



# X.25 Record Boundary Preservation for Data Communications Networks

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## Feature History

Release	Modification
12.2(8)T	This feature was introduced.

This document describes the X.25 Record Boundary Preservation for Data Communications Networks feature in Cisco IOS Release 12.2(8)T. It includes the following sections:

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## Feature Overview

The X.25 Record Boundary Preservation for Data Communications Networks feature enables hosts using TCP/IP-based protocols to exchange data with devices that use the X.25 protocol, retaining the logical record boundaries indicated by use of the X.25 “more data” bit (M-bit).

## When to Use Record Boundary Preservation

Before the introduction of the X.25 Record Boundary Preservation for Data Communications Networks feature, Cisco IOS software provided two methods for enabling the exchange of data between X.25 hosts and hosts using TCP/IP-based protocols: protocol translation and X.25 over TCP (XOT). Protocol translation supports a variety of configurations, including translation of a data stream between an X.25 circuit that is using X.29 and a TCP session. The X.29 protocol is an integral part of protocol translation.

One aspect of X.29 is that it is asymmetric and allows the packaging of data into X.25 packets to be controlled in one direction only. The TCP protocol is stream-oriented, rather than packet-oriented. TCP does not attach significance to TCP datagram boundaries, and those boundaries can change when a datagram is retransmitted. This inability to preserve boundaries makes protocol translation appropriate only for configurations in which the X.25 packet boundary is not significant.

The XOT feature allows X.25 packets to be forwarded over a TCP session. This allows full control over the X.25 circuit, but the host terminating the TCP session must implement the XOT protocol and the X.25 packet layer protocol.

The Record Boundary Preservation (RBP) feature offers a solution positioned between these two options: it allows logical message boundaries to be indicated without requiring the TCP host to be aware of X.25 protocol details.

## How Record Boundary Preservation Works

The TCP protocol does not attach significance to datagram boundaries, so a protocol must be layered over a TCP session to convey record boundary information. The Record Boundary Preservation protocol implements a 6-byte record header that specifies the amount of data following and indicates whether that data should be considered the final part of a logical record. Table 1 describes the format and contents of the record header.

**Table 1** Record Header Format

Byte	Description
Byte 0	Protocol identifier. This byte must contain the value 0xD7.
Byte 1	Protocol identifier. This byte must contain the value 0x4A.
Bytes 2 and 3	Payload length, in bytes, not including the header. Byte 2 contains the most significant byte of the length; byte 3 contains the least significant byte.
Byte 4	“More data” flag. This byte must contain one of the following values: <ul style="list-style-type: none"> <li>0x00—Indicates that this record is the final part of the data unit.</li> <li>0x01—Indicates that this record is not the final part of the data unit.</li> </ul>
Byte 5	Must contain the value 0x00.

When a router configured with RBP receives an X.25 call that matches a configured X.25 RBP map, the router attempts to open a TCP connection to the specified TCP destination. Each TCP session is mapped to one X.25 virtual circuit. If the TCP session is established, then X.25 data packets received from the caller are combined into logical records as indicated by use of the X.25 M-bit, and the contents of the data packets are forwarded to the TCP destination. The boundaries of these records are preserved by the record header.

The router will not split an X.25 data packet across multiple records unless the data packet exceeds the configured maximum record size; however, TCP will segment the data stream at arbitrary byte boundaries in accordance with TCP specifications.

X.25 data packets with the M-bit set may be combined as long as the resulting record does not exceed the configured maximum record size or, if a maximum record size was not configured, the maximum datagram size for the X.25 interface. The “more data” flag in the record header will reflect the value of the M-bit in the final X.25 data packet. This process of combining packets results in a series of zero or more records whose “more data” flag is set to the value 1 followed by a record whose “more data” flag is set to 0.

Incoming X.25 calls with the “delivery confirmation” bit (D-bit) set will be answered with the D-bit set. However, since the router is the endpoint of the X.25 circuit, X.25 data packets will be acknowledged as soon as their contents have been passed to the TCP connection without waiting for an acknowledgment for the TCP data, regardless of the value of the D-bit. TCP data will be acknowledged as soon as it has been converted to X.25 data packets.

The router will not send Receiver Not Ready (RNR) packets on the X.25 circuit; flow control will be accomplished by withholding acknowledgment.

The following situations will cause the X.25 circuit to be cleared (for an SVC) or reset (for a PVC) and the TCP connection to be closed: receipt of a data packet with the “qualified” bit (Q-bit) set; receipt of any packet type other than data, Receiver Ready (RR), or RNR; or a restart or lower-layer reset on the X.25 interface. When the circuit is cleared or reset, any data not yet passed to the TCP connection will be discarded.

When the router receives the records from the TCP session, it strips the record header and, on the basis of the information in the record header, reassembles the records into X.25 data packets. The data is interpreted as a fixed-length header followed by a variable-length payload whose length is specified in the record header. If the protocol ID or flag field in the header is invalid, the TCP connection will be closed and the X.25 circuit will be cleared or reset. The payload length may be greater than the X.25 packet size and need not be a multiple of the X.25 packet size.

A record that has the “more data” flag set will be logically combined with following records until a record that has the “more data” flag cleared is received. This process results in a sequence of maximum-sized X.25 data packets, each with the M-bit set, followed by an X.25 data packet containing the remaining data that does not have the M-bit set. The router will not wait for an entire record to be received before sending a maximum-size X.25 data packet.

As the records are reassembled into X.25 data packets, the packets are forwarded to the corresponding X.25 circuit.

The router will not set the D-bit or Q-bit on X.25 data packets being sent over circuits that are configured with RBP.

Data received by a router from a TCP session will be buffered while waiting for the other connection to be established. If the connection attempt fails, the data will be discarded. When a TCP connection is closed, the X.25 circuit will be cleared or reset, and any data not yet sent on the X.25 circuit will be discarded.

## RBP Header Encoding Examples

The following tables show examples of coding of the RBP header length field for both directions of data transfer (X.25 to RBP and RBP to X.25) for various data sizes. The tables also show the assembly of X.25 complete packet sequences into RBP records and vice versa.

In Table 2, the maximum X.25 packet size is 128 bytes, and the maximum RBP record size is 130 bytes.

**Table 2 Example of Coding of the RBP Header Length Field for Data Transfer from X.25 to RBP**

S.NoDELETE COLUMN?	Data size (bytes)	Number of X.25 data packets	Number of RBP records	Coding of RBP header bytes 2 and 3
1	128	128 (M-bit = 0)	128 ("more data" flag = 0)	Byte-2 = 0x00 Byte-3 = 0x80
2	129	128 (M-bit = 1) 1 (M-bit = 0)	129 ("more data" flag = 0)	Byte-2 = 0x00 Byte-3 = 0x81
3	130	128 (M-bit = 1) 2 (M-bit = 0)	130 ("more data" flag = 0)	Byte-2 = 0x00 Byte-3 = 0x82
4	131	128 (M-bit = 1) 3 (M-bit = 0)	130 ("more data" flag = 1) 1 ("more data" flag = 0)	Byte-2 = 0x00 Byte-3 = 0x83

In Table 3, the maximum RBP record size is 130 bytes, and the maximum X.25 packet size is 128 bytes.

**Table 3 Example of Coding of the RBP Header Length Field for Data Transfer from RBP to X.25**

S.NoDELETE COLUMN?	Data size (bytes)	Number of RBP records	Coding of RBP header bytes 2 and 3	Number of X.25 data packets
1	128	128 ("more data" flag = 0)	Byte-2 = 0x00 Byte-3 = 0x80	128 (M-bit = 0)
2	129	129 ("more data" flag = 0)	Byte-2 = 0x00 Byte-3 = 0x81	128 (M-bit = 1) 1 (M-bit = 0)
3	130	130 ("more data" flag = 0)	Byte-2 = 0x00 Byte-3 = 0x82	128 (M-bit = 1) 2 (M-bit = 0)
4	131	130 ("more data" flag = 1) 1 ("more data" flag = 0)	Byte-2 = 0x00 Byte-3 = 0x83	128 (M-bit = 1) 3 (M-bit = 0)

## Benefits

The X.25 Record Boundary Preservation for Data Communications Networks feature enables X.25 and TCP/IP hosts to exchange data while preserving X.25 packet boundaries and without having to carry the full X.25 protocol over the TCP session.

## Restrictions

- X.25 connections will be supported over leased-line X.25 interfaces only.
- Only the contents of the X.25 data packets and the record boundary information defined by the X.25 M-bit are conveyed to the TCP session. The contents of the X.25 call packet are used only to identify the corresponding **x25 map rbp** command; information from the call packet is not otherwise forwarded to the TCP host.

- When the X.25 circuit is cleared or reset, the X.25 cause and diagnostic codes are not forwarded to the TCP host.
- The call user data specified in incoming or outgoing calls must not conflict with protocol ID values recognized by the router.

## Related Documents

For more information about configuring X.25 networks, refer to the following documents:

- The chapter “Configuring X.25 and LAPB” in the *Cisco IOS Wide-Area Networking Configuration Guide*, Release 12.2
- The section “X.25 and LAPB Commands” in the *Cisco IOS Wide-Area Networking Command Reference*, Release 12.2

## Supported Platforms

- Cisco 2600 series
- Cisco 3620
- Cisco 3631
- Cisco 3640
- Cisco 3660
- Cisco 3725
- Cisco 3745
- Cisco 7100 Series
- Cisco 7200 Series
- Cisco 7500 Series
- Cisco MC3810 Series — Multiservice Access Concentrators

### Determining Platform Support Through Feature Navigator

Cisco IOS software is packaged in feature sets that support specific platforms. To get updated information regarding platform support for this feature, access Feature Navigator. Feature Navigator dynamically updates the list of supported platforms as new platform support is added for the feature.

Feature Navigator is a web-based tool that enables you to quickly determine which Cisco IOS software images support a specific set of features and which features are supported in a specific Cisco IOS image.

To access Feature Navigator, you must have an account on Cisco.com. If you have forgotten or lost your account information, send a blank e-mail to [cco-locksmith@cisco.com](mailto:cco-locksmith@cisco.com). An automatic check will verify that your e-mail address is registered with Cisco.com. If the check is successful, account details with a new random password will be e-mailed to you. Qualified users can establish an account on Cisco.com by following the directions at <http://www.cisco.com/register>.

Feature Navigator is updated regularly when major Cisco IOS software releases and technology releases occur. For the most current information, go to the Feature Navigator home page at the following URL:

<http://www.cisco.com/go/fn>

# Supported Standards, MIBs, and RFCs

## Standards

No new or modified standards are supported by this feature.

## MIBs

No new or modified MIBs are supported by this feature.

To obtain lists of supported MIBs by platform and Cisco IOS release, and to download MIB modules, go to the Cisco MIB website on Cisco.com at the following URL:

<http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml>

## RFCs

No new or modified RFCs are supported by this feature.

## Prerequisites

Documentation of the configuration tasks in this document assumes that you know how to configure X.25 networks.

## Configuration Tasks

See the following sections for configuration tasks for the X.25 Record Boundary Preservation for Data Communications Networks feature. One or more of the following tasks must be completed:

- [Configuring a PVC to Use RBP for Incoming X.25 Connections](#)
- [Configuring SVCs to Use RBP for Incoming X.25 Connections](#)
- [Configuring a PVC to Use RBP for Incoming TCP Connections](#)
- [Configuring SVCs to Use RBP for Incoming TCP Connections](#)

## Configuring a PVC to Use RBP for Incoming X.25 Connections

To configure the router to establish a TCP session in response to data received on an X.25 PVC and to use RBP protocol to transfer data between the X.25 host and the TCP session, use the following command in interface configuration mode:

Command	Purpose
<pre>Router(config-if)# x25 pvc circuit rbp remote host ip-address port port [packetsize in-size out-size] [source-interface interface] [recordsize size] [windowsize in-size out-size]</pre>	<p>Configures the router to establish a TCP session in response to data received on an X.25 PVC and to use RBP protocol to transfer data between the X.25 host and the TCP session.</p> <ul style="list-style-type: none"> <li>• When a PVC is configured to use RBP, the VC must be unique. Multiple commands referencing the same VC (matching logical channel identifier and interface) are not permitted.</li> </ul>

When the **x25 pvc rbp remote** command is configured, the router will wait until a data packet is received on the specified X.25 PVC; in the meantime, the router will acknowledge any X.25 reset packets on the circuit. When a data packet is received, the router will attempt to establish a TCP connection to the configured IP address and TCP port, using a dynamically assigned local TCP port number. If the connection attempt fails, the router will reset the permanent virtual circuit and will wait for another data packet before attempting to establish the TCP connection. Since this command is associated with a specific X.25 circuit, at most one connection may be active per command.

## Configuring SVCs to Use RBP for Incoming X.25 Connections

To configure the router to establish TCP sessions in response to incoming X.25 calls, and to use RBP to transfer data between the X.25 circuit and the corresponding TCP session, use the following command in interface configuration mode:

Command	Purpose
<pre>Router(config-if)# <b>x25 map rbp</b> x121-address [cud string] <b>remote host</b> ip-address port port [<b>accept-reverse</b>] [<b>recordsize</b> size] [<b>source-interface</b> interface]</pre>	Configures the router to establish TCP sessions in response to incoming X.25 calls and to use RBP to transfer data between the X.25 circuit and the corresponding TCP session.

When the **x25 map rbp remote** command is configured, the router will accept an incoming X.25 call if the destination address matches an X.25 address configured on the interface on which the call is received, and if the calling address and call user data matches the configured value. When the call is accepted, the router will attempt to open a TCP connection to the configured IP address and TCP port, using a dynamically assigned local TCP port number. If the TCP connection cannot be opened, the X.25 call will be cleared. The number of X.25 calls that may be accepted is limited only by router resources. No information from the X.25 call packet is provided to the TCP/IP host.

## Configuring a PVC to Use RBP for Incoming TCP Connections

To configure the router to accept an incoming TCP connection on a specified TCP port, and to use RBP over that session to transfer data between the TCP host and an X.25 PVC, use the following command in interface configuration mode:

Command	Purpose
<pre>Router(config-if)# x25 pvc circuit rbp local port port [packet-size in-size out-size] [record-size size] [window-size in-size out-size]</pre>	<p>Configures the router to establish a TCP session to a specified TCP host and port in response to incoming data on an X.25 PVC and to use the RBP protocol over that TCP session to transfer data between the TCP host and the X.25 PVC.</p> <ul style="list-style-type: none"> <li>The local TCP port number must be unique, with the exception that the same TCP port number may be configured once on each of multiple X.25 interfaces that will not be active simultaneously; this includes the case in which one X.25 interface is configured as a backup interface for another X.25 interface.</li> <li>When a PVC is configured to use RBP, the VC must be unique. Multiple commands referencing the same VC (matching logical channel identifier and interface) are not permitted.</li> </ul>

When the **x25 pvc rbp local** command is configured, the router will listen for a TCP connection request to the configured TCP port. Until the connection request is received, any data packets received on the X.25 PVC will cause the PVC to be reset. When the TCP connection request is received, the connection will be accepted, and the router will send an X.25 reset packet over the configured X.25 destination circuit. If the reset packet is not acknowledged, the TCP connection will be closed. Since this command is associated with a specific X.25 circuit, only one connection may be active per command.

## Configuring SVCs to Use RBP for Incoming TCP Connections

To configure the router to establish X.25 circuits in response to incoming TCP connections, and to use RBP to transfer data between the TCP session and the corresponding X.25 circuit, use the following command in interface configuration mode:

Command	Purpose
<pre>Router(config-if)# x25 map rbp x121-address [cud string] local port port [cug group-number] [packet-size in-size out-size] [record-size size] [reverse] [roa name] [throughput in out] [transit-delay milliseconds] [window-size in-size out-size]</pre>	<p>Configures the router to establish X.25 circuits in response to incoming TCP connections on a specified TCP port and to use RBP to transfer data between the TCP session and the corresponding X.25 circuit.</p> <ul style="list-style-type: none"> <li>The local TCP port number must be unique, with the exception that the same TCP port number may be configured once on each of multiple X.25 interfaces that will not be active simultaneously; this includes the case in which one X.25 interface is configured as a backup interface for another X.25 interface.</li> </ul>

When the **x25 map rbp local port** command is configured, the router will listen for a TCP connection request to the configured TCP port. When the connection is accepted, the router will place an X.25 call using the configured X.25 destination interface, destination address, and call user data. If the call is not

successfully completed, the TCP connection will be closed. The number of connections that may be established to the TCP port is limited only by router resources. No information from the TCP connection is included in the X.25 call packet sent to the X.25 host.

## Verifying Record Boundary Preservation

To verify that RBP connections are configured and performing correctly, complete the following steps.

**Step 1** Enter the **show x25 map** command to display information about the configured address maps.

The following is sample output of the **show x25 map** command for a router that is configured with RBP using the **x25 pvc rbp remote** command:

```
Router# show x25 map

Serial1/0:-> rbp, destination host 10.0.0.33 port 9999
PVC, 1 VC:1/P
```

The following is sample output of the **show x25 map** command for a router that is configured with RBP using the **x25 map rbp remote** command:

```
Router# show x25 map

Serial3/0:12132 -> rbp, destination host 10.0.0.32 port 9999
permanent, 1 VC:1024
```

The following is sample output of the **show x25 map** command for a router that is configured with RBP using the **x25 pvc rbp local** command:

```
Router# show x25 map

Serial3/0:<- rbp, listening at port 9999
PVC, 1 VC:2/P
```

The following is sample output of the **show x25 map** command for a router that is configured with RBP using the **x25 map rbp local** command:

```
Router# show x25 map

Serial1/0:12131 <- rbp, listening at port 9999
permanent, 1 VC:1
```

For descriptions of the **show x25 map** display fields, see the [show x25 map](#) command page later in this document.

**Step 2** Enter the **show x25 vc** command to display information about configured SVCs and PVCs.

The following is sample output of the **show x25 vc** command for a PVC configured with record boundary preservation:

```
Router# show x25 vc

PVC 2, State:D1, Interface:Serial3/0
Started 00:08:08, last input 00:00:01, output 00:00:01
recordsize:1500, connected
local address 10.0.0.1 port 9999; remote address 10.0.0.5 port 11029
deferred ack:1
Window size input:2, output:2
Packet size input:128, output:128
PS:2 PR:2 ACK:1 Remote PR:2 RCNT:1 RNR:no
P/D state timeouts:0 timer (secs):0
```

```
data bytes 8000/8000 packets 80/80 Resets 9/0 RNRS 0/0 REJs 0/0 INTs 0/0
```

For descriptions of the **show x25 pvc** display fields, see the [show x25 vc](#) command page later in this document.

**Step 3** Enter the **show tcp** command to display the status of TCP connections.

The following is sample output of the **show tcp** command:

```
Router# show tcp

Stand-alone TCP connection from host 10.0.0.5
Connection state is ESTAB, I/O status:1, unread input bytes:0
Local host:10.0.0.1, Local port:9999
Foreign host:10.0.0.5, Foreign port:11003

Enqueued packets for retransmit:0, input:0 mis-ordered:0 (0 bytes)

TCP driver queue size 0, flow controlled FALSE

Event Timers (current time is 0x1D0CF8):
Timer           Starts    Wakeups      Next
Retrans         11         0            0x0
TimeWait        0          0            0x0
AckHold         10         0            0x0
SendWnd         0          0            0x0
KeepAlive       20         0            0x1DF68C
GiveUp          0          0            0x0
PmtuAger        0          0            0x0
DeadWait        0          0            0x0

iss:2946187848  snduna:2946188909  sndnxt:2946188909  sndwnd: 7132
irs:1353667951  rcvnxt:1353669012  rcvwnd: 7132  delrcvwnd: 1060

SRTT:231 ms, RTTO:769 ms, RTV:538 ms, KRTT:0 ms
minRTT:0 ms, maxRTT:300 ms, ACK hold:200 ms
Flags:passive open, retransmission timeout, keepalive running
gen tcbs

Datagrams (max data segment is 1460 bytes):
Rcvd:22 (out of order:0), with data:10, total data bytes:1060
Sent:21 (retransmit:0, fastretransmit:0), with data:10, total data bytes:1060
```

## Monitoring and Maintaining RBP

To monitor RBP, use the following command in privileged EXEC mode:

Command	Purpose
Router# <b>debug x25</b>	Displays information about X.25 traffic.

## Configuration Examples

This section provides the following configuration examples:

- [PVC Configured to Use RBP for Incoming X.25 Connections Example](#)
- [SVCs Configured to Use RBP for Incoming X.25 Connections Example](#)
- [PVC Configured to Use RBP for Incoming TCP Connections Example](#)
- [SVCs Configured to Use RBP for Incoming TCP Connections Example](#)

### PVC Configured to Use RBP for Incoming X.25 Connections Example

In the following example, when PVC 1 receives a data packet from the X.25 host, the router will attempt to establish a TCP connection to port 9999 at the TCP/IP host that has the IP address 10.0.0.1.

```
Interface Serial1/0
 encapsulation x25
 x25 pvc 1 rbp remote host 10.0.0.1 port 9999
```

### SVCs Configured to Use RBP for Incoming X.25 Connections Example

In the following example, if serial interface 1/0 receives an X.25 call from 12132, the router will map the call and open a TCP connection to port number 9999 at the remote TCP/IP host that has the IP address 10.0.0.1.

```
interface Serial1/0
 encapsulation x25 dce
 x25 address 12030
 x25 map rbp 12132 remote host 10.0.0.1 port 9999
```

### PVC Configured to Use RBP for Incoming TCP Connections Example

In the following example, the router is configured to listen for a TCP connection request on port 9999. When a TCP connection is established, the router will send an X.25 reset over the configured X.25 destination circuit.

```
Interface serial2/1
 encapsulation x25
 x25 pvc 2 rbp local port 9999
```

### SVCs Configured to Use RBP for Incoming TCP Connections Example

In the following example, if the router receives a request for a TCP connection at port 9999, the router will make an X.25 call with no call user data to address 12131.

```
interface Serial1/0
 encapsulation x25 dce
 x25 address 13133
 x25 map rbp 12131 local port 9999
```

# Command Reference

This section documents new and modified commands. All other commands used with this feature are documented in the Cisco IOS Release 12.2 command reference publications.

## New Commands

- [x25 map rbp local](#)
- [x25 map rbp remote](#)
- [x25 pvc rbp local](#)
- [x25 pvc rbp remote](#)

## Modified Commands

- [debug x25](#)
- [show x25 map](#)
- [show x25 vc](#)

# debug x25

To display information about X.25 traffic, use one of the following **debug x25** commands in privileged EXEC mode. The commands allow you to display all information or an increasingly restrictive part of the information.



## Caution

This command can generate large amounts of debugging output. If logging of debug output to the router console is enabled (the default condition), this output may fill the console buffer, preventing the router from processing packets until the contents of the console buffer have been printed. To prevent this, do one or more of the following:

- Disable logging of debug output to the console. Refer to the **logging console** command for more information.
- Configure the router to discard console output when the buffer overflows. Refer to the **logging console guaranteed** command for more information.
- Use this command only when all of the reportable X.25 traffic is less than five packets per second (pps).

To display information about all X.25 traffic, including traffic for X.25, Connection Mode Network Service (CMNS), and X.25 over TCP (XOT) services, use the **debug x25** command (default **all**). To disable debugging output, use the **no** form of this command.

**debug x25**

**no debug x25**

To display information about all X.25 traffic except data and resource record packets, use the **debug x25 events** command. To disable debugging output, use the **no** form of this command.

**debug x25 events**

**no debug x25 events**

To display information about a specific X.25 service class, use the following form of the **debug x25** command. To disable debugging output, use the **no** form of this command.

**debug x25** [**only** | **cmns** | **xot**] [**events** | **all**]

**no debug x25** [**only** | **cmns** | **xot**] [**events** | **all**]

To display information about a specific X.25 or CMNS context, use the following form of the **debug x25** command. To disable debugging output, use the **no** form of this command.

**debug x25 interface** {*serial-interface* | *cmns-interface* **mac** *mac-address*} [**events** | **all**]

**no debug x25 interface** {*serial-interface* | *cmns-interface* **mac** *mac-address*} [**events** | **all**]

To display information about a specific X.25 or CMNS virtual circuit, use the following form of the **debug x25** command. To disable debugging output, use the **no** form of this command.

```
debug x25 interface {serial-interface | cmns-interface mac mac-address} vc number
[events | all]
```

```
no debug x25 interface {serial-interface | cmns-interface mac mac-address} vc number
[events | all]
```

To display information about traffic for all virtual circuits that use a given number, use the following form of the **debug x25** command. The **no** form of this command removes the filter for a particular virtual circuit from the **debug x25 all** or **debug x25 events** output. To disable debugging output, use the **no** form of this command.

```
debug x25 vc number [events | all]
```

```
no debug x25 vc number [events | all]
```

To display information about traffic to or from a specific X.25 over TCP (XOT) host, use the following form of the **debug x25 xot** command. To disable debugging output, use the **no** form of this command.

```
debug x25 xot [remote ip-address [port number]] [local ip-address [port number]]
[events | all]
```

```
no debug x25 xot [remote ip-address [port number]] [local ip-address [port number]]
[events | all]
```

Use the **debug x25** command with the **aodi** keyword to display information about an interface running PPP over an X.25 session. To disable debugging output, use the **no** form of this command.

```
debug x25 aodi
```

```
no debug x25 aodi
```

Syntax Description	
<b>events</b>	(Optional) Displays all traffic except Data and Receiver Ready (RR) packets.
<b>only</b>   <b>cmns</b>   <b>xot</b>	(Optional) Displays information about the specified services: X.25 only, CMNS, or XOT.
<b>all</b>	(Optional) Displays all traffic.
<i>serial-interface</i>	X.25 serial interface.
<i>cmns-interface</i> <b>mac</b> <i>mac-address</i>	MAC address of the CMNS interface and remote host. The interface type can be Ethernet, Token Ring, or FDDI.
<b>vc number</b>	Virtual circuit number, in the range from 1 to 4095.
<b>remote</b> <i>ip-address</i> [ <b>port number</b> ]	(Optional) Remote IP address and, optionally, a port number in the range from 1 to 65535.
<b>local</b> <i>ip-address</i> [ <b>port number</b> ]	(Optional) Local host IP address and, optionally, a port number in the range from 1 to 65535.
<b>aodi</b>	Causes the <b>debug x25</b> command to display Always On/Dynamic ISDN (AO/DI) events and processing information.

**Defaults** All traffic is displayed.

**Command Modes** Privileged EXEC

Release	Modification
10.0	This command was introduced.
12.0(5)T	For DNS-based X.25 routing, additional functionality was added to the <b>debug x25 events</b> command to describe the events occurring while resolving the X.25 address to an IP address using a DNS server. The <b>debug domain</b> command can be used along with <b>debug x25 events</b> to observe the whole DNS-based X.25 routing data flow.
12.0(7)T	For the X.25 CUGs feature, functionality was added to the <b>debug x25 events</b> command to describe events occurring during CUG activity.
12.2(8)T	The <b>debug x25 events</b> command was enhanced to display events specific to Record Boundary Preservation protocol.

**Usage Guidelines** This command is particularly useful for diagnosing problems encountered when placing calls. The **debug x25 all** output includes data, control messages, and flow control packets for all virtual circuits of the router.

All **debug x25** command forms can take either the **events** or **all** keyword. The keyword **all** is the default and causes all packets meeting the other debug criteria to be reported. The keyword **events** omits reports of any Data or Receiver Ready (RR) flow control packets; the normal flow of data and RR packets is commonly large and less interesting to the user, so event reporting can significantly decrease the processor load induced by debug reporting.

The **debug x25 interface** command is useful for diagnosing problems encountered with a single X.25 or CMNS host or virtual circuit.

Because no interface is specified by the **debug x25 vc** command, traffic on any virtual circuit that has the specified number is reported.

Virtual circuit zero (**vc 0**) cannot be specified. It is used for X.25 service messages, such as RESTART packets, not virtual circuit traffic. Service messages can be monitored only when no virtual circuit filter is used.

The **debug x25 xot** output allows you to restrict the debug output reporting to XOT traffic for one or both hosts or host/port combinations. Because each XOT virtual circuit uses a unique TCP connection, an XOT debug request that specifies both host addresses and ports will report traffic only for that virtual circuit. Also, you can restrict reporting to sessions initiated by the local or remote router by specifying 1998 for the remote or local port. (XOT connections are received on port 1998.)

Use the **debug x25 aodi** command to display interface PPP events running over an X.25 session and to debug X.25 connections between a client and server configured for AO/DI.

**Examples** The following is sample output from the **debug x25** command, displaying output concerning the functions X.25 restart, call setup, data exchange, and clear:

```
Router# debug x25

Serial0: X.25 I R/Inactive Restart (5) 8 lci 0
Cause 7, Diag 0 (Network operational/No additional information)
```

```

Serial0: X.25 O R3 Restart Confirm (3) 8 lci 0
Serial0: X.25 I P1 Call (15) 8 lci 1
From(6): 170091 To(6): 170090
  Facilities: (0)
  Call User Data (4): 0xCC000000 (ip)
Serial0: X.25 O P3 Call Confirm (3) 8 lci 1
Serial0: X.25 I D1 Data (103) 8 lci 1 PS 0 PR 0
Serial0: X.25 O D1 Data (103) 8 lci 1 PS 0 PR 1
Serial0: X.25 I P4 Clear (5) 8 lci 1
  Cause 9, Diag 122 (Out of order/Maintenance action)
Serial0: X.25 O P7 Clear Confirm (3) 8 lci 1

```

The following example shows a sequence of increasingly restrictive **debug x25** commands:

```

Router# debug x25

X.25 packet debugging is on

Router# debug x25 events

X.25 special event debugging is on

Router# debug x25 interface serial 0

X.25 packet debugging is on
X.25 debug output restricted to interface Serial0

Router# debug x25 vc 1024

X.25 packet debugging is on
X.25 debug output restricted to VC number 1024

Router# debug x25 interface serial 0 vc 1024

X.25 packet debugging is on
X.25 debug output restricted to interface Serial0
X.25 debug output restricted to VC number 1024

Router# debug x25 interface serial 0 vc 1024 events

X.25 special event debugging is on
X.25 debug output restricted to interface serial 0
X.25 debug output restricted to VC number 1024

```

The following examples show the normal sequence of events for both the AO/DI client and the server sides:

**Client Side**

```
Router# debug x25 aodi
```

```
PPP-X25: Virtual-Access1: Initiating AODI call request
PPP-X25: Bringing UP X.25 AODI VC
PPP-X25: AODI Client Call Confirm Event Received
PPP-X25: Cloning interface for AODI is Di1
PPP-X25: Queuing AODI Client Map Event
PPP-X25: Event:AODI Client Map
PPP-X25: Created interface Vi2 for AODI service
PPP-X25: Attaching primary link Vi2 to Di1
PPP-X25: Cloning Vi2 for AODI service using Di1
PPP-X25: Vi2: Setting the PPP call direction as OUT
PPP-X25: Vi2: Setting vectors for RFC1598 operation on BRI3/0:0 VC 0
PPP-X25: Vi2: Setting the interface default bandwidth to 10 Kbps
PPP-X25: Virtual-Access2: Initiating AODI call request
PPP-X25: Bringing UP X.25 AODI VC
PPP-X25: AODI Client Call Confirm Event Received
```

**Server Side**

```
Router# debug x25 aodi
```

```
PPP-X25: AODI Call Request Event Received
PPP-X25: Event:AODI Incoming Call Request
PPP-X25: Created interface Vi1 for AODI service
PPP-X25: Attaching primary link Vi1 to Di1
PPP-X25: Cloning Vi1 for AODI service using Di1
PPP-X25: Vi1: Setting vectors for RFC1598 operation on BRI3/0:0 VC 1
PPP-X25: Vi1: Setting the interface default bandwidth to 10 Kbps
PPP-X25: Binding X.25 VC 1 on BRI3/0:0 to Vi1
```

**debug x25 events for X.25 CUGs**

The following example of the **debug x25 events** command shows output related to the X.25 closed user groups (CUGs) feature. It shows messages concerning a data communications equipment (DCE) device rejecting a call because the selected network CUG had not been subscribed to by the caller.

```
Router# debug x25 events
```

```
00:48:33:Serial1:X.25 I R1 Call (14) 8 lci 1024
00:48:33: From (3):111 To (3):444
00:48:33: Facilities:(2)
00:48:33: Closed User Group (basic):40
00:48:33: Call User Data (4):0x01000000 (pad)
00:48:33:X.25 Incoming Call packet, Closed User Group (CUG) protection, selected network
CUG not subscribed
00:48:33:Serial1:X.25 O R1 Clear (5) 8 lci 1024
00:48:33: Cause 11, Diag 65 (Access barred/Facility code not allowed)
```

**debug x25 events for DNS-Based X.25 Routing**

The following example of the **debug x25 events** command shows output related to the DNS-Based X.25 Routing feature. It shows messages concerning access to the Domain Name System (DNS) server. In the following example, nine alternate addresses for one XOT path are entered in the DNS server database. All nine addresses are returned to the host cache of the router by the DNS server. However, only six addresses will be used during the XOT switch attempt because this is the limit that XOT allows.

```
Router# debug x25 events
```

```
00:18:25:Serial1:X.25 I R1 Call (11) 8 lci 1024
00:18:25: From (0): To (4):444
00:18:25: Facilities:(0)
```

```

00:18:25: Call User Data (4):0x01000000 (pad)
00:18:25:X.25 host name sent for DNS lookup is "444"
00:18:26:%3-TRUNCATE_ALT_XOT_DNS_DEST:Truncating excess XOT addresses (3)
returned by DNS
00:18:26:DNS got X.25 host mapping for "444" via network
00:18:32:[10.1.1.8 (pending)]:XOT open failed (Connection timed out; remote host not
responding)
00:18:38:[10.1.1.7 (pending)]:XOT open failed (Connection timed out; remote host not
responding)
00:18:44:[10.1.1.6 (pending)]:XOT open failed (Connection timed out; remote host not
responding)
00:18:50:[10.1.1.5 (pending)]:XOT open failed (Connection timed out; remote host not
responding)
00:18:56:[10.1.1.4 (pending)]:XOT open failed (Connection timed out; remote host not
responding)
00:20:04:[10.1.1.3,1998/10.1.1.3,11007]:XOT O P2 Call (17) 8 lci 1
00:20:04: From (0): To (4):444
00:20:04: Facilities:(6)
00:20:04: Packet sizes:128 128
00:20:04: Window sizes:2 2
00:20:04: Call User Data (4):0x01000000 (pad)
00:20:04:[10.1.1.3,1998/10.1.1.3,11007]:XOT I P2 Call Confirm (11) 8 lci 1
00:20:04: From (0): To (0):
00:20:04: Facilities:(6)
00:20:04: Packet sizes:128 128
00:20:04: Window sizes:2 2
00:20:04:Serial1:X.25 O R1 Call Confirm (5) 8 lci 1024
00:20:04: From (0): To (0):
00:20:04: Facilities:(0)

```

### Record Boundary Preservation Examples

The following examples show output for the **x25 debug events** command when record boundary preservation (RBP) has been configured using the **x25 map rbp local** command.

The following display shows establishment of connection:

```

X25 RBP:Incoming connection for port 9999 from 10.0.155.30 port 11001
Serial0/1:X.25 O R1 Call (10) 8 lci 64
  From (5):13133 To (5):12131
  Facilities:(0)
Serial0/1:X.25 I R1 Call Confirm (3) 8 lci 64

```

The following display shows that the X.25 call was cleared by the X.25 host:

```

Serial0/1:X.25 I R1 Clear (5) 8 lci 64
  Cause 0, Diag 122 (DTE originated/Maintenance action)
X25 RBP:X.25 circuit cleared
Serial0/1:X.25 O R1 Clear Confirm (3) 8 lci 64

```

The following display shows that the TCP session has terminated:

```

[10.0.155.30,11000/10.0.155.33,9999]:TCP receive error, End of data transfer
X25 RBP:End of data transfer
Serial0/1:X.25 O R1 Clear (5) 8 lci 64
Cause 9, Diag 122 (Out of order/Maintenance action)
Serial0/1:X.25 I R1 Clear Confirm (3) 8 lci 64

```

The following examples show output of the **x25 debug events** command when RBP has been configured using the **x25 pvc rbp local** command.

The following display shows data on the PVC before the TCP session has been established:

```

X25 RBP>Data on unconnected PVC
Serial1/0:X.25 O D1 Reset (5) 8 lci 1

```

```
Cause 0, Diag 113 (DTE originated/Remote network problem)
Serial1/0:X.25 I D2 Reset Confirm (3) 8 lci 1
```

The following display shows establishment of connection:

```
X25 RBP:Incoming connection for port 9998 from 2.30.0.30 port 11002
Serial1/0:X.25 O D1 Reset (5) 8 lci 1
Cause 0, Diag 0 (DTE originated/No additional information)
Serial1/0:X.25 I D2 Reset Confirm (3) 8 lci 1
```

The following display shows termination of connection when the X.25 PVC was reset:

```
Serial1/0:X.25 I D1 Reset (5) 8 lci 1
Cause 15, Diag 122 (Network operational (PVC)/Maintenance action)
X25 RBP:Reset packet received
Serial1/0:X.25 O D3 Reset Confirm (3) 8 lci 1
```

The following display shows that the TCP session has terminated:

```
[2.30.0.30,11003/2.30.0.33,9998]:TCP receive error, End of data transfer
X25 RBP:End of data transfer
Serial1/0:X.25 O D1 Reset (5) 8 lci 1
Cause 0, Diag 113 (DTE originated/Remote network problem)
Serial1/0:X.25 I D2 Reset Confirm (3) 8 lci 1
```

The following examples show output of the **x25 debug events** command when RBP has been configured using the **x25 map rbp remote** command.

The following display shows that the X.25 call was cleared:

```
Serial0/1:X.25 I R1 Clear (5) 8 lci 1024
Cause 0, Diag 122 (DTE originated/Maintenance action)
X25 RBP:X.25 circuit cleared
Serial0/1:X.25 O R1 Clear Confirm (3) 8 lci 1024
```

The following display shows that the X.25 call was reset:

```
Serial0/1:X.25 I D1 Reset (5) 8 lci 1024
Cause 0, Diag 122 (DTE originated/Maintenance action)
X25 RBP:Reset packet received
Serial0/1:X.25 O R1 Clear (5) 8 lci 1024
Cause 9, Diag 122 (Out of order/Maintenance action)
Serial0/1:X.25 I R1 Clear Confirm (3) 8 lci 1024
```

The following examples show output of the **x25 debug events** command when RBP has been configured using the **x25 pvc rbp remote** command.

The following display shows that the X.25 PVC has been reset:

```
Serial0/0:X.25 I D1 Reset (5) 8 lci 1
Cause 0, Diag 122 (DTE originated/Maintenance action)
X25 RBP:Reset packet received
Serial0/0:X.25 O D2 Reset Confirm (3) 8 lci 1
```

The following display shows that the connection was terminated when the X.25 interface was restarted:

```
Serial0/0:X.25 I R1 Restart (5) 8 lci 0
Cause 0, Diag 122 (DTE originated/Maintenance action)
X25 RBP:X.25 PVC inactive
Serial0/0:X.25 O R2 Restart Confirm (3) 8 lci 0
Serial0/0:X.25 O D1 Reset (5) 8 lci 1
Cause 1, Diag 113 (Out of order (PVC)/Remote network problem)
Serial0/0:X.25 I D3 Reset Confirm (3) 8 lci 1
```

Table 4 describes the significant fields shown in the displays.

**Table 4** *debug x25 Field Descriptions*

Field	Description
Serial0	Interface on which the X.25 event occurred.
X.25	Type of event this message describes.
I	Letter indicating whether the X.25 packet was input (I) or output (O) through the interface.
R3	<p>State of the service or virtual circuit (VC). Possible values follow:</p> <ul style="list-style-type: none"> <li>• R/Inactive—Packet layer awaiting link layer service</li> <li>• R1—Packet layer ready</li> <li>• R2—Data terminal equipment (DTE) restart request</li> <li>• R3—Data circuit-terminating equipment (DCE) restart indication</li> <li>• P/Inactive—VC awaiting packet layer service</li> <li>• P1—Idle</li> <li>• P2—DTE waiting for DCE to connect CALL</li> <li>• P3—DCE waiting for DTE to accept CALL</li> <li>• P4—Data transfer</li> <li>• P5—CALL collision</li> <li>• P6—DTE clear request</li> <li>• P7—DCE clear indication</li> <li>• D/Inactive—VC awaiting setup</li> <li>• D1—Flow control ready</li> <li>• D2—DTE reset request</li> <li>• D3—DCE reset indication</li> </ul> <p>See Annex B of the <i>ITU-T Recommendation X.25</i> for more information on these states.</p>

**Table 4** *debug x25 Field Descriptions (continued)*

Field	Description
Restart	The type of X.25 packet. Possible values follow: <ul style="list-style-type: none"> <li>• R Events <ul style="list-style-type: none"> <li>—Restart</li> <li>—Restart Confirm</li> <li>—Diagnostic</li> </ul> </li> <li>• P Events <ul style="list-style-type: none"> <li>—Call</li> <li>—Call Confirm</li> <li>—Clear</li> <li>—Clear Confirm</li> </ul> </li> <li>• D Events <ul style="list-style-type: none"> <li>—Reset</li> <li>—Reset Confirm</li> </ul> </li> <li>• D1 Events <ul style="list-style-type: none"> <li>—Data</li> <li>—RNR (Receiver Not Ready)</li> <li>—RR (Receiver Ready)</li> <li>—Interrupt</li> <li>—Interrupt Confirm</li> </ul> </li> <li>• XOT Overhead <ul style="list-style-type: none"> <li>—PVC Setup</li> </ul> </li> </ul>
(5)	Number of bytes in the packet.
8	Modulo of the virtual circuit. Possible values are 8 and 128.
lci 0	VC number. See Annex A of the <i>ITU-T Recommendation X.25</i> for information on VC assignment.
Cause 7	Code indicating the event that triggered the packet. The Cause field can only appear in entries for Clear, Reset, and Restart packets. Possible values for the Cause field can vary, depending on the type of packet. See the appendix “X.25 Cause and Diagnostic Codes” in the <i>Cisco IOS Debug Command Reference</i> for an explanation of these codes.
Diag 0	Code providing an additional hint as to what, if anything, went wrong. The Diag field can only appear in entries for Clear, Diagnostic (as “error 0”), Reset, and Restart packets. See the appendix “X.25 Cause and Diagnostic Codes” in the <i>Cisco IOS Debug Command Reference</i> for an explanation of these codes.
(Network operational/ No additional information)	The standard explanations of the Cause and Diagnostic codes ( <i>cause/diag</i> ).

# show x25 map

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

**show x25 map**

---

**Syntax Description** This command has no arguments or keywords.

---

**Command Modes** EXEC

---

Command History	Release	Modification
	10.0	This command was introduced.
	12.2(8)T	This command was modified to display record boundary preservation information for address maps.

---



---

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

- Configured maps (defined by the **x25 map** command)
- Maps implicitly defined by encapsulation permanent virtual circuits (PVCs) (defined by the encapsulating version of the **x25 pvc** command)
- Dynamic maps (from the X.25 Defense Data Network [DDN] or Blacker Front End [BFE] operations)

---

## Examples

### Record Boundary Preservation Examples

The following is sample output of the **show x25 map** command for a router that is configured with RBP using the **x25 pvc rbp remote** command:

```
Router# show x25 map

Serial1/0:-> rbp, destination host 10.0.0.33 port 9999
PVC, 1 VC:1/P
```

The following is sample output of the **show x25 map** command for a router that is configured with RBP using the **x25 map rbp remote** command:

```
Router# show x25 map

Serial3/0:12132 -> rbp, destination host 10.0.0.32 port 9999
permanent, 1 VC:1024
```

The following is sample output of the **show x25 map** command for a router that is configured with RBP using the **x25 pvc rbp local** command:

```
Router# show x25 map

Serial3/0:<- rbp, listening at port 9999
PVC, 1 VC:2/P
```

The following is sample output of the **show x25 map** command for a router that is configured with RBP using the **x25 map rbp local** command:

```
Router# show x25 map

Serial1/0:12131 <- rbp, listening at port 9999
    permanent, 1 VC:1
```

Table 5 describes significant fields shown in the display.

**Table 5** *show x25 map Field Descriptions for Maps That Use Record Boundary Preservation*

Field	Description
Serial1/0	Interface on which this map is configured.
12131	(For SVCs only) X.121 address of the remote host. If any call user data is configured, it will appear in this field also.
-> rbp	Indicates an outgoing TCP session that is configured to use RBP.
<- rbp	Indicates an incoming TCP session that is configured to use RBP.
destination host 10.0.0.32 port 9999	IP address and port number of the destination host for an outgoing TCP session.
listening at port 9999	Port number on which the router is listening for a TCP connection request for incoming TCP sessions.
permanent	Indicates that the address map was explicitly configured using the <b>x25 map rbp local</b> or <b>x25 rbp remote</b> command.
PVC	Indicates that the address map was created when a PVC was configured using the <b>x25 pvc rbp local</b> or <b>x25 pvc rbp remote</b> command.
1 VC:1	Number of circuits associated with the map, followed by a list of circuit numbers. /P indicates a PVC.

### Typical X.25 Maps Example

The following is sample output from the **show x25 map** for five maps that were configured with the **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, window size 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 five maps have been configured for a router: two for serial interface 0, two for serial interface 1, and one for the serial interface 2 (which maps eight protocols to the host).

Table 6 describes significant fields shown in the display.

**Table 6** *show x25 map Field Descriptions for Typical X.25 Maps*

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 protocols 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. Connectionless Network Service (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: <ul style="list-style-type: none"> <li>• CONSTRUCTED—Derived with the DDN or BFE address conversion scheme.</li> <li>• PERMANENT—Map was entered with the <b>x25 map</b> interface configuration command.</li> <li>• PVC—Map was configured with the <b>x25 pvc</b> interface command.</li> </ul>
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.  Note that a single protocol virtual circuit can be associated with a multiprotocol map.

## show x25 vc

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

```
show x25 vc [lcn]
```

<b>Syntax Description</b>	<i>lcn</i>	(Optional) Logical channel number (LCN).
<b>Command Modes</b>	EXEC	
<b>Command History</b>	<b>Release</b>	<b>Modification</b>
	8.3	This command was introduced in a release prior to Release 8.3.
	12.2(8)T	This command was modified to display information about record boundary preservation.

**Usage Guidelines**

To examine a particular virtual circuit number, add an LCN argument to the **show x25 vc** command. This command displays information about virtual circuits (VCs). VCs may be used for a number of purposes, such as the following:

- Encapsulation traffic
- Traffic switched between X.25 services (X.25, Connection-Mode Network Service [CMNS], and X.25 over TCP/IP [XOT])
- PAD traffic
- QLLC traffic

The connectivity information displayed will vary according to the traffic carried by the VC. 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.

### Examples

#### Record Boundary Preservation Example

The following is sample output of the **show x25 vc** command for a PVC configured with record boundary preservation:

```
Router# show x25 vc

PVC 2, State:D1, Interface:Serial3/0
  Started 00:08:08, last input 00:00:01, output 00:00:01
  recordsize:1500, connected
  local address 10.0.0.1 port 9999; remote address 10.0.0.5 port 11029
  deferred ack:1
  Window size input:2, output:2
  Packet size input:128, output:128
  PS:2 PR:2 ACK:1 Remote PR:2 RCNT:1 RNR:no
  P/D state timeouts:0 timer (secs):0
  data bytes 8000/8000 packets 80/80 Resets 9/0 RNRs 0/0 REJs 0/0 INTs 0/0
```

Table 7 describes the fields shown in the sample output that are typical for virtual circuits.

**Table 7** *show x25 vc Field Descriptions*

Field	Description
SVC <i>n</i> or PVC <i>n</i>	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) <sup>1</sup> 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	Time of last output.
Connects...<-->..	Traffic-specific connection information. See <a href="#">Table 9</a> , <a href="#">Table 10</a> , <a href="#">Table 11</a> , and <a href="#">Table 12</a> 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 (and is displayed only when values are not 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 not zero).
data bytes <i>m/n</i> packets <i>p/q</i>	Total number of data bytes sent ( <i>m</i> ), data bytes received ( <i>n</i> ), data packets sent ( <i>p</i> ), and data packets received ( <i>q</i> ) since the circuit was established.

**Table 7** *show x25 vc Field Descriptions (continued)*

Field	Description
Resets <i>t/r</i>	Total number of reset packets transmitted/received since the circuit was established.
RNRs <i>t/r</i>	Total number of Receiver Not Ready packets transmitted/received since the circuit was established.
REJs <i>t/r</i>	Total number of Reject packets transmitted/received since the circuit was established.
INTs <i>t/r</i>	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 8](#) describes the fields specific to VCs configured with record boundary preservation.

**Table 8** *show x25 vc Field Descriptions for VCs That Use Record Boundary Preservation*

Field	Description
recordsize	Maximum record size for the session.
connected	Connection status.
local address; port	IP address and port number of the local end of the TCP session.
remote address; port	IP address and port number of the remote end of the TCP session.
input queue	Number of inbound X.25 data packets not yet processed. This field appears in the display only when the value is not zero.
record buffer	Number of bytes of X.25 data in the current partial record (not including data packets in the input queue). This field appears in the display only when the value is not zero.
deferred ack	Number of X.25 data packets that have been received and processed but not yet acknowledged. This field appears in the display only when the value is not zero.

### Encapsulated Traffic Example

The following is sample output of 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 9 describes the connection fields specific to encapsulation traffic.

**Table 9** *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 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: <ul style="list-style-type: none"> <li>cisco—Cisco’s traditional method was used to set up a single protocol virtual circuit.</li> <li>ietf—The IETF’s standard RFC 1356 method was used to set up a single protocol virtual circuit.</li> <li>snap—The IETF’s Subnetwork Access Protocol (SNAP) method for IP encapsulation was used.</li> <li>multi—the IETF’s multiprotocol encapsulation method was used.</li> </ul>
Data PID	Identifies the method used for PID when sending datagrams. The available methods are as follows: <ul style="list-style-type: none"> <li>none—The virtual circuit is a single-protocol virtual circuit; no PID is used.</li> <li>ietf—The IETF’s standard RFC 1356 method for identifying the protocol is used.</li> <li>snap—The IETF’s SNAP method for identifying IP datagrams is used.</li> </ul>

### Locally Switched X.25 Traffic Example

The following is sample output of 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 10 describes the connection fields for virtual circuits carrying locally switched X.25 traffic.

**Table 10** *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 <a href="#">Table 13</a> 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.

**Locally Switched X.25 Traffic Between PVCs and SVCs Example**

The following is sample output of 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 11](#) describes the connection fields for virtual circuits carrying locally switched X.25 traffic between PVCs and SVCs.

**Table 11** 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.

**Remotely Switched X.25 Traffic Example**

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 12](#) describes the connection fields for virtual circuits carrying remotely switched X.25 traffic.

**Table 12** 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 <a href="#">Table 13</a> for PVC status messages.

**Table 12** *show x25 vc Remote X.25 Traffic Field Descriptions (continued)*

Field	Description
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 13 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) and in the PVCBAD system error message. Some states apply only to remotely switched PVCs.

**Table 13** *X.25 PVC Status Messages*

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 has 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.

## x25 map rbp local

To configure the router to establish X.25 circuits in response to incoming TCP connections on a specified TCP port, and to use record boundary preservation (RBP) to transfer data between the TCP session and the corresponding X.25 circuit, use the **x25 map rbp local** command in interface configuration mode. To delete the map, use the **no** form of this command.

```
x25 map rbp x121-address [cud string] local port port [cug group-number] [packet-size in-size
out-size] [record-size size] [reverse] [roa name] [throughput in out] [transit-delay
milliseconds] [window-size in-size out-size]
```

```
no x25 map rbp x121-address [cud string] local port port
```

Syntax Description	
<i>x121-address</i>	X.121 address of the remote host.
<b>cud</b> <i>string</i>	(Optional) Call user data (CUD) to be included in the X.25 call request, as a hexadecimal string.
<b>port</b> <i>port</i>	TCP port number on which the router should listen.
<b>cug</b> <i>group-number</i>	(Optional) Closed user group (CUG) number (from 1 to 9999) used for the mapping in an outgoing call.
<b>packet-size</b> <i>in-size</i> <i>out-size</i>	(Optional) Proposes maximum input packet size ( <i>in-size</i> ) and maximum output packet size ( <i>out-size</i> ). Both values typically are the same and must be one of the following values: 16, 32, 64, 128, 256, 512, 1024, 2048, or 4096.
<b>record-size</b> <i>size</i>	(Optional) Maximum length of a record.
<b>reverse</b>	(Optional) Specifies reverse charging for outgoing calls.
<b>roa</b> <i>name</i>	(Optional) Specifies the name defined by the <b>x25 roa</b> 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.
<b>throughput</b> <i>in out</i>	(Optional) Sets the requested throughput class values for input ( <i>in</i> ) and output ( <i>out</i> ) throughput across the network. Values for <i>in</i> and <i>out</i> are in bits per second (bps) and range from 75 to 48000 bps.
<b>transit-delay</b> <i>milliseconds</i>	(Optional) Transit delay value in milliseconds (0 to 65534) for an outgoing call, for networks that support transit delay.
<b>window-size</b> <i>in-size</i> <i>out-size</i>	(Optional) Inbound and outbound window sizes (the number of packets permitted in each direction before an acknowledgment is required). Both values typically are the same, must be in the range from 1 to 127, and must be less than the value set by the <b>x25 modulo</b> command.

**Defaults** No SVC is configured.

**Command Modes** Interface configuration

**Command History**

Release	Modification
12.2(8)T	This command was introduced.

**Usage Guidelines**

RBP enables X.25 hosts to exchange data with TCP/IP hosts via TCP sessions while maintaining X.25 packet boundaries.

When the **x25 map rbp local** command is configured, the router will listen for a request for a TCP connection to the specified TCP port. When the connection request is accepted, the router will then attempt to place an X.25 call on the interface on which the command was configured, using the X.25 address of the interface as the calling address, the X.121 address specified in the command as the destination address, and the call user data specified in the command. If the call is not successfully completed, the TCP connection will be closed.

The number of connections that may be established to the TCP port is limited only by router resources (such as memory, processor utilization, and available X.25 circuits).

When connections that will be established by the TCP/IP host are configured, the local TCP port number must be unique, with the exception that the same TCP port number may be configured once on each of multiple X.25 interfaces that will not be active simultaneously; this includes the case in which one X.25 interface is configured as a backup interface for another X.25 interface.

No information from the TCP connection is included in the X.25 Call packet sent to the X.25 host.

**Examples**

In the following example, when the router receives a TCP connection request on port 9999, the host will make an X.25 call to X.121 address 12131 with no call user data.

```
interface Serial1/0
 encapsulation x25 dce
 x25 address 13133
 x25 map rbp 12131 local port 9999
```

**Related Commands**

Command	Description
<b>show x25 map</b>	Displays information about configured address maps.
<b>show x25 vc</b>	Displays information about active SVCs and PVCs.
<b>x25 map rbp remote</b>	Configures the router to establish TCP sessions in response to incoming X.25 calls and to use RBP to transfer data between the X.25 circuit and the corresponding TCP session.
<b>x25 modulo</b>	Sets the window modulus.
<b>x25 pvc rbp local</b>	Configures the router to accept an incoming TCP connection on a specified TCP port and to use the RBP to transfer data between the TCP host and an X.25 PVC.
<b>x25 pvc rbp remote</b>	Configures the router to establish a TCP session in response to data received on an X.25 PVC and to use RBP to transfer data between the X.25 host and the TCP session.
<b>x25 roa</b>	Specifies a sequence of packet network carriers.

## x25 map rbp remote

To configure the router to establish TCP sessions in response to incoming X.25 calls, and to use record boundary preservation (RBP) to transfer data between the X.25 circuit and the corresponding TCP session, use the **x25 map rbp remote** command in interface configuration mode. To delete the map, use the **no** form of this command.

```
x25 map rbp x121-address [ cud string] remote host ip-address port port [accept-reverse]
recordsize size [source-interface interface]
```

```
no x25 map rbp x121-address [ cud string] remote host port port
```

### Syntax Description

<i>x121-address</i>	X.121 address of the remote host.
<b> cud string</b>	(Optional) Call user data (CUD) to be included in the X.25 call request, as a hexadecimal string.
<b> host ip-address</b>	Remote IP address for the TCP connection request.
<b> port port</b>	Remote TCP port number for the TCP connection request.
<b> accept-reverse</b>	(Optional) 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.
<b> recordsize size</b>	(Optional) Maximum length of a record.
<b> source-interface interface</b>	(Optional) Name of an interface whose IP address will be used as the local IP address for the TCP connection.

### Defaults

No SVC is configured.

### Command Modes

Interface configuration

### Command History

Release	Modification
12.2(8)T	This command was introduced.

### Usage Guidelines

RBP enables X.25 hosts to exchange data with TCP/IP hosts via TCP sessions while maintaining X.25 packet boundaries.

The router will accept an incoming X.25 call if the source address and call user data in the call request match the values configured in the **x25 map rbp remote** command. If the  **cud** parameter is specified in the command, the call user data in the incoming call must match the configured value exactly. If the  **cud** parameter is not specified in the command, the call user data must not conflict with any protocol ID recognized by the router, but it is otherwise ignored.

If an incoming call requests reverse charging, and the  **accept-reverse** option is not specified in the matching map, the call will be refused.

If the incoming call is accepted, the router will attempt to open a TCP connection to a configured IP address and TCP port using a dynamically assigned local TCP port number. If the TCP connection cannot be opened, the X.25 call will be cleared.

The number of X.25 calls that may be accepted is limited only by router resources.

No information from the X.25 call packet is provided to the TCP/IP host.

### Examples

In the following example, when serial interface 1/0 receives a call from a remote host that has the X.121 address 12132, the router will open a TCP connection to port number 9999 on the TCP/IP host that has the IP address 10.0.0.1.

```
interface Serial1/0
  encapsulation x25 dce
  x25 address 12030
  x25 map rbp 12132 remote host 10.0.0.1 port 9999
```

### Related Commands

Command	Description
<b>show x25 map</b>	Displays information about configured address maps.
<b>show x25 vc</b>	Displays information about active SVCs and PVCs.
<b>x25 map rbp local</b>	Configures the router to establish X.25 circuits in response to incoming TCP connections on a specified TCP port and to use RBP to transfer data between the TCP session and the corresponding X.25 circuit.
<b>x25 pvc rbp local</b>	Configures the router to accept an incoming TCP connection on a specified TCP port and to use the RBP to transfer data between the TCP host and an X.25 PVC.
<b>x25 pvc rbp remote</b>	Configures the router to establish a TCP session in response to data received on an X.25 PVC and to use RBP to transfer data between the X.25 host and the TCP session.

## x25 pvc rbp local

To configure the router to accept an incoming TCP connection on a specified TCP port, and to use record boundary preservation (RBP) over that session to transfer data between the TCP host and an X.25 permanent virtual circuit (PVC), use the **x25 map rbp local** command in interface configuration mode. To delete the PVC, use the **no** form of this command.

```
x25 pvc circuit rbp local port port [packetsize in-size out-size] [recordsize size]
[windowsize in-size out-size]
```

```
no x25 pvc circuit
```

Syntax Description		
<b>circuit</b>	<i>circuit</i>	Virtual-circuit channel number, which must be less than the virtual circuits assigned to the switched virtual circuits (SVCs).
<b>port</b>	<i>port</i>	TCP port number on which the router should listen.
<b>packet</b> <i>size in-size out-size</i>	<i>in-size out-size</i>	(Optional) Maximum input packet size ( <i>in-size</i> ) and output packet size ( <i>out-size</i> ) 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.
<b>record</b> <i>size size</i>	<i>size</i>	(Optional) Maximum length of a record.
<b>window</b> <i>size in-size out-size</i>	<i>in-size out-size</i>	(Optional) Packet count for input window ( <i>in-size</i> ) and output window ( <i>out-size</i> ) for the PVC. Both values are typically the same, must be in the range from 1 to 127, and must be less than the value set for the <b>x25 modulo</b> command.

### Defaults

No PVC is configured.

The PVC window and maximum packet sizes default to the interface default values.

### Command Modes

Interface configuration

### Command History

Release	Modification
12.2(8)T	This command was introduced.

### Usage Guidelines

Record boundary preservation (RBP) enables X.25 hosts to exchange data with TCP/IP hosts via TCP sessions while maintaining X.25 packet boundaries.

When connections that will be established by the TCP/IP host are configured, the local TCP port number must be unique, with the exception that the same TCP port number may be configured once on each of multiple X.25 interfaces that will not be active simultaneously. This includes situations in which one X.25 interface is configured as a backup interface for another X.25 interface.

When the **x25 pvc rbp local** command is configured, the router will listen for a TCP connection request to the configured TCP port. Until the connection request is received, the router will acknowledge any X.25 reset packets on the circuit. When the TCP connection request is received, the connection will be accepted, and the router will send an X.25 reset packet over the configured X.25 destination circuit. If the reset packet is not acknowledged, the TCP connection will be closed.

Since this command is associated with a specific X.25 circuit, only one connection may be active per command.

When a PVC is configured, the virtual circuit must be unique. Multiple commands referencing the same virtual circuit (matching logical channel identifier and interface) are not permitted.

When connections that will be established by the TCP/IP host are configured, the local TCP port number must be unique, with the exception that the same TCP port number may be configured once on each of multiple X.25 interfaces that will not be active simultaneously. This includes the case in which one X.25 interface is configured as a backup interface for another X.25 interface.

### Examples

The following example shows the configuration of a PVC with RBP. In this example, the router will listen for a TCP connection request on port 9999. When a TCP connection is established, the router will send an X.25 reset over the configured X.25 destination circuit.

```
Interface serial2/1
 encapsulation x25
 x25 pvc 2 rbp local port 9999
```

### Related Commands

Command	Description
<b>show x25 map</b>	Displays information about configured address maps.
<b>show x25 vc</b>	Displays information about active SVCs and PVCs.
<b>x25 map rbp local</b>	Configures the router to establish X.25 circuits in response to incoming TCP connections on a specified TCP port and to use RBP to transfer data between the TCP session and the corresponding X.25 circuit.
<b>x25 map rbp remote</b>	Configures the router to establish TCP sessions in response to incoming X.25 calls and to use RBP to transfer data between the X.25 circuit and the corresponding TCP session.
<b>x25 pvc rbp remote</b>	Configures the router to establish a TCP session in response to data received on an X.25 PVC and to use RBP to transfer data between the X.25 host and the TCP session.

## x25 pvc rbp remote

To configure the router to establish a TCP session in response to data received on an X.25 permanent virtual circuit (PVC) and to use record boundary preservation (RBP) to transfer data between the X.25 host and the TCP session, use the **x25 pvc rbp remote** command in interface configuration mode. To delete the PVC, use the **no** form of this command.

```
x25 pvc circuit rbp remote host ip-address port port [packetsize in-size out-size]
[source-interface interface] [recordsize size] [windowsize in-size out-size]
```

```
no x25 pvc circuit
```

### Syntax Description

<i>circuit</i>	Virtual-circuit channel number, which must be less than the virtual circuits assigned to the switched virtual circuits (SVCs).
<b>host</b> <i>ip-address</i>	Remote IP address for the TCP connection.
<b>port</b> <i>port</i>	TCP port number on which the router should listen.
<b>packetsize</b> <i>in-size out-size</i>	(Optional) Maximum input packet size ( <i>in-size</i> ) and output packet size ( <i>out-size</i> ) 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.
<b>source-interface</b> <i>interface</i>	(Optional) Name of an interface whose IP address will be used as the local IP address for the TCP connection.
<b>recordsize</b> <i>size</i>	(Optional) Maximum length of a record.
<b>windowsize</b> <i>in-size out-size</i>	(Optional) Packet count for input window ( <i>in-size</i> ) and output window ( <i>out-size</i> ) for the PVC. Both values are typically the same, must be in the range from 1 to 127, and must be less than the value set for the <b>x25 modulo</b> command.

### Defaults

The PVC window and maximum packet sizes default to the interface default values.

### Command Modes

Interface configuration

### Command History

Release	Modification
12.2(8)T	This command was introduced.

### Usage Guidelines

RBP enables X.25 hosts to exchange data with TCP/IP hosts via TCP sessions while maintaining X.25 packet boundaries.

When a PVC is configured, the virtual circuit must be unique. Multiple commands referencing the same virtual circuit (matching logical channel identifier and interface) are not permitted.

When the **x25 pvc rbp remote** command is configured, the router will wait until a data packet is received on a specific X.25 PVC. Until it receives a data packet, the router will acknowledge any X.25 reset packets on the circuit. When a data packet is received, the router will attempt to establish a TCP

connection to a configured IP address and TCP port, using a dynamically assigned local TCP port number. If the connection attempt fails, the router will reset the PVC and wait for another data packet before reattempting to establish the TCP connection.

Since the **x25 pvc rbp remote** command is associated with a specific X.25 circuit, at most one connection may be active per command.

### Examples

The following example shows an X.25 host configured to use a PVC with RBP. When PVC 1 receives a data packet, the router will attempt to establish a TCP connection to port 9999 at the TCP/IP host that has the IP address 10.0.0.1.

```
interface serial1/0
  encapsulation x25
  x25 pvc 1 rbp remote host 10.0.0.1 port 9999
```

### Related Commands

Command	Description
<b>show x25 map</b>	Displays information about configured address maps.
<b>show x25 vc</b>	Displays information about active SVCs and PVCs.
<b>x25 map rbp local</b>	Configures the router to establish X.25 circuits in response to incoming TCP connections on a specified TCP port and to use RBP to transfer data between the TCP session and the corresponding X.25 circuit.
<b>x25 map rbp remote</b>	Configures the router to establish TCP sessions in response to incoming X.25 calls and to use RBP to transfer data between the X.25 circuit and the corresponding TCP session.
<b>x25 pvc rbp local</b>	Configures the router to accept an incoming TCP connection on a specified TCP port, and to use the RBP to transfer data between the TCP host and an X.25 PVC.

# Glossary

**CUD**—call user data. Field in an X.25 data packet that contains encapsulated upper-layer information.

**CUG**—closed user group. A collection of DTE devices for which the network controls access among members and between members and nonmembers. A DTE may subscribe to zero, one, or more CUGs. A DTE that does not subscribe to a CUG is referred to as being in the open part of the network.

**D-bit**—“delivery confirmation” bit. Data packet flag used to request end-to-end acknowledgment for the packet.

**DCE**—data communications equipment. Devices and connections of a communications network that make up the network end of the user-to-network interface. The DCE provides a physical connection to the network, forwards traffic, and provides a clocking signal used to synchronize data transmission between DCE and DTE devices. Modems and interface cards are examples of DCE.

**DTE**—data terminal equipment. Device at the user end of a user-network interface that serves as a data source, destination, or both. DTE connects to a data network through a DCE device (for example, a modem) and typically uses clocking signals generated by the DCE. DTE includes such devices as computers, protocol translators, and multiplexers.

**local acknowledgment**—Method whereby a switch acknowledges a received data packet before it has received acknowledgment of the data from the next hop.

**M-Bit**—“more data” bit. Data packet flag that indicates that at least one more data packet is required for completion of a message of contiguous data.

**PVC**—permanent virtual circuit. Virtual circuit that is permanently established.

**Q-bit**—“qualified” bit. Data packet flag that signifies that the packet’s user data is a control signal for the remote device, not a message for the user.

**RBP**—record boundary preservation. Protocol that defines a way for hosts using TCP/IP-based protocols to exchange data with devices that use the X.25 protocol, preserving the logical record boundaries conveyed by the X.25 M-bit (“more data” bit).

**SVC**—switched virtual circuit. Virtual circuit that is dynamically established on demand and is torn down when transmission is complete. SVCs are used in situations in which data transmission is sporadic.

**X.121**—ITU-T standard describing an addressing scheme used in X.25 networks. Sometimes called the X.25 address.

**X.25**—ITU-T standard that defines how connections between DTE and DCE are maintained for remote terminal access and computer communications in PDNs. X.25 specifies LAPB, a data-link layer protocol, and PLP, a network layer protocol.

**XOT**—X.25 over TCP.