25 pvc *number1* **svc** *x121-address* [*flow-control-options*] [*call-control-options*]

Syntax Description

number1	Logical channel ID of the PVC. Value must be lower than any range of circuit numbers defined for SVCs.
svc	Specifies a switched virtual circuit type.
x121-address	Destination X.121 address for opening an outbound switched virtual circuit and source X.121 address for matching an inbound switched virtual circuit.
flow-control-options	(Optional) Adds certain features to the mapping specified; can be any of the options listed in Table 44.
call-control-options	(Optional) Adds certain features to the mapping specified; can be any of the options listed in Table 45.

Default

No switched PVC is configured. The PVC window and maximum packet sizes default to the interface default values.

The default idle time comes from the interface on which the **x25 pvc** command is configured, not the interface on which the call is sent/received.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 11.2 F.

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

On an outgoing call, the packet size facilities and window size facilities will be included. The call will be cleared if the call accepted packet specifies different values.

On an incoming call, requested values that do not match the configured values will be refused.

Table 44 lists the flow control options supported by X.25 during PVC to SVC switching.

Table 44 Flow Control Options

Option	Description
packetsize *in-size out-size*	Maximum input packet size (*in-size*) and output packet size (*out-size*) for both the PVC and SVC. Values may differ but must be one of the following: 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 both the PVC and SVC. Both values may differ but must be in the range 1 to 127 and must be less than the value set for the **x25 modulo** command.

Table 45 lists the call control options supported by X.25 during PVC to SVC switching.

Table 45 Call Control Options

Option	Description
idle *minutes*	Idle time-out for the SVC. This option will override the interface's **x25 idle** command value only for this circuit.
no-incoming	Establishes a switched virtual circuit to the specified X.121 address when data is received from the permanent virtual circuit, but does not accept calls from this X.121 address.
no-outgoing	Accepts an incoming call from the specified X.121 address, but does not attempt to place a call when data is received from the permanent virtual circuit. If data is received from the permanent virtual circuit while no call is connected, the PVC will be reset.
accept-reverse	Causes the Cisco IOS software to accept incoming reverse-charged calls. If this option is not present, the Cisco IOS software clears reverse-charged calls unless the interface accepts all reverse-charged calls.

Example

The following example configures PVC to SVC switching between two serial interfaces:

```
x25 routing
interface serial0
 encapsulation x25
 x25 address 201700
 x25 ltc 128
 x25 idle 2
interface serial2
 encapsulation x25 dce
 x25 address 101702

x25 route ^20 interface serial0
x25 route ^10 interface serial2
interface serial0

 x25 pvc 5 svc 101601 packetsize 128 128 windowsize 2 2 no-incoming
 x25 pvc 6 svc 101602 packetsize 128 128 windowsize 2 2 no-outgoing idle 0
 x25 pvc 7 svc 101603 packetsize 128 128 windowsize 2 2
```

Any call with a destination address beginning with 20 will be routed to serial interface 0. Any call with a destination address beginning with 10 will be routed to serial interface 2. (Note that incoming calls will not be routed back to the same interface from which they arrived.)

Traffic received on PVC 5 on serial interface 0 will cause a call to be placed from address 201700 to the X.121 address 101601. The routing table will then forward the call to serial interface 2. If no data is sent or received on the circuit for two minutes, the call will be cleared, as defined by the **x25 idle** command. All incoming calls from 101601 to 201700 will be refused, as defined by the *no-incoming* attribute.

The second **x25 pvc** command configures the circuit to allow incoming calls from 101602 to 201700 to be connected to PVC 6 on serial interface 1. Because idle is set to 0, the call will remain connected until cleared by the remote host or an X.25 restart. Because outgoing calls are not permitted for this connection, if traffic is received on PVC 6 on serial interface 0 before the call is established, the traffic will be discarded and the PVC will be reset.

The last **x25 pvc** command configures the circuit to accept an incoming call from 101603 to 201700 and connects the call to PVC 7 on serial interface 0. If no data is sent or received on the circuit for two minutes, the call will be cleared. If traffic is received on PVC 7 on serial interface 0 before the call is established, a call will be placed to 101503 to 201700.

x25 pvc (XOT)

To connect two permanent virtual circuits (PVCs) across a TCP/IP LAN, use the XOT service form of the **x25 pvc** interface configuration command.

x25 pvc *number1* **xot** *address* **interface serial** *string* **pvc** *number2* [*option*]

Syntax Description

number1	PVC number of the connecting device.
xot	Indicates two PVCs will be connected across a TCP/IP LAN using XOT.
address	IP address of the device 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.
number2	Remote PVC number on the target interface.
option	(Optional) Adds certain features for the connection; can be either option listed in Table 46.

Default

No PVCs are connected across a TCP/IP LAN. The PVC window and packet sizes default to the interface default values.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.3.

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

Each X.25-over-TCP (XOT) connection relies on a TCP session to carry traffic. To ensure that these TCP sessions remain connected in the absence of XOT traffic, use the **service tcp-keepalives-in** and **service tcp-keepalives-out** global configuration commands. If TCP keepalives are not enabled, XOT permanent virtual circuits (PVCs) might encounter problems if one end of the connection is reloaded. When the reloaded host attempts to establish a new connection, the other host refuses the new connection because it has not been informed that the old session is no longer active. Recovery from this state requires the other host to be informed that its TCP session is no longer viable so that it attempts to reconnect the PVC.

Also, TCP keepalives inform a router when an XOT switched virtual circuit (SVC) session is not active, thus freeing the router's resources.

Table 46 lists the PVC tunnel options supported by X.25.

Table 46 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.

Examples

The following example enters the parameters for one side of a connection destined for a platform other than the Cisco 7000 series with RSP7000:

```
service tcp-keepalives-in
service tcp-keepalives-out
interface serial 0
 x25 pvc 1 xot 172.20.1.2 interface serial 1 pvc 2
```

The following example enters the parameters for one side of a connection destined for the Cisco 7000 series with RSP7000:

```
service tcp-keepalives-in
service tcp-keepalives-out
interface serial 0
 x25 pvc 1 xot 172.20.1.2 interface serial 1/1 pvc 2
```

See the section "X.25 and LAPB Configuration Examples" in the *Wide-Area Networking Configuration Guide* for more complete configuration examples.

Related Commands

You can use the master indexes or search online to find documentation of related commands.

service tcp-keepalives-in
service tcp-keepalives-out

x25 remote-red

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

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

Syntax Description

host-ip-address	IP address of the host or 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

No table is set up.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

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 serial interface 0:

```
interface serial 0
 x25 remote-red 172.20.9.3 remote-black 172.20.9.13
 x25 remote-red 192.108.15.1 remote-black 192.108.15.26
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

show x25 remote-red
x25 bfe-decision

x25 route

To create an entry in the X.25 routing table (to be consulted for forwarding incoming calls and for placing outgoing PAD or protocol translation calls), use an appropriate form of the **x25 route** global configuration command. To remove an entry from the table, use the **no** form of the command.

x25 route [**#***position*] {[*selection*] [*modification*]} *disposition* [*xot-keepalive*]
no x25 route [**#***position*] {[*selection*] [*modification*]} *disposition*

Syntax Description

#*position*	(Optional) A pound sign (#) followed by a number designates the position in the routing table at which to insert the new entry. If no *position* value is given, the entry is appended to the end of the routing table.
selection	(Optional) The *selection* options identify when the subsequent *modification* and *disposition* elements apply to an X.25 call; any or all variables may be specified for a route. See Table 47 in the "Usage Guidelines" section for the valid selection keyword and argument options. Although each individual selection criterion is optional, at least one *selection* or *modification* element must be specified in the **x25 route** command.
modification	(Optional) Modifies the source or destination addresses of the selected calls. The standard regular expression substitution rules are used, where a match pattern and rewrite string direct the construction of a new string. See Table 48 in the "Usage Guidelines" section for the valid modification keyword and argument options. Although each individual modification is optional, at least one *selection* or *modification* element must be specified in the **x25 route** command.
disposition	Specifies the disposition of a call matching the specified selection pattern. See Table 52 in the "Usage Guidelines" section for the valid disposition keyword and argument options.
xot-keepalive	(Optional) Specifies an XOT keepalive period and number of XOT keepalive retries. XOT relies on TCP to detect when the underlying connection is dead. TCP detects a dead connection when transmitted data goes unacknowledged for a given number of attempts over a period of time. See Table 53 in the "Usage Guidelines" section for keepalive options.

Default

No entry is created in the X.25 routing table.

Command Mode

Global configuration

Usage Guidelines

The enhanced **x25 route** command replaces the **x25 map cmns** command. The **x25 route alias** form of this command (supported in earlier releases) has been replaced by the **x25 alias** command.

The *selection* criteria **source** and **dest-ext** first appeared in Cisco IOS Release 11.2 F. The interface *disposition* to a CMNS destination first appeared in Cisco IOS Release 11.2 F; in prior releases, CMNS routing information was implied by maps defining an NSAP prefix for a CMNS host's MAC address. The **clear** interface *disposition* first appeared in Cisco IOS Release 11.2 F; in prior releases, the disposition was implicit in a route to the Null 0 interface. The *modification* elements are long-standing but newly applicable to all dispositions in Cisco IOS Release 11.2 F.

Note The entire command must be entered on one line.

Selection Options

Selection options specify match criteria. When a call matches all selection criteria in an X.25 route, then the specified modification and disposition are used for the call.

As many as four selection options can be used to determine the route:

- Called X.121 network interface address (destination host address)
- Calling X.121 network interface address (source host address)
- Called address extension (destination NSAP address)
- X.25 packet's call user data (CUD) field

Table 47 lists the *selection* options for the **x25 route** command. At least one *selection* or *modification* element must be specified in the **x25 route** command.

Table 47 X25 Route Command Selection Options

Selection Options	Description
destination-pattern	(Optional) Destination address pattern, which is a regular expression that can represent either one X.121 address (such as ^1111000$) or any address in a group of X.121 addresses (such as ^1111.*).
source *source-pattern*	(Optional) Source address pattern, which is a regular expression that can represent either one X.121 source address (such as ^2222000$) or any address in a group of X.121 addresses (such as ^2222.*).
dest-ext *nsap-destination-pattern*	(Optional) NSAP destination address pattern, which is a regular expression that can represent either an NSAP destination address (such as ^11.1111.0000$) or an NSAP prefix (such as ^11.1111.*). Note: A period (.) in the pattern is interpreted as a character wildcard, which will not interfere with a match to the actual period in the NSAP; if desired, an explicit character match may be used (such as ^11\.1111\..*).
cud *user-data-pattern*	(Optional) Call user data (CUD) pattern, which is specified as a regular expression of printable ASCII text. The CUD field may be present in a call packet. The first few bytes (commonly 4 bytes long) identify a protocol; the specified pattern is applied to any user data after the protocol identification.

Note The X.121 and NSAP addresses are specified as regular expressions. A common error is to specify the address digits without anchoring them to the beginning and end of the address. For example, the regular expression 1111 will match an X.121 address that has four successive 1s somewhere in the address; to specify the single X.121 address, the form ^1111$ must be used.

Regular expressions are used to allow pattern-matching operations on the addresses and user data. A common operation is to do prefix matching on the X.121 DNIC field and route accordingly. The caret (^) is a special regular expression character that anchors the match at the beginning of the pattern. For example, the pattern ^3306 will match all X.121 addresses with a DNIC of 3306.

Modification Options

Addresses typically need to be modified when traffic from a private network that uses arbitrary X.121 addresses must transit a public data network, which must use its own X.121 addresses. The easiest way to meet the requirement is to specify in the **x25 route** command a way to modify the private address into a network X.121 address or to modify a network X.121 address into a private address. The addresses are modified so that no change to the private addressing scheme is required.

The *modification* options use the standard UNIX regular expression substitution operations to change an X.25 field. A pattern match is applied to an address field, which is rewritten as directed by a rewrite pattern.

Table 48 lists the *modification* options for the **x25 route** command. At least one *selection* or *modification* element must be specified in the **x25 route** command.

Table 48 X25 Route Command Modification Options

Modification Option	Description
substitute-source *rewrite-source*	(Optional) Calling X.121 address rewrite pattern. The source address, *source-pattern*, and this *rewrite-source* pattern are used to form a new source address. If no *source-pattern* is specified, any *destination-pattern* match pattern is used. If neither match pattern is specified, a default match pattern of **.*** is used. See Table 49 and Table 50 for summaries of pattern and character matching, respectively. See Table 51 for a summary of pattern rewrite elements.
substitute-dest *rewrite-dest*	(Optional) Called X.121 address rewrite pattern. The destination address, *destination-pattern*, and this *rewrite-dest* pattern are used to form a new destination address. If no *destination-pattern* is specified, a default match pattern of **.*** is used. See Table 49 and Table 50 for summaries of pattern and character matching, respectively. See Table 51 for a summary of pattern rewrite elements.

Note As of Cisco IOS Release 11.3, the **substitute-source** and **substitute-dest** options also apply to PAD calls.

Source address. A modification of the source address is directed by the rewrite string using one of three possible match patterns. If the **source** *source-pattern* selection option is defined, it is used with the *source-rewrite* string to construct the new source address; otherwise, a *destination-pattern* regular expression is used (for backwards compatibility) or a wildcard regular expression (.*) is used. In the *rewrite-source* argument, the backslash character (\) indicates that the digit immediately following the argument selects a portion of the matched address to be inserted into the new called address.

Destination address. A modification of the destination address is directed by the rewrite string using one of two possible match patterns. If the *destination-pattern* selection option is defined, it is used with the *destination-rewrite* string to construct the new destination address; otherwise, a wildcard regular expression (.*) is used. In the *rewrite-dest* argument, the backslash character (\) indicates that the digit immediately following the argument selects a portion of the original called address to be inserted into the new called address.

Refer to Table 49, Table 50, and Table 51 for summaries of pattern matching, character matching, and pattern rewrite elements. Note that up to nine pairs of parentheses can be used to identify patterns to be included in the modified string. A more complete description of the pattern-matching characters is found in the "Regular Expressions" appendix in the *Dial Solutions Command Reference*.

Table 49 Pattern Matching for X.25 Route Selection and Modification Options

Pattern	Description
*	Matches 0 or more occurrences of the preceding character.
+	Matches 1 or more occurrences of the preceding character.
?	Matches 0 or 1 occurrences of the preceding character.[1]

1. Precede the question mark with Ctrl-V to prevent the question mark from being interpreted as a help command.

Table 50 Character Matching for X.25 Route Selection and Modification Options

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

Table 51 Pattern Replacements for X.25 Route Selection and Modification Options

Pattern	Description
\0	The pattern is replaced by the entire original address.
\1...9	The pattern is replaced by strings that match the first through ninth parenthetical part of the X.121 address.

Disposition Option

The **xot-source** disposition option can improve the resilience of the TCP connection if, for instance, a loopback interface is specified. By default, a TCP connection's source IP address is that of the interface used to initiate the connection; a TCP connection will fail if either the source or destination

IP address is no longer valid. Because a loopback interface never goes down, its IP address is always valid. Any TCP connections originated using a loopback interface can be maintained as long as a path exists to the destination IP address, which may also be the IP address of a loopback interface.

Table 52 lists the *disposition* choices for the **x25 route** command. You are required to select one of these choices.

Table 52 X25 Route Command Dispositions

Disposition	Description
interface *serial-interface*	Route the selected call to the specified X.25 serial interface.
interface *cmns-interface* **mac** *mac-address*	Route the selected call out the specified broadcast interface via CMNS to the LAN destination station. The broadcast interface type can be Ethernet, Token Ring, or FDDI. The interface numbering scheme depends on the router interface hardware.
xot *ip-address* [*ip2-address* [...[*ip6-address*]]] [**xot-source** *interface*]	Route the selected call to the XOT host at the specified IP address. Subsequent IP addresses are tried, in sequence, only if XOT is unable to establish a TCP connection with a prior address.
clear	Terminate the call.

XOT Keepalive Options

TCP maintains each connection using a keepalive mechanism that starts with a default time period and number of retry attempts. If a received XOT connection is dispatched using a route with explicit keepalive parameters, those values will be used for the TCP connection. If an XOT connection is sent using a route with explicit keepalive parameters, those values will be used for the TCP connection.

Table 53 lists and describes the *xot-keepalive* options for the **x25 route** command.

Table 53 X25 Route Command XOT Keepalive Options

XOT-Keepalive Option	Description
xot-keepalive-period *seconds*	Number of seconds between keepalives for XOT connections. The default is 60 seconds.
xot-keepalive-tries *count*	Number of times TCP keepalives should be sent before dropping the connection. The default value is 4 times.

X.25 Routing Action when a Match Is Found

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 or a broadcast interface running CMNS, the router attempts to forward the call to that host. If the interface is not operational, the subsequent routes are checked for forwarding to an operational interface. If the interface is operational but out of available virtual circuits, the call is cleared. Otherwise, the expected Clear Request or Call Accepted message is forwarded back toward the originator. A call cannot be forwarded out the interface on which it arrived.

If the matching route specifies an XOT disposition, a TCP connection is established to port 1998 at the specified IP address, which must be an XOT host. The Call Request packet is forwarded to the remote host, which applies its own criteria to handle the call. If, upon receiving an XOT call, a routing table entry is not present, or the destination is unavailable, a Clear Request is sent back and the TCP connection is closed. Otherwise, the call is handled and the expected Clear Request or Call Accepted packet is returned. Incoming calls received via XOT connections that match a routing entry specifying an XOT destination are cleared. This restriction prevents Cisco routers from establishing an XOT connection to another router that would establish yet another XOT connection.

Examples

The following example uses regular expression pattern matching characters to match just the initial portion of the complete X.25 address. Any call with a destination address beginning with 3107 that is received on an interface other than serial 0 is forwarded to serial 0.

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

The following example prevents X.25 routing for calls that do not specify a source address:

```
x25 route source ^$ clear
```

The following example configures alternate XOT hosts for the routing entry. If the first address listed is not available, subsequent addresses are tried until a connection is made. If no connection can be formed, the call is cleared.

```
x25 route ^3106$ xot 172.20.2.5 172.20.7.10 172.10.7.9
```

The following example clears calls that contain a 3 in the source address. The disposition keyword **clear** is new:

```
x25 route source 3 clear
```

The following example clears calls that contain two consecutive 3's in the source address:

```
x25 route source 33 clear
```

The following example clears a call to the destination address, 9999:

```
x25 route ^9999$ clear
```

The following example specifies a route for specific source and destination addresses. (The ability to combine source and destination patterns is a new feature.)

```
x25 route ^9999$ source ^333$ interface serial 0
```

The following example routes the call to the XOT host at the specified IP address. The disposition keyword **xot** is new. In prior releases the keyword **ip** was used.

```
x25 route ^3333$ xot 172.21.53.61
```

The following example routes calls containing the destination extension address preamble 11.1234:

```
x25 route dest-ext ^11.1234.* interface serial 0
```

The following example rewrites the destination address as 9999. There must be a minimum of four 8's in the address. (8888888 will change to 9999.)

```
x25 route 8888 substitute-dest 9999 interface serial 0
```

The following example substitutes only part of the destination address. "^88" specifies the original destination string must begin with 88. "(.*)" indicates the string can end with any number, 0-9, and can be more than one digit. "99\1" changes the destination address to 99 plus whatever matches ".*" in the original destination address. For example, 8881 will change to 9981.

```
x25 route ^88(.*) substitute-dest 99\1 interface serial 0
```

The following example substitutes only part of the destination address and also removes a specified number of digits from the address. "^88" specifies the original destination string must begin with 88. "(..)" matches any two digits. "(.*)" specifies the string can end with any number, 0-9, and can occur zero or more times. Thus any address that starts with 88 and has four or more digits will be rewritten to start with 99 and omit the third and fourth digits. For example, 881234 will change to 9934.

```
x25 route ^88(..)(.*) substitute-dest 99\2 interface serial 0
```

The following example looks for a specified destination address and changes the source address. "9999" is the destination address. The original source address changes to "2222" because the call is made to the destination 9999.

```
x25 route ^9999$ substitute-source 2222 interface serial 0
```

The following example rewrites the source address based upon the source address. "9999" matches any destination address with four consecutive 9s. "^...(.*)" matches any source address with at least three digits; the command removes the first three digits and rewrites any digits after the first three as the new source address. For example, a call to 9999 from the source address 77721 will be forwarded using the calling address 21 and the called address 9999.

```
x25 route 9999 source ^...(.*) substitute-source \1 interface serial 0
```

The following example adds a digit to the source and destination addresses patterns. "09990" is the destination address pattern. The source can be any address. "9\0" specifies to add a leading 9 to the destination address pattern. "3\0" specifies to add a leading 3 to the source address pattern. For example, a call using source 03330 and destination 09990 will change to 303330 and 909990, respectively.

```
x25 route 09990 source .* substitute-dest 9\0 substitute-source 3\0 interface serial 0
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

show x25 route

x25 routing

To enable X.25 switching or tunneling, use the **x25 routing** global configuration command. To disable the forwarding of X.25 calls, used the **no** form of this command.

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

This command first appeared prior to Cisco IOS Release 10.0.

The **x25 routing** command enables X.25 switching between the X.25 services (X.25, CMNS and XOT). X.25 calls will not be forwarded until this command is issued.

The **use-tcp-if-defs** keyword may be needed for receiving XOT calls from 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 all calls. In this case, the Cisco IOS software normally forces universally acceptable flow control values (window sizes of 2 and maximum packet sizes of 128) on the connection. Because some equipment disallows modification of the flow control values in the call confirm, the **use-tcp-if-defs** keyword causes 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 Cisco IOS software.

Example

The following example enables X.25 switching:

```
x25 routing
```

x25 roa

To specify a sequence of packet network carriers, use the **x25 roa** global configuration command. To remove the specified name, use the **no** form of this command.

x25 roa *name number*
no x25 roa *name*

Syntax Description

name	Recognized Operating Agency (ROA, formerly called a Recognized Private Operating Agency, or RPOA), which must be unique with respect to all other ROA 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 ROA; up to 10 numbers are accepted.

Default

No packet network carriers are specified.

Command Mode

Global configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

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

Example

The following example sets an ROA name and then sends the list via the X.25 user facilities:

```
x25 roa green_list 23 35 36
interface serial 0
 x25 facility roa green_list
 x25 map ip 172.20.170.26 10 roa green_list
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 facility
x25 map

x25 suppress-called-address

To omit the destination address in outgoing calls, use the **x25 suppress-called-address** interface configuration command. To reset this command to the default state, use the **no** form of this command.

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

Syntax Description

This command has no arguments or keywords.

Default

The called address is sent.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

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.

As of Cisco IOS Release 11.3, this command also applies to PAD calls.

Example

The following example suppresses or omits the called address in Call Request packets:

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

x25 suppress-calling-address

To omit the source address in outgoing calls, use the **x25 suppress-calling-address** interface configuration command. To reset this command to the default state, use the **no** form of this command.

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

Syntax Description

This command has no arguments or keywords.

Default

The calling address is sent.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

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.

As of Cisco IOS Release 11.3, this command also applies to PAD calls.

Example

The following example suppresses or omits 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	Time in seconds. The default is 60 seconds.

Default

60 seconds

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Example

The following example sets the T10 timer to 30 seconds:

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

x25 t11

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

x25 t11 *seconds*

Syntax Description

seconds	Time in seconds. The default is 180 seconds.

Default

180 seconds

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Example

The following example sets the T11 timer to 90 seconds:

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

x25 t12

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

x25 t12 *seconds*

Syntax Description

seconds	Time in seconds. The default is 60 seconds.

Default

60 seconds

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Example

The following example sets the T12 timer to 30 seconds:

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

x25 t13

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

x25 t13 *seconds*

Syntax Description

seconds	Time in seconds. The default is 60 seconds.

Default

60 seconds

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Example

The following example sets the T13 timer to 30 seconds:

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

x25 t20

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

x25 t20 *seconds*

Syntax Description

seconds	Time in seconds. The default is 180 seconds.

Default

180 seconds

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Example

The following example sets the T20 timer to 90 seconds:

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

x25 t21

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

x25 t21 *seconds*

Syntax Description

seconds	Time in seconds. The default is 200 seconds.

Default

200 seconds

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Example

The following example sets the T21 timer to 100 seconds:

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

x25 t22

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

x25 t22 *seconds*

Syntax Description

seconds	Time in seconds. The default is 180 seconds.

Default

180 seconds

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Example

The following example sets the T22 timer to 90 seconds:

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

x25 t23

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

x25 t23 *seconds*

Syntax Description

seconds	Time in seconds. The default is 180 seconds.

Default

180 seconds

Command Mode

Interface configuration

Usage Guidelines

This command first appeared prior to Cisco IOS Release 10.0.

Example

The following example sets the T23 timer to 90 seconds:

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

x25 threshold

To set the data packet acknowledgment threshold, use the **x25 threshold** interface configuration command.

x25 threshold *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. The default is 0, which disables the acknowledgment threshold.

Default

0 (which disables the acknowledgment threshold)

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 11.2F; it replaces the longstanding form **x25 th**.

This command instructs 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.

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. This command improves line responsiveness at the expense of bandwidth.

This command only applies to encapsulated traffic over X.25 (datagram transport), not to routed traffic.

Example

The following example sends an explicit Receiver Ready acknowledgment when it has received 5 data packets that it has not acknowledged:

```
interface serial 1
 x25 threshold 5
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 win
x25 wout

x25 use-source-address

To override the X.121 addresses of outgoing calls forwarded over a specific interface, use the **x25 use-source-address** interface configuration command. Use the **no** form of this 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

This command first appeared prior to Cisco IOS Release 10.0.

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 update is necessary when you are forwarding calls from private data networks to public data networks (PDNs).

Example

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

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

x25 win

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

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 first appeared prior to Cisco IOS Release 10.0.

This command determines the default number of packets a virtual circuit 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 5 packets may be received before an X.25 acknowledgment is sent:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 modulo
x25 threshold
x25 wout

x25 wout

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

x25 wout *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 first appeared prior to Cisco IOS Release 10.0.

This command determines the default number of packets a virtual circuit 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 5 for the number of outstanding unacknowledged packets for virtual circuits:

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

Related Commands

You can use the master indexes or search online to find documentation of related commands.

x25 modulo
x25 threshold
x25 win

x29 access-list

To limit access to the access server from certain X.25 hosts, use the **x29 access-list** global configuration command. To delete an entire access list, use the **no** form of this command.

x29 access-list *access-list-number* {**deny | permit**} *x121-address*
no x29 access-list *access-list-number*

Syntax Description

access-list-number	Number of the access list. It can be a value between 1 and 199.
deny	Denies access and clears call requests immediately.
permit	Permits access to the protocol translator.
x121-address	If applied as an inbound access class, specifies the X.121 address that can or cannot have access (with or without regular expression pattern-matching characters). The X.121 address is the source address of the incoming packet. If applied as an outbound access class, then the address specifies a destination to where connections are allowed.

Default

No access lists are defined.

Command Mode

Global configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

An access list can contain any number of access list items. The list items are processed in the order in which you entered them, with the first match causing the permit or deny condition. If an X.121 address does not match any of the regular expressions in the access list, access is denied.

Access lists take advantage of the message field defined by Recommendation X.29, which describes procedures for exchanging data between two PADs, or between a PAD and a DTE device.

The UNIX-style regular expression characters allow for pattern matching of characters and character strings in the address. Various pattern-matching constructions are available that allow many addresses to be matched by a single regular expressions. For more information, refer to the "Regular Expressions" appendix in the *Dial Solutions Command Reference*.

The access lists must be applied to a vty with the **access-class** command.

Example

The following example permits connections to hosts with addresses beginning with the string 31370:

```
x29 access-list 2 permit ^31370
```

x29 profile

To create a PAD profile script for use by the **translate** command, use the **x29 profile** global configuration command.

x29 profile {**default** | *name*} *parameter*:*value* [*parameter*:*value*]

Syntax Description

default	Specifies default profile script.
name	Name of the PAD profile script.
parameter:*value*	X.3 PAD parameter number and value separated by a colon. You can specify multiple parameter-value pairs.

Default

The default PAD profile script is used. The default for inbound connections is:

```
2:0, 4:1, 15:0, 7:21
```

Command Mode

Global configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0.

When an X.25 connection is established, the access server acts as if an X.29 Set Parameter packet had been sent containing the parameters and values set by the **x29 profile** command and sets the access server accordingly.

For incoming PAD connections, the Protocol Translator uses a default PAD profile to set the remote X.3 PAD parameters unless a profile script is defined with the **translate** command.

Examples

The following profile script turns local edit mode on when the connection is made and establishes local echo and line termination upon receipt of a Return packet. The name *linemode* is used with the **translate** command to effect use of this script.

```
x29 profile linemode 2:1 3:2 15:1
```

To override the default PAD profile, create a PAD profile script named “default” by using the following command:

```
x29 profile default 2:1 4:1, 15:0, 4:0
```

Related Commands

You can use the master indexes or search online to find documentation of related commands.

translate