Chapter 11

Integrated Services Digital Network (ISDN)

Introduction

This section describes the ISDN (Integrated Services Digital Network) service provided by the router, and how to set up and use ISDN on the router.

This feature is available on routers with PIC bays.

ISDN is defined by the ITU-T in a range of Recommendations. The principles of ISDN are stated in the ITU-T Recommendation I.120 (1988). The underlying principle is the support of a wide range of voice (telephone calls) and non-voice (data exchange) applications in the same network. This is done through the provision of a range of services using a limited set of connection types and user-network interface arrangements. These limitations serve to make international ISDN interconnection feasible. The primary application of ISDN is the provision of both circuit and packet switching, but ISDN also supports non-switched connections. The fundamental building block of ISDN is a 64 kbit/s switched digital connection.

The two most common methods for providing ISDN access at a customer's premises are called Basic Rate Access and Primary Rate Access. Basic Rate Access consists of two 64 kbit/s B channels and one 16 kbit/s D channel, whereas Primary Rate Access consists of up to 30 64 kbit/s B channels and one 64 kbit/s D channel.

The B channels are user channels, and carry digital data, PCM-encoded voice, or a mixture of lower rate traffic. All traffic on a B channel goes to the same destination, but each B channel may go to a different destination.

The following connections may be set up over a B channel:

- Circuit-switched—the circuit is set up by common channel signalling over the D channel (see below).
- Packet-switched—data is exchanged via a X.25 packet switching node.
- Semipermanent—the connection is set up by prior arrangement with the service provider. For more information about configuring the router to use semipermanent ISDN connections, see Chapter 12, Time Division Multiplexing (TDM).

The D channel serves the following purposes:

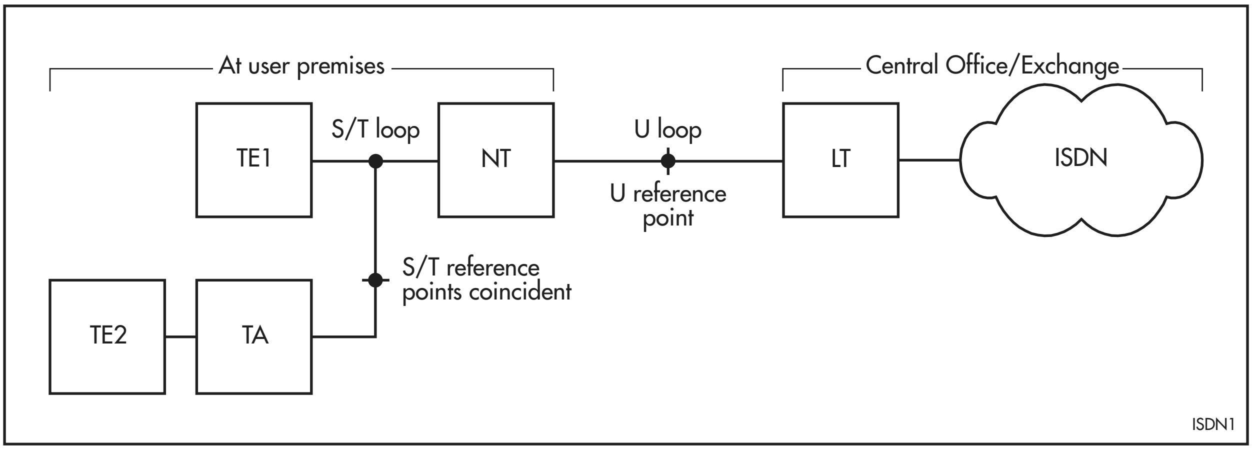
- Common channel signalling to control circuit switching.
- Low speed packet switching.

Basic Rate Access

A block diagram of a typical Basic Rate Access circuit is shown in Figure 11-1 on page 11-5. The router is classed as TE1 (Terminal Equipment, type 1). A TE2 is not directly compatible with ISDN and requires a Terminal Adapter (TA) so that it can use an ISDN. AR400 Series routers with PICs installed are all compatible with ISDN and do not require a TA for connection to the ISDN. The S/T loop portion of the circuit operates over a strictly limited distance and is intended for operation within customer premises. The S/T loop may be shared by a number of TE1s and TAs communicating with a single *Network Termination* (NT). The U loop may be several kilometres and runs between the NT and the *Line Termination* (LT) on the ISDN service provider's premises.

The letters S, T, and U refer to reference points in the ITU-T Recommendations defining ISDN. In most countries the NT is provisioned by the ISDN service provider as part of the Basic Rate Access circuit. However, provision of the NT is the customer's responsibility in the USA. This has encouraged CPE suppliers to integrate the NT into their equipment to avoid the requirement for a separate NT. The router provides Basic Rate Interfaces for connection to either the S/T or U loops. The S/T interfaces may be used anywhere in the world (the customer may need to provide the NT in the USA), but the U interface may only be used in the USA. The characteristics of the two interface types are described in the following figure.

Figure 11-1: A typical ISDN Basic Rate Access circuit



S/T Interfaces

Operation of the 4-wire S/T loop is defined in ITU-T Recommendation I.430. The S/T loop may be shared by more than one TE or TA, although there is usually only one NT. There are a number of possible configurations for the TEs and the NT. The simplest is a point-to-point configuration where one NT communicates with one TE and a 100Ω termination resistor is connected across the receive and transmit pairs at each of the NT and TE. The short passive bus configuration is intended for use where up to 8 TEs are required to communicate with the NT. The TEs may be distributed anywhere along a passive bus up to 200 metres. Termination resistors are located at the NT and at the other end of the passive bus; the TEs do not require termination resistors. An extended passive bus configuration comprises a group of TEs situated within 25 to 50 metres of one another on a bus that can be up to 500 metres long. As with short passive bus, the termination resistors are located at the NT and at the other end of the bus, but not in the TEs. Branched passive bus is similar to extended passive bus, but in this case the termination resistors are located at the NT and just before the group of TEs at the opposite end of the bus, rather than at the very end.

Connection from the S/T loop to a TE is made via an RJ45 8-pin connector. The four centre pins on the connector are used for the transmit and receive pairs. Power may be transferred from the NT to TEs (or vice-versa) over the signal wires or one of the outer pairs.

The 2B+D channels of the Basic Rate Access circuit require 144 kbits/s. However, once framing, synchronisation and other overhead bits are added, the total bit rate is 192 kbits/s. Data is transferred between the TEs and the NT in 48-bit frames, one frame every 250 microseconds. Each of these frames carries 4 D channel data bits and 16 bits for each of the B channels. Note the distinction between these frames used for communication between the TE and

NT, and the HDLC frames used for user data transport over the B channels and for communication with the ISDN over the D channel. The HDLC frames are carried over the S/T loop frames.

Provision has been made in I.430 for additional communication channels for use between the TE and NT. Since these channels are synchronised by setting the M bit in every twentieth S/T frame their operation is called multiframing. There are 5 S channels in the NT to TE direction and one Q channel in the TE to NT direction. Each of these channels provides a data rate of 800 bit/s.

Since it is permissible to have more than one TE on an S/T loop there is a possible contention problem. The ISDN protocol ensures that a B channel is allocated to only one TE at a time, so contention for the B channels is resolved by the network. On the D channel, the LAPD addressing scheme (see "LAPD" on page 11-26) ensures that in the NT to TE direction data reaches its correct destination. However, in the TE to NT direction a mechanism is necessary to avoid transmission by two TEs at one time and to recover from situations where simultaneous transmission does occur. Details of this mechanism are beyond the scope of this discussion, but the essential elements are:

- The detection of collisions by TEs that are transmitting.
- One of the TEs involved in the collision completes its transmission successfully.
- A priority scheme to reduce collisions whereby the priority of a TE is reduced once it has completed a transmission until all other TEs have had a chance to transmit.

An additional feature of the priority scheme is the provision of two priority classes. The higher priority class is used for signalling information.

ITU-T Recommendation I.430 defines five transmission states for the S/T loop (Table 11-1 on page 11-6).

Table 11-1: S/T loop transmission states defined by ITU-T Recommendation I.430

State	Meaning
INFO 0	No signal being transmitted.
INFO 1	TE transmits a continuous signal to wake up the NT.
INFO 2	NT transmits a continuous signal to wake up the TE, or in response to INFO 1 from the TE.
INFO 3	TE transmitting data, the fully operational state.
INFO 4	NT transmitting data, the fully operational state.

The circumstances when each device transmits a particular INFO signal and the events that cause transmission to change are determined by a state machine defined in I.430.

The usual transmission state for a TE and a NT at power on is INFO 0. Either of these devices may instigate a change to a higher state. This is known as activation. A higher layer in a TE can issue an activation request to the physical layer which, when in the deactivated state, begins transmitting INFO 1 to wake up the NT. I.430 requires that the activation request time out through the use of a timer called T3 that has a maximum value of 30 seconds.

When a Basic Rate Access link is used to provide a semipermanent connection the activation and deactivation procedures may be disabled by the service provider. In this case the INFO 1 state is never entered, and the NT transmits INFO 2 by default and INFO 4 when it receives INFO 3 from the TE.

U Interfaces

In the USA, customer-provided equipment is connected to the U loop; in other countries the ISDN service provider supplies the NT. Operation of the NT is defined in the American National Standards Institute (ANSI) standard T1.601-1992. The 2-wire U loop may be not be shared by multiple NTs; it is a simple point-to-point link. Power is available on the U loop and the T1.601 standard specifies requirements for sealing current and DC metallic termination. DC and low frequency AC signalling formats are specified for initiating Insertion Loss Measurement and Quiet maintenance modes.

Data is transferred between the NT and the LT in 240-bit frames at a rate of one every 1.5 milliseconds. Each frame carries 96 bits for each B channel and 24 bits for the D channel. The remaining bits are used for synchronisation, an *Embedded Operations Channel* (EOC), CRC checking of the frames and the transfer of status bits between the NT and LT. The most important of the status bits are the “act” and “dea” bits that control the activation and deactivation of the interface. Another bit, the “febe” bit, when set indicates that a CRC error in a frame transmitted by the NT has been detected by the LT. The quality of the transmission over the U loop can be monitored by counting the CRC errors detected by the NT and the CRC errors reported by the LT through the “febe” bit. Note the distinction between these frames used for communication between the NT and LT, and the HDLC frames used for user data transport over the B channels and for communication with the ISDN over the D channel. The HDLC frames are carried over the U loop frames.

When the NT is powered on, the U interface is in a deactivated state. The loop may be activated by either the NT or the LT. There is a defined procedure when the loop is activated and each end sets its echo cancellation parameters. This procedure may take as long as 15 seconds. Once both the NT and LT have synchronised to each other's signal, the LT changes the “act” bit in its transmitted frames from 0 to 1. When the NT sees this change, the activation process is complete. Unlike the S/T loop, which may be deactivated when there are no calls in progress, the LT tries to keep the U loop active at all times. The LT initiates a deactivation of the link by changing the “dea” bit in the frames it transmits to the NT from 1 to 0.

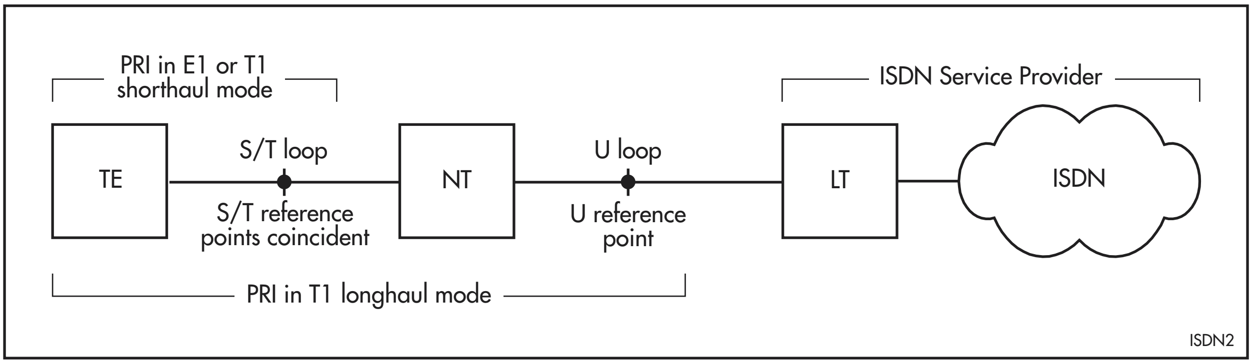
Primary Rate Access

Primary Rate Access provides access to an ISDN at a higher data rate than that provided by Basic Rate Access. Two data rates are defined—1544 kbit/s (used in the USA and Japan) and 2048 kbit/s (used in New Zealand, Australia and European countries). The router supports Primary Rate Access at 2048 kbit/s providing 30 B channels and one D channel per interface (E1), and at 1544 kbit/s providing 23 B channels and one D channel per interface (T1).

E1—2048 kbit/s

The 30 B + D channels of Primary Rate Access require 1984 kbit/s of bandwidth for data. An additional 64 kbit/s channel is added for framing and other information, bringing the total bit rate to 2048 kbit/s. As with Basic Rate Access, the interface between customer equipment and telecommunications provider equipment is at the S/T reference point. The following discussion refers to the situation where the S and T reference points are coincident and the interface is between a type 1 TE and an NT (Figure 11-2 on page 11-8). See ITU-T Recommendation I.411 for more detailed information. The connection is called the *Primary Rate link* and is defined in ITU-T Recommendation I.431.

Figure 11-2: ISDN Primary Rate Access interface between the router and ISDN service provider.



In contrast to Basic Rate Access, a Primary Rate link is always a point-to-point configuration between one TE and one NT. The physical and electrical characteristics of the link are defined in ITU-T Recommendation G.703. The electrical connection may be over either a 75Ω impedance coaxial pair or a 120Ω impedance symmetrical pair. Various standards are used for the physical connector.

Data is transferred between the TE and the NT in 256-bit frames, each frame containing 8 bits for each of the 32 slots. Slot 0 is reserved for framing and synchronisation purposes, slot 16 is used for the D channel and the remaining slots make up the 30 B channels. If the Primary Rate interface (PRI) is used for a non-ISDN application (on a dedicated 2 Mbit/s link for example), then slot 16 is available for general use along with slots 1 to 31. Slot 0 would still be dedicated to framing.

Bits 2 to 8 of each even numbered frame contain the frame alignment signal 0011011 that is used by the receiver to synchronise to the frame structure. In the router's implementation of Primary Rate Access this is called frame synchronisation; elsewhere it is often called double-frame synchronisation, as it is a multiframe format with two frames in the multiframe. The first bit of every frame is reserved for international use and is used to create a multiframe structure that is 16 frames long. This is divided into two sub-multiframes each of 8 frames long (Figure 11-3 on page 11-9).

This multiframe structure is superimposed on the double-frame structure so there are two stages in the synchronisation process, firstly to the frame structure in the double-frame and secondly to the 16-frame multiframe.

The international bits of frames 1, 3, 5, 7, 9 and 11 in the 16-frame multiframe contain the multiframe alignment signal (001011) that is used by the receiver to synchronise to the multiframe structure. The international bits of the even numbered frames are called the C bits, and are used for a *Cyclic Redundancy Check* (CRC) that operates over each sub-multiframe. The C bits in one sub-multiframe are the results of the CRC calculation over the preceding sub-multiframe. As the purpose of the 16-frame multiframe is to provide a block of data over which to calculate a CRC, synchronisation to this multiframe structure is called CRC-4 synchronisation.

The international bits of frames 13 and 15 of the multiframe are called the E bits. The E bits may optionally be used to report the reception of sub-multiframes containing CRC errors. That is, if a sub-multiframe with a CRC error is received then the E bit of a transmitted sub-multiframe is set to zero. If there is no CRC error to report, or if the option is not supported by the service provider, then the E bits are set to 1. The purpose of the E bit option is to assist in the isolation of faults in the Primary Rate link or beyond.

Figure 11-3: Multiframe structure used in the frame synchronisation process for Primary Rate (E1) Access

	Sub-multiframe (SMF)	Frame Number	Bits 1 to 8 of the frame							
			1	2	3	4	5	6	7	8
Multiframe	I	0	C1	0	0	1	1	0	1	1
		1	0	1	A	Sa4	Sa5	Sa5	Sa7	Sa8
		2	C2	0	0	1	1	0	1	1
		3	0	1	A	Sa4	Sa5	Sa5	Sa7	Sa8
		4	C3	0	0	1	1	0	1	1
		5	1	1	A	Sa4	Sa5	Sa5	Sa7	Sa8
		6	C4	0	0	1	1	0	1	1
		7	0	1	A	Sa4	Sa5	Sa5	Sa7	Sa8
	II	8	C1	0	0	1	1	0	1	1
		9	1	1	A	Sa4	Sa5	Sa5	Sa7	Sa8
		10	C2	0	0	1	1	0	1	1
		11	1	1	A	Sa4	Sa5	Sa5	Sa7	Sa8
		12	C3	0	0	1	1	0	1	1
		13	E	1	A	Sa4	Sa5	Sa5	Sa7	Sa8
		14	C4	0	0	1	1	0	1	1
		15	E	1	A	Sa4	Sa5	Sa5	Sa7	Sa8

E = CRC-4 Error indication bits; Sa4 to Sa8 = Spare bits; C1 to C4 = CRC-4 bits;
A = Remote alarm indication

In the case of a PRI being used for a non-ISDN dedicated link the CRC-4 multiframe structure is not used. This means that CRC-4 synchronisation, CRC-4 checking and error reporting via the E bits are disabled.

The A bits are used to implement a Remote Alarm Indication (RAI). The A bits are normally 0 but are set to 1 in transmitted frames to indicate loss of layer 1 capability at the receiver, e.g. loss of signal or frame synchronisation. The Sa bits are known as the national bits and as such may be used for different purposes from one country to another. If they are not used then they are set to 1. Bit 2 of each odd numbered frame is set to one (the opposite of the setting of bit 2 in even numbered frames) to reduce the chances of spurious frame alignment.

There are three transmission states on the Primary Rate link: no signal, normal operational frames and Alarm Indication Signal (AIS). AIS is sent by the NT to the TE when there is a fault in the ISDN affecting the data received by the NT for transmission to the TE.

T1 - 1544 kbit/s

A T1 interface may be capable of driving a short haul line (less than 656ft, 200m) to a CSU/NT1 or a long haul line (less than 6000ft, 1800m) direct or via repeaters to the Central Office. The electrical characteristics that apply to the signal on short haul lines are termed DSX-1 and the electrical characteristics that apply to the signal on long haul lines are termed DS1. In general, the DS1 characteristics are a relaxed version of the DSX-1 characteristics with the same basic pulse shapes. These characteristics are defined in ANSI standards T1.102 (1993), T1.403 (1995) and T1.408 (1990). The interface corresponds to the S /T reference point for short haul operation and the U reference point for long haul operation (Figure 11-2 on page 11-8).

For short haul installations the shape of the transmitted pulse may need to be adjusted depending upon the line length, in order to meet the required pulse shape at the receiver. Similarly, for long haul installations where the line length is significantly less than the maximum possible, the transmitted signal may need to be attenuated so that the receiver is not over driven. This attenuation is called *Line Build Out* (LBO).

The electrical encoding is bipolar *Alternate Mark Inversion* (AMI) in which succeeding ones are encoded as pulses of opposite polarity. A zero is encoded as the absence of a pulse. In order to maintain synchronisation at the receiver the standards require that no more than 15 consecutive zeroes be transmitted. This can be accomplished in the following ways:

- By ensuring that the data transmitted meets the “ones” density requirement.
- By changing a zero (‘0’) data bit to a one (‘1’) bit where the requirement would be violated.
- By transmitting a bipolar violation to indicate to the receiver where a run of zeroes has been altered to meet the requirement.

A bipolar violation is two successive ones of the same polarity. When bipolar violations are used in this way, they are transmitted in opposite pairs so that the DC balance is not disturbed and may be recognised as zero substitutions rather than encoding errors. The method of this type used for T1 is called *Binary Eight Zero Substitution* (B8ZS), which replaces eight zeroes with “00011011”, where each of the “11” pairs has a bipolar violation of the opposite polarity. The second method for meeting the requirement leads to data corruption and is useful only when the bit changed to a one is not a data bit, or single bit errors can be tolerated (e.g. a low-order bit in a voice channel). For T1, bit seven is often targeted for replacement by a one since bit eight (the lowest order bit) may be used for signalling and must not be corrupted. Where bit seven of an all-zero time-slot is replaced with a one this is known as *Bipolar with 7 Zero Suppression* (B7ZS).

A T1 interface may also be used for semi-permanent, non-ISDN applications. In this case it may be used to provision a 1536 kbit/s circuit or one or more n × 64/56 kbit/s circuits. For multiple circuits the telecommunication service provider may be able to route the circuits to different endpoints thereby providing a way of amalgamating several n × 64/56 circuits into one T1 link. The interface is always used in a point-to-point configuration, not in a shared bus arrangement as is possible with Basic Rate Access.

Data is transferred over the T1 link in 193-bit frames with a frame repetition rate of 8kHz giving a bit rate of 1544 kbit/s. The first bit of a frame is the framing (F) bit and the remaining 192 bits may be divided into 24 8-bit slots. For an ISDN installation slot 24 is used for the D channel, leaving 23 B channels for data transfer. For non-ISDN applications all 24 slots may be used either as one 1536 kbit/s circuit or as a number groups of one or more slots. Additionally, data transfer over each slot may be restricted to seven of the eight bits to give 56 kbit/s per slot rather than the usual 64 kbit/s.

A specific number of 193-bit frames make up a superframe (equivalent to a multiframe in E1 parlance). There are two superframe formats—Superframe (SF) and Extended Superframe (ESF).

The SF format, also known as D4, contains 12 frames and the F bit is used for framing only (Table 11-2 on page 11-11). Six of the framing bits are called the terminal framing (Ft) bits and are used to identify frame boundaries. The other six bits are called signalling framing (Fs) bits and are used to identify the superframe boundary and hence the robbed-bit signalling bits (when used.

Table 11-2: Superframe format

	F bits			**Bit use in each channel time slot**	
Frame number	**Superframe bit number**	**Terminal Framing (F_t)**	**Signalling framing (F_s)**	**Data**	**Robbed-bit signalling¶**
1	0	1	-	1–8	-
2	193	-	0	1–8	-
3	386	0	-	1–8	-
4	579	-	0	1–8	-
5	772	1	-	1–8	-
6	965	-	1	1–7	8
7	1158	0	-	1–8	-
8	1351	-	1	1–8	-
9	1544	1	-	1–8	-
10	1737	-	1	1–8	-
11	1930	0	-	1–8	-
12	2123	-	0	1–7	8

¶ Multiple-state signalling can be supported (See ANSI T1.107). See ANSI T1.403-1995 Annex C for definition of robbed-bit signalling states. If robbed-bit signalling is not implemented, all eight bits may be available for data.

1. Frame 1 transmitted first. Bit 1 of each time slot transmitted first.

2. Frame 6, and 12 are denoted as signalling frames.

The ESF format contains 24 frames and the F bit is used to provide a 2 kbit/s framing pattern sequence (FPS), a 4 kbit/s data link (DL) and a 2 kbit/s cyclic redundancy check (CRC) channel (Table 11-3 on page 11-13). The FPS is used to identify the frame and superframe boundaries and the robbed-bit signalling bits (when used). The DL is used for carrying performance and control information. The CRC channel is used for carrying a CRC-6 code and serves to provide a check on the bit error rate of the link. The CRC bits transmitted in a superframe are the result of a CRC calculation over the previous superframe.

Robbed-bit signalling provides a method of passing signalling information associated with each of the slots. It uses ("robs") one bit from each slot in every sixth frame. Robbed-bit signalling is not compatible with 64 kbit/s data transfer and is only used with voice or switched 56 kbit/s services.

Maintenance signals are transmitted in-band in the SF format and in the DL of the ESF format. The SF in-band signals are two alarms (Yellow/RAI and Blue/AIS) and loopback activation and deactivation signals. The ESF DL may also provide additional performance monitoring capabilities.

Table 11-3: Extended superframe format

Frame number	F bits				Bit use in each channel time slot	
	Superframe bit number	Framing pattern sequence (FPS)	Data Link (DL)	Cyclic redundancy check (CRC-6)	Data	Robbed-bit signalling¶
1	0	-	m	-	1–8	-
2	193	-	-	C1	1–8	-
3	386	-	m	-	1–8	-
4	579	0	-	-	1–8	-
5	772	-	m	-	1–8	-
6	965	-	-	C2	1–7	8
7	1158	-	m	-	1–8	-
8	1351	0	-	-	1–8	-
9	1544	-	m	-	1–8	-
10	1737	-	-	C3	1–8	-
11	1930	-	m	-	1–8	-
12	2123	1	-	-	1–7	8
13	2316	-	m	-	1–8	-
14	2509	-	-	C4	1–8	-
15	2702	-	m	-	1–8	-
16	2895	0	-	-	1–8	-
17	3088	-	m	-	1–8	-
18	3281	-	-	C5	1–7	8
19	3474	-	m	-	1–8	-
20	3667	1	-	-	1–8	-
21	3860	-	m	-	1–8	-
22	4053	-	-	C6	1–8	-
23	4246	-	m	-	1–8	-
24	4439	1	-	-	1–7	8

¶ Multiple-state signalling can be supported (See ANSI T1.107). See ANSI T1.403-1995 Annex C for definition of robbed-bit signalling states. If robbed-bit signalling is not implemented, all eight bits may be available for data.

1. Frame 1 transmitted first. Bit 1 of each time slot transmitted first.

2. Frame 6, 12, 18 and 24 are denoted as signalling frames.

The Yellow alarm, known internationally as the *Remote Alarm Indication* (RAI), is transmitted by an interface in the outgoing direction when it has lost the incoming signal. The Blue alarm, known internationally as the *Alarm Indication Signal* (AIS) is transmitted by a network element when it has no other signal to send (e.g. a repeater that has lost its incoming downstream signal transmits AIS in the downstream direction). AIS is an all-ones unframed signal.

Two types of loopback are defined for T1 lines: line and payload. For a line loopback all 193 bits of the received frame are looped back. For a payload loopback the 192-bit “payload” of each received frame is looped back while the F bit is generated as before. For the SF format the in-band loopback activation signal is a framed signal consisting of repetitions of four zeroes followed by a single one overwritten by the F bit where necessary. In some administrations an inverted activation signal may be used. The signal must be transmitted for at least 5 seconds before it takes effect. The in-band deactivation signal is a framed signal consisting of repetitions of two zeroes followed by a single one, overwritten by the F bit where necessary. As with the activation signal it must be transmitted for at least 5 seconds to take effect. For the ESF format loopback activation and deactivation requests are sent as messages over the DL. There are separate messages for line and payload activation and deactivation.

Two signal formats may be used by the telecommunication service provider on the ESF Data Link: bit-patterned and message-oriented. The former comprises repeated bit patterns that allow the transmission of Yellow Alarm as well as line and payload activation and deactivation. When message-oriented signalling is in use, performance monitoring messages can be exchanged over the DL. Performance reports are sent once per second and contain performance information for each of the four preceding one second intervals. The performance reports contain counts of the number of various error events that occurred in the respective one second interval. The possible error events are CRC error, F bit error, severely errored framing (two framing errors within 3ms), line code violation and framing slip. The ANSI standard T1.231 defines how this performance data shall be stored and organised so that it may be used for monitoring and problem isolation.

There are two common versions of ESF Data Link operation: ANSI T1.403 and AT&T 54016. The latter is an older standard and is expected to be phased out of operation over time. The two versions differ in the format of message-oriented packets, performance report operation and loopback actuation and release signals. AT&T 54016 defines command and response messages for the transfer and reset of performance data rather than have an unsolicited periodic report. As performance data is sent only in response to commands from the network rather than in periodic reports, far end performance statistics are not normally available for a T1 link operating according to AT&T 54016.

ISDN on the Router

The ISDN Basic Rate S/T Interface (BRI) on the router conforms to ITU-T Recommendation I.430. The majority of the features required by I.430 are implemented by a specialised integrated circuit called the S/T transceiver. The BRI supports point-to-point, short and extended passive bus, and branched passive bus connection modes. The BRI is not powered from the NT, nor can it detect power from the NT. The router operates as a TE and does not offer TA functionality. The BRI detects multiframing and indicates this to the manager, but the BRI does not make use of the Q or S data channels.

The BRI U interface on the router is only for use in the USA, and conforms to ANSI standard T1.601-1992. The U interface transceiver integrated circuit used is not the same for all U interfaces. Connection to the U loop is via an RJ45 8-pin connector using only the middle pair. The router's U interface does not take power from the U loop. The U interface meets the T1.601 sealing current and DC metallic termination requirements, as well as supporting the DC and low frequency AC signalling formats for initiating Insertion Loss Measurement and Quiet maintenance modes.

All BRI interfaces on the router support the automatic TEI (Terminal Endpoint Identifier) assignment mode of operation.

Two versions of Primary Rate Interface (PRI) are available for the router, an interface that supports only E1 (2048 kbit/s) and a interface that supports both E1 and T1 (1544 kbit/s). Both versions may be used for both ISDN and non-ISDN applications. When used for ISDN the normal mode of operation is as a TE. The PRI operates in a NT mode but this is intended for testing only. Different physical interface options are provided depending on the specific interface model. A balanced (twisted-pair) connection is available for all interface versions (120Ω for E1 and 100Ω for T1). Some E1 interfaces also have an unbalanced coaxial connection via two 75Ω BNC connectors.

For E1 the PRI implements the CRC-4 error procedure defined in ITU-T recommendation G.706 and may be configured to report CRC errors via the E bit in operational frames as per I.431. The threshold for the number of CRC-4 errors beyond which a loss of frame alignment is assumed is configurable to suit differing international standards. The bit pattern transmitted in idle slots and the minimum number of flags between HDLC frames transmitted over B channels may also be configured.

For T1 the PRI supports both short haul/DSX-1 and long haul/DS1 operation. Note that when configured for long haul situation the CSU/NT1 is effectively integrated into the router interface. Three line encoding methods are supported: AMI, B7ZS and B8ZS. For AMI, no zero substitution is performed by the interface but all transmitted HDLC data is inverted so that HDLC bit stuffing ensures a sufficient ones density in those time-slots used for data transmission. For B7ZS, HDLC data is also inverted and bit seven of an all-zero time-slot is replaced with a one. For B8ZS, ones density is ensured using the standard scheme.

Both SF and ESF superframe formats are supported. When using the ESF format the interface may be configured to activate either a line or payload loopback in response to an in-band loopback request. The ANSI T1.403 and AT&T 54016 Data Link message formats are both supported and performance data that meets the requirements of AT&T 54016 and ANSI T1.231 is always available for the near end of the T1 link. However, in AT&T 54016 mode, far end performance data is not available. In T1 mode the interface complies with standards and recommendations ANSI T1.403, ANSI T1.408, ANSI T1.231, AT&T 54016 and AT&T 62411.

BRI Physical Layer

The physical layer of the Basic Rate Interface (BRI) for the router is implemented in the BRI software module. The module requires no user configuration for normal ISDN operation. When used to support a semipermanent connection, some configuration is required. See below and Chapter 12, Time Division Multiplexing (TDM) for more information. Commands are provided to show the status of the module, and to examine and reset a number of data and error counters. The BRI module may be also be reset, but this should not be necessary during normal operation. A set of commands is also provided for testing the interface, but these should not be used during normal operation because they interfere with the functioning of the router. Each command may specify the BRI interface on which it is to operate. For example:

```
show bri=0 state
```

shows the state of the first Basic Rate Interface. The BRI interface number is optional in some commands and if omitted, the command operates on all installed BRI interfaces.

When a layer 2 module (for example the Point-to-Point Protocol, PPP) wishes to use a BRI, it *attaches* to the BRI module and specifies the slots it will use. The BRI module then allocates a *channel number* to the layer 2 module for use when data is passed between the modules. In the following description, the B channels of the BRI are called slots and the groupings of slots being used by layer 2 modules are called channels. Data transferred over the BRI for each channel is encapsulated in HDLC frames.

Configuring and Controlling the Basic Rate Interface

The BRI software module does not require user configuration for normal ISDN operation, but the following command may be required when the interface is used for semipermanent connections:

```
set bri=n activation={normal|always} mode={isdn|tdm|mixed}
    [isdnslots=slot-list] [tdmslots=slot-list]
```

where *n* is the number of the BRI interface and must be specified. The **activation** parameter controls the operation of the layer 1 state machine. The default is **normal** and is the normal mode of ISDN operation. Setting **activation** to **always** indicates that the interface is connected to a link that is expected to be active at all times. When the link is not active, the router does not attempt to activate the link by sending INFO 1. The **mode** parameter determines whether the interface provides normal ISDN call functionality, or semipermanent connections, or a mixture of both. The default **mode** for a BRI interface is ISDN and by default all of the slots are available for ISDN calls. The **isdnslots** parameter can be used to restrict the slots available for calls by specifying a list of eligible slots, effectively disabling some of the slots on a BRI link. If **mode** is set to **tdm** the D channel is disabled and no ISDN calls can be made over the interface. See Chapter 12, Time Division Multiplexing (TDM) for more information about using an interface in TDM mode. When **mode** is set to **mixed** one slot may be used for an ISDN call and the other slot for a semipermanent connection.

Caution The **mode** parameter of the **set bri** command affects the way the router behaves when connected to a network to the extent that, if configured inappropriately for the network to which it is connected, it may not conform to the national standards applying to that network. Therefore care must be taken when using this command. Please seek the advice of your authorised distributor or reseller, or ISDN service provider when changing the mode of operation from the default, which is the correct mode for connecting to a standard ISDN network.

Caution Semipermanent connections are not available in the USA and the router does not permit the **mode** of a BRI U interface to be set **tdm** or **mixed,** or the **activation** mode set to **always**.

For example, to allow slot B1 to be used for an ISDN call, slot B2 to be used for a semipermanent connection and to disable the normal activation procedures, enter the command:

```
set bri=0 activation=always mode=mixed isdnslots=1 tdmslots=2
```

In a slot list the numbers 1 and 2 correspond to slots B1 and B2, respectively.

The BRI software module and hardware may be reset with the command:

```
reset bri=n
```

where *n* is the number of the BRI interface. This command is not required for normal operation and should only be used under advice from your authorised distributor or reseller.

To aid diagnosing TE/NT problems, debug messages generated as a result of certain events can be redirected to a port or to a Telnet session (Table 11-4 on page 11-17).

Table 11-4: Categories of debug messages generated by the BRI software module

Category	Meaning
Errors	A BRI software module internal error.
Indications	An indication from the layer 1 state machine to a higher layer or the management layer.
State changes	A change of state for the layer 1 state machine.
Events	An event that is an input to the layer 1 state machine.

The commands:

```
enable bri[=instance] debug[={errors|indications|states|
    events|all}]
disable bri[=instance] debug[={errors|indications|states|
    events|all}]
```

allow a single debug option to be enabled or disabled on each invocation. However, successive commands can be used to disable or enable any desired combination of debug options. For example, the command sequence:

```
disable bri debug=all
enable bri debug=errors
enable bri debug=indications
enable bri debug=events
```

enables the **errors**, **indications**, and **event** debug options on all BRI interfaces.

The command:

```
show bri debug
```

displays the state of the debug categories.

The BRI module has several test modes that are used for testing the BRI hardware and for Telecommunication authority testing for standards conformance purposes. The commands:

```
disable bri=instance test[=test]
enable bri=instance test=test
```

allow a single hardware test to be disabled or enabled on each invocation (see "Command Reference" on page 11-61 for a complete list of hardware test modes).

However, any number of hardware tests may be run simultaneously by using successive commands to disable or enable particular hardware tests. For example, the command sequence:

```
disable bri=0 test
enable bri=0 test=8
enable bri=0 test=9
```

enables hardware tests 8 and 9 on interface BRI0. The commands:

```
disable bri=instance ctest
enable bri=instance ctest=ctest
```

allow the currently running conformance test to be disabled or a single specified conformance test to be enabled (see "Command Reference" on page 11-61 for a complete list of hardware test modes). Only one conformance test may be running at any one time.

The current conformance test modes may be viewed with the commands:

```
show bri test
show bri ctest
```

Please note that the TEST and CTEST modes are required for manufacturer testing only and should not be activated while the system is in normal use because they interfere with the functioning of the router.

Examining the Status of the Basic Rate Interface

The status of the BRI can be displayed with the command:

```
show bri state
```

For a BRI S/T interface the display shows:

- The operational mode of the interface: TE or NT.
- The state of the physical layer state machine: "Inactive", "Sensing", "Deactivated", "Awaiting Signal", "Identifying Input", "Synchronized", "Activated" or "Lost framing".
- The received and transmitted INFO signals. In normal operation the BRI transceiver receives INFO 4 from the NT and transmits INFO 3.
- Whether an activation request is being processed or the loop is activated.
- Whether the TE is synchronised to the NT.
- The activation mode of the interface: "normal" or "always"

- The mode of the interface: “ISDN”, “TDM” or “mixed”.
- The slots available for ISDN calls (only displayed when the interface is not in TDM mode).
- The slots available for TDM groups (only displayed when the interface is not in ISDN mode).
- The current D channel priority class, which may vary from one D channel frame to the next.
- The higher layer modules to which the B channels are attached, and whether the B channels are aggregated.
- Whether the transceiver has detected multiframing in the data stream from the NT.

For a BRI U interface the display shows:

- The operational mode of the interface: TE (or LT: test mode on some hardware models only).
- The state of the physical layer state machine: “Deactivated”, “Activating”, “Pending active”, “Active” or “Pending deactivated”.
- Whether an activation request is being processed or the loop is activated.
- Whether the router is synchronised to the LT.
- The activation mode of the interface: always “normal”.
- The mode of the interface: always “ISDN”.
- The most recent EOC message received.
- The current maintenance mode: “none”, “Quiet”, “Insertion Loss Test Mode”.
- The slots available for ISDN calls.
- Whether the B channels are attached to a higher layer module and whether the B channels are aggregated.

The command:

```
show bri configuration
```

shows the higher layer modules (if any) that have been attached to the BRI interface. The display shows:

- The modules attached to the D, B1 and B2 channels.
- The bandwidth of the channel (for B channels only).
- A list of up to four addresses used to filter incoming frames on the D channel. The addresses are compared with the 16-bit field of the layer 2 frame that contains the SAPI and TEI for a D channel frame. The filter reduces the loading on the BRI software module by not interrupting it for frames intended for other TEs.
- An address mask that specifies the bits of an address that are significant for comparison when filtering incoming D channel frames.

Monitoring Operation of the Basic Rate Interface

The BRI module provides a set of counters for monitoring the BRI interface. The counters are divided into 3 categories: interface counters, BRI counters and diagnostic counters. Counters from any of these categories can be displayed using the command:

```
show bri counter[={interface|bri}]
```

If a category is not specified, all categories are displayed. If **interface** is specified, the counters from the interfaces table of the interfaces MIB relating to the BRI are displayed. If **bri** is specified, counters relevant to a Basic Rate interface in particular, that are stored in the enterprise MIB, are displayed. The output has multiple sections, one for the BRI as a whole and one for each active channel. The meaning of each of the counters is described in **show bri counter** command on page 11-123.

The counters in each category may be cleared to zero using the command:

```
reset bri counter[={interface|bri}]
```

If a category is not specified, all counters are cleared.

Using the **reset bri counter** command on page 11-98 to clear the counters does not clear the MIB counters themselves. Instead, the contents of the MIB counters are copied to offset storage locations that are subtracted from the MIB counters before being displayed by the **show bri counter** command on page 11-123.

PRI Physical Layer

The physical layer software of the Primary Rate Interface (PRI) for the router is implemented in the PRI module. The module requires minimal user configuration for normal operation. Commands are provided to change user-configurable parameters, show the status of the module, and to examine and reset a number of data and error counters. The PRI module may also be reset, but this should not be necessary during normal operation. A set of commands is also provided for testing the interface, but these should not be used during normal operation because they interfere with the functioning of the router. Each command may specify the PRI interface on which it is to operate. For example:

```
show pri=0 state
```

shows the state of the first Primary Rate interface. The PRI interface number is optional in many cases. If the interface is not specified the command operates on all installed PRI interfaces.

When a layer 2 module (for example the Point-to-Point Protocol, PPP) wishes to use a PRI it *attaches* to the PRI module and specifies the slots it will use. The PRI module then allocates a *channel number* to the layer 2 module for use when data is passed between the modules. In the following description, the B channels of the PRI are called slots and the groupings of slots being used by layer 2 modules are called channels. Data transferred over the PRI for each channel is encapsulated in HDLC frames. Note that these HDLC frames are distinct from the lower level 256-bit frame structure described above.

Configuring and Controlling the Primary Rate Interface

An E1 PRI interface is configured with the command:

```
set pri=n mode={isdn|tdm|mixed} [isdnslots=slot-list]
    [tdmslots=slot-list] clock=source crc=mode idle=character
    interframe_flags=extra-flags error_threshold=error-frames
```

and a T1 PRI interface is configured with the command:

```
set pri=n mode={isdn|tdm|mixed} [isdnslots=slot-list]
    [tdmslots=slot-list] clock=source encoding={b8zs|b7zs|ami}
    framing={sf|esf} linelength=0..65535 lbo={none|-7.5db|
    -15db|-22.5db} code={standard|alternate}
    inbandloopback={line|payload}
    interframe_flags=extra-flags
```

Caution The **mode** parameter of the **set pri** command affects the way the router behaves when connected to a network to the extent that, if configured inappropriately for the network to which it is connected, it may not conform to the national standards applying to that network. Therefore care must be taken when using this command. Please seek the advice of your authorised distributor or reseller, or ISDN service provider when changing the mode of operation from the default, which is the correct mode for connecting to a standard ISDN network.

The **mode** parameter determines whether the interface is used solely for ISDN calls, or solely for TDM groups, or for a mixture of the two. The **isdnslots** and **tdmslots** parameters specify the slots that are reserved for ISDN calls and those reserved for TDM groups. By default **mode** is set to **isdn** and all slots are reserved for ISDN calls.

The **clock** parameter determines whether the PRI derives its transmit clock signal from the received signal (line) or an internal clock. The **crc** parameter (E1 only) specifies the CRC procedure to be used by the interface: **off** (no CRC used), **checking** (calculate and compare CRCs) and **reporting** (calculate and compare CRCs, and report any errors). The **idle** parameter is used to set the character transmitted in slots that are not assigned to any module. The **interframe_flags** parameter specifies the minimum number of *extra* flags transmitted, per slot, between HDLC frames being sent over a PRI channel. The actual number of flags transmitted per slot between HDLC frames is at least **interframe_flags** + 1. The **error_threshold** parameter (E1 only) determines the number of multiframes with CRC-4 errors received in one second that force a new search for CRC-4 synchronisation.

For compliance with national and international standards, the **crc** and **error_threshold** parameters (E1 only) of the **set pri** command on page 11-113 must be set to values specific to the country where the PRI interface is to be used. When the Q.931 profile is set or changed for a PRI interface (with the **set q931** command on page 11-117), the values of CRC and **error_threshold** for the PRI interface are automatically set to the correct values for the specified Q.931 profile. These values are set automatically when the **set system territory** command on page 11-120 of Chapter 11, Integrated Services Digital Network (ISDN) changes the Q.931 profile for a PRI interface.

The **encoding** parameter (T1 only) determines the method used to encode the binary bits as voltage levels in the transmitted signal. The basic encoding is AMI in all cases but this is modified in order to ensure that no more than 15 consecutive zeroes are transmitted. Specifying AMI disables zero substitution, specifying B7ZS causes bit seven of an all-zero time-slot to be replaced by a one and B8ZS selects substitution of eight zeroes by a signal containing two bipolar violations. The **framing** parameter (T1 only) selects either the SF (D4) or ESF multiframe format.

The **linelength** parameter (T1 only) selects the length of the line to the CSU/NT1 for a DSX-1 installation (0 to 655 feet) or if the length is greater than 655 specifies that the installation is a long haul installation (the CSU is provided by the interface). The **lbo** parameter (T1 only) specifies the Line Build Out (attenuation) required for reduced length long haul installations. The **code** parameter (T1 only) specifies the code to be recognised as the in-band loopback request signal, either **standard** or **alternate**. The **inbandloopback** parameter (T1 only) specifies the sort of loopback to activate in response to an in-band loopback request. This applies only to T1 ESF framing as a payload loopback is not possible with SF/D4 framing.

The PRI software module and hardware may be reset with the command:

```
reset pri=n
```

where *n* is the number of the PRI interface. This command is not required for normal operation and should only be used under advice from your authorised distributor or reseller.

To aid diagnosing TE/NT problems, debug messages generated as a result of certain events can be redirected to a port or to a Telnet session (Table 11-5 on page 11-22).

Table 11-5: Categories of debug messages generated by the PRI software module

Category	Meaning
Errors	A PRI software module internal error.
Indications	An indication from the layer 1 state machine to a higher layer or the management layer.
State changes	A change of state for the layer 1 state machine.
Events	An event that is an input to the layer 1 state machine.

The commands:

```
disable pri[=instance] debug[={errors|indications|states|
    events|all}]
enable pri[=instance] debug[={errors|indications|states|
    events|all}]
```

allow a single debug option to be disabled or enabled on each invocation. However, successive commands can be used to disable or enable any desired combination of debug options. For example, the command sequence:

```
disable pri debug=all
enable pri debug=errors
enable pri debug=indications
enable pri debug=events
```

enables the **errors**, **indications**, and **event** debug options on all PRI interfaces.

The command:

```
show pri debug
```

displays the state of the debug categories.

The PRI module has several test modes that are used for testing the PRI hardware and for Telecommunication authority testing for standards conformance purposes. The commands:

```
disable pri=instance test[=test]
enable pri=instance test=test
```

allow a single hardware test to be disabled or enabled on each invocation. However, any number of hardware tests may be run simultaneously by using successive commands to disable or enable particular hardware tests. For example, the command sequence:

```
disable pri=0 test
enable pri=0 test=8
enable pri=0 test=9
```

enables hardware tests 8 and 9 on interface PRI0. The commands:

```
disable pri=instance ctest
enable pri=instance ctest=ctest
```

allow the currently running conformance test to be disabled or a single specified conformance test to be enabled. Only one conformance test may be running at any one time.

The current conformance test modes may be viewed with the commands:

```
show pri test
show pri ctest
```

Please note that the **test** and **ctest** modes are required for manufacturer testing only and should not be activated while the system is in normal use because they interfere with the functioning of the router.

Examining the Status of the Primary Rate Interface

The status of the PRI can be displayed with the command:

```
show pri state
```

The display shows:

- The type of the interface: E1 or T1.
- The operational mode of the interface: TE or NT.
- The HDLC controller type for the interface: SCC or QMC.
- The mode of the interface: ISDN, TDM or mixed.
- The slots available for ISDN calls (only displayed when the interface is not in TDM mode).
- The slots available for TDM groups (only displayed when the interface is not in ISDN mode).
- The State of the physical layer state machine: Operational, FC1 (Network outbound fault), FC2 (Local inbound fault), FC3 (Network inbound fault), or FC4 (Local outbound fault).
- The clock source, line or internal.
- The termination impedance for the line (E1 only): 120 ohms (unbalanced, twisted pair) or 75 ohms (balanced, coaxial).
- The CRC-4 mode (E1 only): off, checking or reporting.

- The CRC-4 error threshold (E1 only) for invoking a new search for frame alignment.
- The character that is sent in an idle slot.
- The minimum number of flags per slot transmitted between frames.
- The line length (T1 only) to the CSU (short haul) or nearest repeater (long haul).
- The Line Build Out (LBO) attenuation setting (T1 only) for long haul installations.
- The line encoding (T1 only): AMI, B7ZS or B8ZS.
- The HDLC data polarity (T1 only): normal or inverted. Inverted is selected automatically when AMI or B7ZS encoding is selected.
- The framing format selected (T1 only): SF/D4 or ESF.
- The Data Link (DL) signal format automatically selected (T1 only): message oriented or bit-patterned.
- The DL mode automatically selected (T1 only): T1.403 or AT&T 54016.
- The in-band loopback type (T1 only): line or payload.
- The in-band loopback code (T1 only): standard or alternate.
- The current state of the receive path, in terms of the presence of possible error conditions, the number of times each condition has occurred (momentarily or for a longer time) and for how long the PRI has experienced that condition.
- Error indications received from the network, which indicate error conditions either between the TE and the NT, or beyond the NT within the network.
- Error indications transmitted to the network by the PRI module about any receive error condition that the PRI module experienced.

The command:

```
show pri configuration
```

shows the higher layer modules (if any) that have been attached to the PRI interface.

The display shows:

- The modules attached to each channel.
- The slots assigned to each channel.
- The module instance identifier used to relate the channel number to a higher layer module instance.
- The effective bandwidth of each channel.
- The slots that are not being used by any module.

Monitoring Operation of the Primary Rate Interface

The PRI module provides a set of counters for monitoring the PRI interface. The counters are divided into 5 categories: interface counters, state counters, PRI counters link counters and diagnostic counters. The state counters are displayed using the command:

```
show pri state
```

Counters from the other four categories are displayed using the command:

```
show pri counter[={interface|link|pri|diagnostic}]
    [channel=channel] [history[=interval]] [{near|far|both}]
```

The **channel** parameter displays counters for a specific active channel and may be "D", a number from 0 to 31 (E1), or a number from 0 to 23 (T1).

If **interface** is specified, the counters from the interfaces table of the interfaces MIB relating to the PRI are displayed.

If **link** is specified, the counters stored in the enterprise MIB that are relevant to the operation of the E1/T1 link during the current 15 minute interval and over the past 24 hours are displayed.

If **history** is specified then the link counters for the preceding 96 15-minute intervals are displayed. Only the **link** counter category may be specified with the **history** parameter. If the router has been rebooted within the last 24 hours, then counters for fewer than 96 time intervals are displayed. If a time interval number is specified, then only counters for that interval are displayed.

If one of **near**, **far**, or **both** is specified, then the link counters for the near end, far end, or both ends of the link respectively, are displayed. These parameters may only be specified with the **link** counter category. Counters for the far end of the link are not available for T1-SF and E1-noCRC framing options or if the T1-ESF Data Link is operating in the AT&T 54016 mode. The default is **both**.

The **channel** parameter is not valid for the **interface** or **link** categories as the counters refer to the interface as a whole. The **history** and **near/far/both** parameters are not allowed with the **link** category.

If **pri** is specified, the counters stored in the enterprise MIB that are relevant to the channels of a Primary Rate interface are displayed. If a channel is also specified, only PRI counters for the specified channel are displayed.

If **diagnostic** is specified, hardware error counters and diagnostic information relevant to the operation of the PRI software module are displayed. If a channel is also specified, only diagnostic counters for the specified channel are displayed.

If a counter category is not specified, all categories are displayed.

The counters in each category (including **state**) may be cleared to zero by the command:

```
reset pri counter[={interface|link|pri|diagnostic|state}]
```

Use of the command without specifying a category causes all counters to be cleared.

Using the **reset pri counter** command on page 11-100 to clear the counters does not clear the MIB counters themselves. Instead, the MIB counter contents are copied to offset storage locations that are subtracted from the MIB counters before being displayed by the **show pri counter** command on page 11-153.

LAPD

LAPD is the Link Access Protocol for the ISDN D channel, as defined by ITU-T Recommendation Q.921. It is a layer 2, or data link layer, protocol used for communication between ISDN Terminal Equipment (TE, i.e. the router) and Network Equipment (NT, i.e. the ISDN exchange). LAPD provides addressing, flow control, and error detection for higher layer users of the ISDN D channel. LAPD is similar to LAPB (layer 2 of X.25), with the addition of multiple logical connections that allow a single D channel to support multiple layer 3 entities. LAPD is not used on ISDN B channels.

In normal operation the LAPD module does not require any configuring since the default configuration allows it to function fully. The default for BRI interfaces is to operate with automatic TEI (Terminal Endpoint Identifier) assignment. PRI interfaces have TEI values assigned by ITU-T Recommendation Q.921.

BRI Versus PRI

The major difference between Basic and Primary Rate Interfaces as far as LAPD is concerned is that BRI S/T interfaces use a bus configuration whereas PRI interfaces use a point-to-point configuration. The BRI S/T bus allows multiple devices (such as telephones and routers) to be connected to a single Basic Rate ISDN port at the exchange. To allow the different devices to be separately addressed each one is assigned a TEI. To allow these TEI values to be managed LAPD has a management protocol operating on its own logical connection. LAPD on a PRI interface does not use this bus system since only one device can be connected to each Primary Rate ISDN port at the exchange. However, the logical connection used for TEI management is still present on a PRI interface for compatibility with certain ISDN networks around the world.

Operation

The main purpose of LAPD is to provide Q.931 Call Control with a data link layer. Because Q.931 Call Control is mainly used when a call is being made or brought down there is a lot of spare bandwidth on the D channel. To allow this to be used LAPD can also operate as the data link layer for Q.931 Packet Mode and X.25 Packet Mode Operation. These modes allow the D channel to be used for the transfer of data, as well as for call control.

The LAPD parameters are specified by the LAPD standard and should not be changed.

Packet mode support

As mentioned above, LAPD can operate as the link layer for X.25 packet mode operation. Different ISDN profiles have different flavours of packet mode operation, but some of the ways that packet mode operations are supported are given here.

Some ISDN routers in the USA and Canada require a fixed TEI for packet mode operations even when data and voice calls are made using dynamic TEI allocation. To specify a fixed TEI for packet mode operation, use the command:

```
add lapd=interface xtei=tei
```

The TEI specified must be from 0 to 63.

If a fixed TEI is not required and the router is required to perform SPID initialisation, packet mode operations must take place on the same TEI as a DLC (Data Link Connection) with a SPID that subscribes to the packet mode service. To specify the SPID that subscribes to the packet mode service, use the command:

```
add lapd=interface xspid=spid-index
```

The SPID index specified is either “1” or “2”, corresponding to the SPID1 and SPID2 parameters used in the **set q931** command on page 11-117.

Fault Finding

The output from the **show lapd** command on page 11-147 can be useful when trying to find the cause of a fault in an ISDN link.

One possible problem involves obtaining a TEI from the network. A TEI is required for the D channel of each basic rate interface before a link can be established (the TEI for primary rate interfaces is always 0).

If the interface is set for automatic TEI assignment (the normal BRI setup) and an attempt has been made by the router to make a call then the **show lapd** command on page 11-147 should display a TEI for the interface (with a range of 64 to 126). If no TEI is present it means that the automatic TEI procedure is not operating.

The **dlc** parameter in the display can be used to check the state of each Data Link Connection (DLC, or logical link operating on the D channel). On both Basic Rate and Primary Rate interfaces there should be a SAPI of 63 for TEI management and a SAPI of 000 for Q.931 Call Control. The DLC for a CES of 001 is the DLC used to transport Q.931 Call Control information. If a call has been made on the ISDN interface then the state of this DLC should always be ALIVE. If it reads DEAD then the DLC for that interface cannot be used for Q.931 signalling.

The **show lapd state** command on page 11-151 and the **show lapd count** command on page 11-150 may be used to provide state and counter information about a LAPD interface.

Default Setup

The standard LAPD configurations are shown in Table 11-6 on page 11-28 (Basic Rate Interfaces) and Table 11-7 on page 11-28 (Primary Rate Interfaces).

Table 11-6: Standard LAPD configuration for an ISDN Basic Rate Interface

Mode	Auto								
Debug	Off								
TEI	Provided by the network								
T, N and k values (for each SAPI):									
SAPI	**Layer 3**	**T200**	**T201**	**T202**	**T203**	**N200**	**N201**	**N202**	**k**
0	Q.931 Call Control	10	10	20	100	3	260	3	1
1	Q.931 Packet Mode	10	10	20	100	3	260	3	3
16	X.25 Packet Mode	10	10	20	100	3	1024	3	3
63	LAPD Management	10	10	20	100	3	260	3	1

Table 11-7: Standard LAPD configuration for an ISDN Primary Rate Interface

Mode	nonAuto								
Debug	Off								
TEI	0								
T, N and k values (for each SAPI):									
SAPI	**Layer 3**	**T200**	**T201**	**T202**	**T203**	**N200**	**N201**	**N202**	**k**
0	Q.931 Call Control	10	N/A	N/A	100	3	260	N/A	7
1	Q.931 Packet Mode	10	N/A	N/A	100	3	260	N/A	7
16	X.25 Packet Mode	10	N/A	N/A	100	3	1024	N/A	7
63	LAPD Management	10	N/A	N/A	100	3	260	N/A	7

Addressing

The LAPD frame uses the HDLC frame format. The addressing function of LAPD allows multiple layer 3 entities to operate on one D channel and allows terminals on a BRI bus to be addressed. The 16-bit address in the HDLC frame is called the Data Link Control Identifier (DLCI). The DLCI is made up of a Service Access Point Identifier (SAPI), a Terminal Endpoint Identifier (TEI), and some additional control bits.

The SAPI determines the type of the layer 3 entity being addressed (Table 11-8 on page 11-28).

Table 11-8: SAPI values used by LAPD to specify types of layer 3 entities

Value	Frame
0	Q.931 Call Control Information.
1	Q.931 Packet Mode Information.
16	X.25 Packet Mode Information.
63	LAPD Management Information.

The TEI indicates the specific logical device (in point-to-point connections) or a group of logical devices (in broadcast connections) within the individual SAP identified by the SAPI. TEI values are shown in Table 11-9 on page 11-29 (Basic Rate Interfaces) and Table 11-10 on page 11-29 (Primary Rate Interfaces).

Table 11-9: TEI values used by LAPD to specify logical devices attached to a Basic Rate Interface

Value	Use
0	Reserved for NT2 equipment
1-63	Non-automatic assignment for TE equipment. The user assigns these.
64-126	Automatic assignment for TE equipment. The network assigns these.
127	All ones broadcast address.

Table 11-10: TEI values used by LAPD to specify logical devices attached to a Primary Rate Interface

Value	Use
0	Used for all terminals.
1-126	Not used.
127	All ones broadcast address.

The Data Link Connection (DLC) is the name given for each valid combination of a SAPI and a TEI; each DLC is an individual logical link.

The Connection Endpoint Suffix (CES) is used by a layer 3 entity to identify individual DLCs within the layer 3 SAP.

Frame Control Fields

There are three types of LAPD frames (Table 11-11 on page 11-29).

I frames are used to transfer layer 3 data. Their control fields contain module 128 number sent and received counters to allow a window of unacknowledged frames to be sent before an acknowledge is received.

S frames are used by LAPD for link flow control. Their control fields only contain a number received count.

U frames provide additional data transfer or link control functions. They are used by LAPD for the transfer of management information.

Table 11-11: LAPD frame types

Type	Use	Control Field Size
I	Numbered information frames	16 bits
S	Supervisory frames	16 bits
U	Unnumbered information frames	8 bits

Non-Associated Signalling

An ISDN interface normally uses its own D channel for signalling for the calls made on the interface. However, it is possible to configure a mode of operation where a given D channel provides the signalling for a number of ISDN interfaces. The advantage of this is that the D channels that are unused for signalling can then be used as B channels, since on a PRI interface the D channel and B channel have the same bandwidth and underlying signalling structure.

This feature is known as *non-associated signalling* or *common D channel*. The ISDN network must support the feature. At present the router supports this feature when the Q.931 profile of participating interfaces is set to JAPAN. LAPD commands set up the interfaces that are taking part in non-associated signalling, while Q.931 commands give each interface a unique ID.

To set up an ISDN interface to be a master interface for non-associated signalling, use the command:

```
set lapd=instance nasmode=master
```

To set up an ISDN interface to be a slave interface for non-associated signalling, use the command:

```
set lapd=instance nasmode=slave nasmaster=master-interface
```

where *master-interface* is the instance number or interface name of an ISDN interface whose **nasmode** is **master**.

To identify the ISDN interfaces for non-associated signalling, use the command:

```
set q931=instance intid=hex-string
```

where *hex-string* is a sequence of hexadecimal digits that give the interface ID in hexadecimal. The interfaces operating in non-associated signalling mode and their interface IDs are arranged by subscription to the ISDN provider. Note that the interface ID is a hexadecimal value; if the interface ID was, for example, the digit “0”, the interface ID would have to be entered as INTID=30, since 30 is the hexadecimal value for the digit 0. The format of interface identifiers must be clearly understood and this information should be explicitly requested from the ISDN provider.

Configuration Example

A router with a single BRI interface has been upgraded with the addition of a T1 PRI interface. All 24 available channels on the PRI interface are to be used, rather than using one as a D channel. This is achieved using non-associated signalling, with the existing BRI interface acting as the master interface and the new PRI interface as the slave interface. The interface identifiers for the BRI and PRI interfaces are “00” and “01” respectively (in hexadecimal). The following commands are required:

```
set lapd=0 nasmode=master

set lapd=1 nasmode=slave nasmaster=bri0

set q931=bri0 intid=00

set q931=pri0 intid=01
```

To check the setup, use the command:

```
show lapd
```

which produces an output like that showing in Figure 11-4 on page 11-31. Note the NAS parameters in the first few lines. The PRI interface, while having the SAPIs 63 and 0, does not have any configured DLCs on these SAPIs. This is because the PRI D channel has been detached from and is now available as an extra B channel.

Figure 11-4: Example output from the **show lapd** command for non-associated signalling.

```
Interfaces:
ISDN    Type    TEI Mode    Debug    TEI    NAS mode    NAS master
----------------------------------------------------------------------
BRI0      TE   automatic      off      -    Master      -
PRI0      TE     nonAuto      off    000    Slave       BRI0
----------------------------------------------------------------------

SAPs:
ISDN    SAPI    T200   T201   T202   T203   N200   N201   N202   k
--------------------------------------------------------------------
BRI0      063  000010 000010 000020 000100 000003 000260 000003 001
          000  000010 000010 000020 000100 000003 000260 000003 001
PRI0      063  000010      -      - 000100 000003 000260      -  007
          000  000010      -      - 000100 000003 000260      -  007
--------------------------------------------------------------------

DLCs:
ISDN  SAPI  CES  TEI  State   V(S)   V(A)  rxN(S)   V(R)  rxN(R)
--------------------------------------------------------------------
BRI0   063  000  127  bcast      -      -      -      -      -
       000  000  127  bcast      -      -      -      -      -
            001   -    DEAD   0000   0000   0000   0000   0000
PRI0   063  -
       000  -
--------------------------------------------------------------------

Packet parameters:
--------------------------------------------------------------------
BRI0
    Packet mode TEIs:  -
    Packet mode SPIDs: -
PRI0
    Packet mode TEIs:  -
    Packet mode SPIDs: -
--------------------------------------------------------------------
```

Q.931

Recommendation Q.931 and related recommendations from the ITU-T cover the network layer of Digital Subscriber Signalling System No. 1, which handles the user–network interface for control of ISDN calls. The Q931 module in the router implements the Q.931 protocol, on behalf of call control modules CC (for data calls), PBX (for voice calls) and X25T (for packet data calls).

There are many features and options available in the Q.931 protocol, and different network providers have implemented different flavours. The router must be tested against a particular implementation and gain approval before it can be used in a particular network. The Q931 module contains the functionality required to connect to a number of ISDN networks, but the particular network to which the router is connected must be specified, using the command:

```
set q931=interface profile={5ess|aus|china|dms-100|etsi|
    japan|korea|ni1|nz}
```

The **profile** parameter specifies the Q.931 implementation that runs on a particular ISDN interface. The profile is set automatically whenever the router territory is changed by the **set system territory** command on page 11-120 of Chapter 11, Integrated Services Digital Network (ISDN). The default territory is 'Europe', which sets the profile to ETSI.

If you are not sure which profile to use, contact your authorised distributor or reseller, or ISDN service provider.

Caution Failure to select the correct profile invalidates the approval of this product with respect to the applicable national standards for the country where the product is used.

Other Q.931 parameters may be set using the command:

```
set q931=interface [timer={off|time}] [nonum={accept|reject}]
    [nosub={accept|reject}] [num1=number] [num2=number]
    [rate={56k|64k}] [spid1=spid] [spid2=spid]
    [sub1=subaddress] [sub2=subaddress]
```

As an aid to resolving Q.931-related problems, Q.931 debugging messages may be enabled or disabled with the commands:

```
enable q931=interface debug={mdecode|mraw|sdlc|sinterface|
    sspid|sspidfile|state|trace}
disable q931=interface debug={mdecode|mraw|sdlc|sinterface|
    sspid|sspidfile|state|trace}
```

The **mraw** and **mdecode** options display Q.931 messages sent or received via the specified ISDN interface, on the terminal from which the command was entered. The **mraw** option displays a raw dump of the entire message, as a hexadecimal representation of the octets of the message. The **mdecode** option displays a partially decoded version of the message. The call index, message type and information elements (IEs) in the message are all displayed, along with a raw dump of the contents of each IE.

The **trace** option provides a full trace of all subroutines executed in the Q931 module. This option is intended for use by router development and customer service engineers only.

The other options provide display of the various state machines in the Q931 module. The **state** option provides state and event debugging for ISDN calls.

The **sspid** option provides state and event debugging for the SPID state machine. The **sspidfile** option provides state and event debugging for the SPID file state machine. The SDLC option provides state and event debugging for the DLC state machine. The **sinterface** option provides state and event debugging for the interface state machine.

A Q.931 interface, an active call, or all active calls on an interface may be reset with the command:

```
reset q931=interface [call={call-index|all}]
```

where *call-index* is the index of an active Q.931 call. A **restart** message for the interface or call(s) is sent to the network. The specified call index must be the index for Q.931, not for call control. To display a list of Q.931 calls, use the command:

```
show q931 call
```

Service Profile Identifiers (SPIDs)

A feature of Basic Rate ISDN in the US and Canada is the requirement for the TE (that is, the router) to initialise before making calls. Initialisation consists of registering a Service Profile Identifier (SPID) with the ISDN switch to which the router is connected. The router sends the SPID to the ISDN switch in an **information** message, and if the ISDN switch accepts the SPID, it sends an **information** message back with the endpoint identifier that identifies the router in future call setup and disconnection.

The main points of SPIDs and SPID initialisation are as follows:

- Only certain profiles require the router to perform SPID initialisation, typically those for use in the USA and Canada.
- Valid SPIDs can be set for the router in a number of ways, including manual entry and automatic notification from the ISDN switch.
- SPID initialisation takes place every time the router is given a new TEI on a given DLC. A different SPID is required for each DLC.
- SPIDs are a sequence of decimal digits. Typically, the SPID includes the directory number.
- The router provides extensive debugging and monitoring facilities to help track SPID initialisation.

Profiles That Require SPIDs

The profiles that require SPID initialisation are the Basic Rate profiles NI1, 5ESS and DMS-100. The profile AUS for Australian Basic Rate uses SPIDs when SPIDs are defined manually. This provides support for the Spectrum service in Australia, which runs on DMS-100 switches.

Profiles that do not allow SPIDs go directly to the SPID OP state from the INIT state. Profiles that require SPID initialisation make transitions in the SPID state machine based on the SPIDs defined.

Definition of SPIDs

SPIDs can be defined in a number of ways, only some of which are related to management commands. For this reason, SPIDs are not stored as part of the router configuration, but in separate SPID files. The SPID files contain all the SPID information for a single DLC on a Basic Rate interface.

The command:

```
set q931=interface [spid1=spid] [spid2=spid]
```

sets manual SPIDs. The command:

```
set q931=interface [num1=number] [num2=number]
```

sets generic SPIDs, in the case where the number consists of 10 digits. A generic SPID consists of a 10 digit directory number (3 digit area code and 7 digit local number) suffixed by the digits "0101".

SPIDs can also be defined via the auto-SPID mechanism. The router sends an **information** message to the ISDN switch containing the universal SPID (the string "01010101010101"). If the ISDN switch supports the auto-SPID procedure, it responds with a sequence of **information** messages containing valid SPID values. The router can select one of these SPIDs in certain circumstances, or store the SPIDs for display via the command:

```
show q931=interface spid
```

A SPID can be selected for use with the command:

```
enable q931=interface aspid=index
```

The router automatically selects a SPID when the ISDN switch presents only one or two valid SPIDs. Since the router can operate with either one or two SPIDs, in both cases the router saves the SPIDs and attempts SPID initialisation.

At any time the whole auto-SPID procedure can be restarted with the command:

```
activate q931=interface aspid
```

This command deletes all existing auto-SPID information and initiates another request for auto-SPID information. If the router had already initialised with a manual or generic SPID and the auto-SPID request fails, the router reverts to the manual or generic SPID.

SPID Initialisation

Every time a given DLC is assigned a TEI, SPID initialisation must take place on that DLC. In normal operation, a TEI is assigned for a DLC when the router first starts up, and this TEI remains while the router is active. SPID initialisation takes place by the router sending an **information** message containing the SPID currently defined for the DLC. This SPID is taken from the SPID file, and depending on the previous sequence of SPID initialisation and commands entered may be a manual SPID, a generic SPID, a SPID selected via the auto-SPID procedures, the universal SPID, or no SPID at all. The SPID file state machine keeps track of all previous SPID operations. The SPID file state can be seen in the output of the command

```
show q931=interface spid
```

During operation, it is possible for a given TEI to be removed and a new one assigned. This is not a normal situation, and is usually due to communication being lost between the router and the ISDN switch at a lower layer. When a new TEI is assigned, SPID initialisation must take place again before calls can be made from the router.

SPID Debugging

The process of SPID assignment and initialisation is one of the most problematical in connecting devices to Basic Rate ISDN. Because of this, a number of debugging facilities have been provided to help the process. To enable debugging of the SPID initialisation process use the command:

```
enable q931=interface debug=sspid
```

This command displays events and state transitions of SPID initialisation to the device from which the command was entered. The SPID states are given in Table 11-12. The SPID events are given in Table 11-13 on page 11-36.

Table 11-12: SPID Initialisation States

State	Description
NULL	Initial state for the SPID state machine at router restart.
IWAIT1	Router has sent specific SPID and is waiting for response from the network.
IWAIT2	The network has sent a prompt for SPID initialisation and the router has replied.
IWAIT3	The router has previously performed SPID initialisation, has seen a network prompt for SPID initialisation and has replied.
AWAIT1	The router is attempting auto ISDN switch detection and has sent a specific SPID.
AWAIT2	The router is attempting auto ISDN switch detection, has sent a Protocol Version Control message to the network and is waiting for a response.
AWAIT3	The router is attempting auto ISDN switch detection, has seen a prompt for SPID initialisation from the network and has replied.
5ESSNOTINIT	The router profile is 5ESS and an initialisation request has been sent to the network.
ASPID1	The router has sent the universal SPID (for auto SPID procedures) and is waiting for a response from the network.
ASPID2	The router has seen a network congestion message and is waiting (for 10 minutes) to restart auto SPID procedures.
ASPID3	The router has seen a number of auto SPID values and is waiting for user intervention to select the correct SPID(s).
ASPID4	The router is attempting auto ISDN switch detection, has sent the universal SPID (for auto SPID procedures) and is waiting for a response from the network.
OP	SPID initialisation has successfully taken place and normal operation can begin.
5ESSPINIT	The router profile is 5ESS and the router has initialised for point-to-point operation.

Table 11-12: SPID Initialisation States (cont.)

State	Description
5ESSMINIT	The router profile is 5ESS and the router has initialised for point-to-multipoint operation.

Table 11-13: SPID Initialisation Events

Event	Description
ASD	Perform auto ISDN switch detection.
INIT	Initialise.
TSPID	SPID timeout.
INFO	Received an **information** message containing SPID information.
DLRELEASE	The LAPD data link has been released.
RESET	Reset the SPID state machine.
MIM	5ESS management information message.
RELCOMP	Received a **release complet**E message.
MESSAGE	Received a call control message that has implications for SPID initialisation.

SPID information is stored in SPID files. SPID file states are defined to control the manual, generic, and auto-SPID information used in SPID initialisation. To enable debugging of the SPID file state machine, use the command:

```
enable q931=interface debug=sspidfile
```

The states and events for the SPID file state machine are given in Table 11-14 on page 11-36 and Table 11-15 on page 11-37 respectively.

Table 11-14: SPID File States

State	Description
1	No SPIDs entered, auto SPID not run or in progress.
2	Manual SPID last one entered.
3	Generic SPID last one entered.
4	Auto SPID successful.
5	Auto SPID failed (non-initialising terminal).
6	Manual or generic SPID failed (non-initialising terminal).
7	Manual SPID after successful auto SPID.
8	Generic SPID after successful auto SPID.
9	ISDN switch only supports non-initialising terminal.
10	Manual SPID passed, auto SPID initiated.
11	Generic SPID passed, auto SPID requested.
12	Manual SPID passed.
13	Manual SPID passed, generic SPID entered.

Table 11-15: SPID File Events

Event	Description
SetSPID	The user has configured a SPID with the **set q931** command on page 11-117.
SetDN10	The user has configured a 10 digit directory number with the SET Q931 NUM1/2 command
AutoSPIDPass	The auto SPID has been used for initialisation and initialisation has succeeded.
AutoSPIDFail	The auto SPID has been used for initialisation and initialisation has failed.
ConfSPIDPass	The configured SPID has been used for initialisation and initialisation has succeeded.
ConfSPIDFail	The configured SPID has been used for initialisation and initialisation has failed.
ConfSPIDTimeout	The configured SPID has been used for initialisation and the TSPID timer went off.
SPIDInit	The SPID file has been reinitialised.
NITIndication	An indication has been received that the router has to operate as a non-initialising terminal.
SetAutoSPID	The user has requested auto SPID procedures be retried.
ClearSPID	A manually configured SPID has been cleared.

Automatic ISDN Switch Detection

The router can, for Basic Rate interfaces in the USA and Canada, automatically detect the type of ISDN switch to which it is connected. This process is automatically initiated at router start-up when the router's personality PROM indicates that the router is manufactured for the USA market. The results of automatic ISDN switch detection are stored in a file whose name has the format:

```
brin.asd
```

where *n* is the interface index. The automatic ISDN switch detection process can be debugged with the command:

```
enable q931=interface debug=sinterface
```

The interface states and events are given in Table 11-16 on page 11-38 and Table 11-17 on page 11-38.

Table 11-16: Automatic ISDN Switch Detection States

State	Description
ASD-0	Initial state for the auto ISDN switch detection state machine at router restart.
ASD-1	Auto ISDN switch detection has been initiated by resetting the physical layer.
ASD-2	A TEI has been assigned at the LAPD layer and a data link establish requested.
ASD-3	The data link has established and an ASD event has been sent to the SPID state machine.
ASD-4	The first SPID ASD event timed out and we have reset the physical layer again.
ASD-5	A TEI has been assigned at the LAPD layer again and a data link establish requested.
ASD-6	The data link has established again and an ASD event has been sent to the SPID state machine.
Operational	The interface type has been established and SPID initialisation can proceed.

Table 11-17: Automatic ISDN Switch Detection Events

Event	Description
ASD request	Request to begin auto ISDN switch detection.
Set profile	The interface type (profile) has been manually set.
DL-Establish	The data link layer has established.
5ESS msg	A message identifying the network as a 5ESS custom ISDN switch has been received.

Table 11-17: Automatic ISDN Switch Detection Events (cont.)

Event	Description
SPID timeout	The SPID procedures have timed out.
ASD valid	The SPID state machine has been able to determine what sort of ISDN switch the router is attached to.
TEI assign	LAPD has assigned a TEI for the interface.
TEI remove	LAPD has removed the TEI for the interface.
DL-Release	The data link layer has been released.

Call Control

ISDN call control is responsible for maintaining and controlling ISDN calls. The call control module uses Q.931 to set up and tear down ISDN calls. Call control provides the interface between modules (such as PPP) that wish to use ISDN to send data, and the modules that directly control ISDN in the router.

In the description of ISDN call control, a distinction is made between an active call and a call definition. A call definition contains the configurable details of an ISDN call. Call definitions are modified by commands to configure the way that the router makes and responds to actual ISDN calls. An active call is an actual ISDN call. Each active call is the result either of a call definition being activated, or of an incoming call that has been matched to a call definition.

Before the router can make or accept ISDN calls, at least one call definition must be configured. Depending on the type of call configured, user modules, such as PPP, may also need to be attached to the call definition. The configuration of the call definitions determines the behaviour of all ISDN calls in the router. To allow flexibility in a large number of situations, the call definition has a large number of possible options, and many ways of achieving the same result, of connecting two routers with an ISDN call. Up to 1024 ISDN call definitions can be configured on the router.

The call definition serves two basic functions; to define how a router makes ISDN calls, and to define how a router receives ISDN calls. For an ISDN call to be made successfully between two routers, the active call on each router must be associated with a call definition. For this reason, call definitions may end up being defined in pairs on the two routers that are to communicate, with each call definition referencing information associated with the other call definition.

Two basic models of operation of call definitions are available on the router. In the first, each call definition is linked in some way with a call definition on another router. The call definition option description below details how the calls may be linked. Each call definition in this model is usually configured to be attached to by a higher layer protocol, and the higher layer instances are created before the call is activated.

In the second model of operation, a single call definition is set up on a router that receives a large number of calls from different routers. The call definition is configured to extract some portion of the incoming **setup** message and use it to provide identification of the remote router. The remote router identification is used to configure higher layer modules and to dynamically create interfaces. This model provides a good way to allow a large number of remote routers to call a single central router, without having to create a large number of call definitions on the central router.

As there are a large number of options for call definitions, it is important to understand those options that relate to the situation in which the router is used, with respect to the model of operation and to the actual ISDN network. Having determined the best way to set up ISDN call definitions for a particular situation, it is advisable to use similar call definitions for all calls.

The following paragraphs outline the options of call definitions in broad groups.

*Outgoing **setup** parameters* specify the format and content of the **setup** messages originated by the router when it is making a call. To allow successful connection between routers, information must be carried in the **setup** message that can be interpreted at the remote router. Information elements in the **setup** message can be used to carry this information. The router carries information in three different information elements, the user–user data IE, the called subaddress IE and the calling party number IE. Each of these can be independently configured to carry the required connection information. The user–user data IE and called subaddress IE can be configured to carry the local call name or the remote call name. The called subaddress IE can also be configured to carry an arbitrary string of digits. The calling party number IE can be configured to carry the calling number of the call, the number of the Q.931 interface that the call uses, or to carry no number, which is then supplied by the network.

A router receiving an ISDN call must have some way of identifying and checking the call. *Searching and checking parameters* in the call definition control this function. A call definition can be configured to search on the incoming call's user–user data IE, called subaddress IE or calling party number IE. Calls can also be set up to respond to any incoming call. As with the outgoing **setup** parameters, user–user data and called subaddress IEs can be compared with the call name or the remote call name. The following procedure is used to associate an incoming ISDN call with a call definition:

1. If the incoming call **setup** message contains a called subaddress IE, search all call definitions that allow searching on the called subaddress IE for a call definition with a call name or remote call name matching the contents of the called subaddress IE in the call **setup** message. If a match is found, use the matching call definition to handle further processing of the call. Otherwise, go to step 2.
2. If the incoming call **setup** message contains a user–user data IE, search all call definitions that allow searching on the user–user data IE for a call definition with a call name or remote call name matching the contents of the user–user data IE in the call **setup** message. If a match is found, use the matching call definition to handle further processing of the call. Otherwise, go to step 3.
3. If the incoming call **setup** message contains a calling party number IE, and the IE contains calling party number digits, search all call definitions that allow searching on the calling party number IE for a call definition with a called number matching the contents of the calling party number IE in the call **setup** message. If a match is found, use the matching call definition to handle further processing of the call. Otherwise, go to step 4.

4. Search for a call definition configured to match any incoming call **setup** message. If a match is found, use the matching call definition to handle further processing of the call. Otherwise, reject the call.

Once identified, an ISDN call can also be checked. Checks can be made against the user–user data and called subaddress IE, as well as the calling party number IE. Calling party number information is also known as CLI (calling line information). CLI provides the greatest number of options as well as the greatest security, because the CLI is verified by the ISDN and cannot be falsified. An ISDN call in the router can be set up to require that CLI be present and that the number in the CLI be in a configured list of numbers.

Call precedence is used to resolve call collisions. These occur when two routers attempt to make a call to each other at the same time, and the call definition at each end is associated with an outgoing and incoming call simultaneously. The precedence parameter in the call definition determines active calls that are cleared and accepted. Call precedence must be set **in** on one router and **out** on the other for this scheme to work.

Call tenacity refers to the ability of the router to retry ISDN calls that fail. Calls may be retried as a series of retry groups. Each retry group consists of a series of retries. The time between retries and retry groups and the number of calls in a retry group and the number of retry groups may all be specified. An alternate number to try may also be specified. This is used when all retries and retry groups have been tried and failed. A separate parameter specifies that a call is to be held up at all costs, so that it is retried even when all retries have failed.

The *required* or *preferred* ISDN interface for a call to use may be specified. If the required interface is specified, the call may only be made on that interface. If the preferred interface is specified, the call is tried on that interface first. In either case, the call is tried only on an interface that has a free channel.

The *call holdup* facility ensures that a call, once established, is held active for a specified minimum period of time. This ensures that the maximum benefit is obtained for calls made over a network that has a minimum call charge.

The alternate number facility gives the network manager the option of defining an alternate ISDN number for any ISDN call, which is independent of the main ISDN number. If a call to the main number fails, the alternate number, if defined, is used to make a backup call but with the following restrictions:

- ISDN call retry parameters (RN1, RN2, RT1, RT2) apply only to the main number, not to the alternate number. The alternate number is tried only once.
- If call retry parameters are defined in such a way as to ensure that the main number is actually retried, the alternate number is not used until all retries have been tried and have failed.
- The **keepup** parameter, if set to **true**, ensures that the call is retried from scratch. That is, the main number is tried and retried and then the alternate number is tried. The effect of the **keepup** parameter is checked only after the alternate number has been tried and failed.

This combination of flags and parameters ensures that a flexible combination of retries of the main and alternate numbers is achievable.

The *call back* facility enables a call to be configured to call back the originator of an incoming call.

Call bumping makes use of call priorities assigned to voice and data calls to terminate an existing active call in favour of a new call with a higher priority. For voice calls the priorities allowed are normal and high. For data calls, the priority is a number from 0 to 99. The rules for call bumping are:

- Call bumping takes place when all B channels on a given ISDN interface are in use and a new incoming or outgoing call is made.
- A high priority voice call is never bumped.
- A normal priority voice call can only be bumped by a high priority voice call.
- Data calls are bumped according to their priority (Table 11-18 on page 11-42).

Table 11-18: Call priority and call bumping

Calls of priority...	**Are bumped by...**
0-19	Incoming or outgoing voice calls and incoming or outgoing data calls of higher priority.
20-39	Outgoing voice calls and incoming or outgoing data calls of higher priority.
40-59 (including the default priority of 50)	High priority outgoing voice calls and incoming or outgoing data calls of higher priority.
60-99	High priority outgoing voice calls and outgoing data calls of higher priority.

Although Table 11-18 on page 11-42 specifies that a call can be bumped by an incoming call, it is likely that the ISDN to which the router is attached will not offer another incoming call if all B channels are in use. Instead, a busy signal is returned to the originating caller.

Calls are added (defined) and deleted with the commands:

```
add isdn call=name number=number precedence={in|out}
    options...
delete isdn call=name
```

A call definition can be modified with the command:

```
set isdn call options...
```

Calls are enabled and disabled with the commands:

```
enable isdn call=name
disable isdn call=name
```

Calls are made and disconnected with the commands:

```
activate isdn call=name
deactivate isdn call=name
```

The command:

```
show isdn call
```

displays information about call definitions and active calls.

Call Logging

A call logging facility records details of events associated with ISDN calls. Log entries are sorted according to the time the call was initiated. Call logging is enabled or disabled with the commands:

```
enable isdn log
disable isdn log
```

An entry is added to the log when a call is initiated. When the log exceeds a predefined maximum length, the oldest entry that is in the **cleared** state is removed from the log. If no entries qualify the log is allowed to grow larger than the maximum defined length. Log messages can be sent to an asynchronous port on the router when the log entry enters the **cleared** state. The maximum length of the log and the port where messages should be sent can be set with the command:

```
set isdn log [port={0..23|none}] [length=0..100]
```

Setting the **port** parameter to **none** disables the forwarding of messages to an asynchronous port. The default for **port** is **none**. The default for **length** is 25. Call logging is enabled by default.

The command:

```
show isdn log
```

displays the current contents of the call log.

In addition to the call logging facility, the following events associated with ISDN calls are logged to the logging facility:

- Call activated.
- Call disconnected after normal call clearing.
- Call cleared due to an error condition.

For more information about the storage and display of these log messages, see Chapter 60, Logging Facility.

Using a Domain Name Server

For calls designed to carry IP traffic, an IP address is required. A *Domain Name Server* (DNS) can be used to determine the IP address for individual users. A domain name can be defined using the command:

```
add isdn domainname=domain-name
```

When a user logs in to the router, the user's login name is added before the domain name and a DNS lookup is performed using the resulting string. If the lookup is successful, the response is used as the IP address for the user.

The domain name may be deleted using the command:

```
delete isdn domainname
```

The currently assigned domain name can be displayed with the command:

```
show isdn domainname
```

Appropriate entries must be created in the DNS to map entries of the form *login-name.domain-name* to IP addresses.

Slotted Interface Numbering

BRI and PRI interfaces are collectively termed "slotted" interfaces, in reference to their 64 kbit/s slot-based channel structure. For each slotted interface operating in ISDN mode, there are LAPD and Q931 module instances. These instances are identified by the index of the slotted interface. For example, when there is a BRI interface on the base board of the router and a PRI interface on an expansion card, instance 0 of the LAPD module and instance 0 of the Q931 module correspond to the BRI0 interface. Instance 1 of the LAPD module and instance 1 of the Q931 module correspond to the PRI0 interface.

Slotted interfaces that are operating in TDM mode do not need LAPD or Q931 module instances, so when a slotted interface is set to TDM mode the corresponding LAPD and Q931 instances are destroyed. Any remaining instances are not renumbered. Following the example above, if the BRI0 interface is set to TDM mode LAPD instance 0 and Q931 instance 0 are destroyed. LAPD instance 1 and Q931 instance 1 corresponding to the PRI0 interface are unaffected.

Always On/Dynamic ISDN (AODI)

Always On/Dynamic ISDN (AODI) is a networking service that provides a connection to TCP/IP-based services that is always available, and that adjusts bandwidth as required by the traffic traversing the connection.

AODI uses the ISDN D channel X.25 packet service to maintain a permanent connection between the end-user router and the Internet provider. This provides a constant, low-cost connection for low bandwidth requirements such as sending and receiving Email, news feeds, etc. When additional bandwidth is required, for example for web browsing, AODI automatically adds circuit switched connections over the ISDN B channels. When the additional bandwidth is no longer required, the B channels are dropped while the X.25 service remains.

Components of AODI

AODI is not a distinct protocol, but a service comprising features from other protocols, which when configured correctly, combine to provide the AODI service. The components of AODI are:

- D channel support for X.25 packet mode.
- X.25 support for PPP.
- ISDN B channel support for PPP.
- PPP support for multilink, bandwidth-on-demand and BAP.

D Channel Support for X.25 Packet Mode

The main purpose of the ISDN D channel is to act as a path for ISDN call control. The Q.931 protocol uses the D channel to send messages to, and receive messages from, the network in order to make and tear down calls. As an optional feature, the D channel can also be used to make X.25 packet mode connections to other X.25 devices on the ISDN, or other X.25 devices on packet mode networks. A device makes connections to the ISDN on the D channel by opening Data Link Connections (DLCs) on the D channel. A given DLC can be used by either Q.931 or X.25 for communicating with the network. However, in some cases, extra configuration may be required to allow X.25 to communicate.

In most countries, only one DLC is opened on the D channel. This is used by X.25 if X.25 is configured to use the D channel. In the USA, the DLC to be used by X.25 must be specified. A given TEI (that identifies the DLC) may be used (in which case a new DLC is opened), or an existing DLC selected by specifying which SPID is available for X.25 use. Identifying the SPID identifies the DLC.

X.25 Support for PPP

The router supports MIOX (*Multiprotocol Interconnect Over X.25*), which lets different higher layer protocols use an X.25 service. When an X.25 call is made, the data in the call setup message specifies which higher layer protocol should run over the call. One value for this data has been specified to indicate that the higher layer protocol is to be PPP.

By configuring MIOX and PPP correctly, a PPP link can be established over an X.25 interface. The AODI specification mandates that only X.25 switched virtual circuits (SVCs) are to be used for AODI.

ISDN B Channel Support for PPP

ISDN B channels are available for use by a number of different traffic types, including voice and data. The router allows PPP to run over ISDN B channels, controlled by ISDN call control call definitions. Calls can be configured for outgoing and incoming access, with a large number of options.

PPP Support for Multilink, Bandwidth-on-demand and BAP

AODI requires that the separate PPP connections on the D channel and on the B channels be joined together as a PPP multilink bundle. This allows the effective bandwidth of a PPP interface to be increased by making a number of different connections, and logically joining them together. The addition and removal of PPP links from the multilink bundle is controlled by BAP (*Bandwidth Allocation Protocol*).

The PPP links running on the B channel must be configured to run as bandwidth-on-demand links, otherwise when the PPP interface is configured, all links are brought up at once. Bandwidth-on-demand means that certain links are brought up when the bandwidth requirements of the multilink bundle demand it.

Configuring AODI

The following example illustrates the steps required to configure the router to communicate with an ISP using AODI. Only the configuration of the router is shown. The configuration shown is for a USA ISDN, to illustrate the extra commands for USA X.25 packet mode. Table 11-19 on page 11-46 lists the configuration parameters.

Table 11-19: Example configuration parameters for AODI

Parameter	Value
Router IP address/mask	202.36.163.55/255.255.255.0
ISP X.25 DTE address	1234567890
Routers X.25 DTE address	1243452345
ISP ISDN number	1234567899
TEI for X.25 packet mode	21

In this example, the router has a single ISDN interface, BRI0. This is also referred to by its interface index, 0. The system territory and Q.931 profile are assumed to be set correctly for this router.

To configure AODI:

1. **Configure X.25 packet mode TEI on LAPD.**

   A TEI has been supplied by the ISDN service provider for the use of X.25 on LAPD. To enter this information into the LAPD configuration, use the command:

   ```
   add lapd=0 xtei=21
   ```

   This ensures that when X.25 attaches to LAPD, LAPD assigns a DLC with a TEI of 21. This is required because the network expects X.25 messages on TEI 21.

   The setting of a TEI for use by X.25 is a network dependent option. The only currently known profiles that may require the TEI to be set are the USA profiles NI1, 5ESS and DMS-100. Contact your ISDN service provider for more information.

2. **Configure X.25 to use LAPD.**

   An X.25 DTE interface must be created to use LAPD, using the command:

   ```
   create x25t=0 over=lapd0 dte=1243452345
   ```

   The DTE address specified is the router's own DTE address. The ISDN service provider provides this information.

3. **Configure a MIOX circuit for use by PPP.**

   A MIOX circuit must be configured to allow X.25 calls to be made to the correct remote DTE address. This circuit can then be used by higher layers, including PPP:

   ```
   add miox=0 circ=aodi dte=1234567890
   ```

   The DTE specified is the DTE address of the router at the remote end of the link. The ISDN service provider provides this information.

4. **Configure an ISDN call for use by PPP.**

   To allow PPP to make calls on the B channels of the ISDN interface, ISDN call definitions must be created. These call definitions specify the remote number to call, and how the call is to be identified to the remote router. In this case, the remote router has Caller Line Identification (CLI) enabled, and the network presents the caller's number (this router's number) without any configuration being required:

   ```
   add isdn call=aodi num=1234567899 prec=out
   ```

5. **Configure PPP to use the MIOX circuit and ISDN call.**

   Having created the underlying links for PPP, the PPP interface itself can be configured. The primary link is over the MIOX call, while the B channels are configured as demand links:

   ```
   create ppp=0 over=miox0-aodi
   add ppp=0 over=isdn-aodi type=demand number=2
   ```

6. **Configure bandwidth parameters on the PPP interface.**

   The bandwidth parameters on a PPP interface let the user configure conditions under which extra bandwidth is to be requested and excess bandwidth removed. The parameters are **uprate** (the usage percentage above which extra bandwidth is requested), **uptime** (the time in seconds that the excess usage must be present), **downrate** (the usage percentage below which excess bandwidth is removed) and **downtime** (the time in seconds that the lower usage must be present). The defaults for these parameters are 80%, 30s, 20% and 60s respectively.

   These values do not work very well for AODI because of the disparity between the speed of the X.25 link and the ISDN call link. The **uprate** converts to an absolute utilisation of 12.8 kbps (80% of 16 kbps), while the **downrate** (when a single ISDN B channel is in use) converts to an absolute utilisation of 16 kbps (20% of 80 kbps). This means that a steady offered load of, say, 14 kbps, overloads the X.25 call on its own and causes a B channel to be added. At this point, however, the offered load is below **downrate** and the B channel call is dropped (after a minute). This oscillating pattern of a call being brought up, then dropped, continues as long as the offered load remains in the band 12.8–16 kbps.

   A better set of utilisation parameters might be **uprate**=90% (absolute value of 14.4 kbps) and **downrate**=15% (absolute value of 12 kbps). For the transition from the X.25 call plus one B channel to the X.25 call plus two B channels, the absolute values become 72 kbps and 21.6 kbps respectively, which is also a stable configuration. To set these parameters, enter the command:

```
set ppp=0 uprate=90 uptime=20 downrate=15 downtime=60
```

The **uptime** and **downtime** parameters are set according to how responsive the user wants the router to be to changes in offered load.

Another option altogether is to allow the remote end (in this example, the ISP), to make the decisions on bandwidth allocation. This involves setting the bandwidth parameters to values that ensure that the router never brings up or takes down calls based on them, using the command:

```
set ppp=0 uprate=100 uptime=1000000 downrate=0
    downtime=1000000
```

7. **Configure IP to use the PPP interface.**

The final step is to configure the IP interface that uses the PPP interface:

```
add ip int=ppp0 ip=202.36.163.55 mask=255.255.255.0
```

Data Over Voice

Some ISDN service providers charge a premium for data calls, compared to voice calls. However, the premium can be avoided by faking a voice call and then sending data over the voice call. Both ends of the link—the device making the call and the device receiving the call—need to be configured correctly to perform this stunt, because if anything special appears in the call setup message the ISDN service provider would be able to detect this and still charge the premium.

To configure data over voice (DOV):

1. **Configure the calling router to make voice calls.**

The calling router must be configured to use the voice bearer capability when making a DOV call, using either of the following commands:

```
add isdn call=call-name dov={on|off|yes|no|true|false}
    [other-call-options...]
```

```
set isdn call=call-name dov={on|off|yes|no|true|false}
    [other-call-options...]
```

The **dov** parameter specifies whether the outgoing call setup message has data bearer capability or voice bearer capability selected. If **dov** is set to **on**, voice bearer capability is specified and the ISDN service treats the call as a voice call. If **dov** is set to **off**, data bearer capability is specified and the ISDN service treats the call as a data call.

2. **Configure the answering router to recognise the DOV calls.**

The answering router must be configured to recognise a DOV call, by defining a special ISDN number for DOV calls on the Q931 interface:

```
set q931=interface dovnumber=number
```

The **dovnumber** parameter specifies an ISDN number for the interface. The number specified for **dovnumber** must be a valid ISDN number supplied by the ISDN service provider. If a call is received on this interface with a voice bearer capability and a called number matching the value specified for **dovnumber**, the call is treated as a data call, not a voice call.

Configuration Examples

The following examples illustrate the steps required to configure ISDN for a range of network functions, from a basic ISDN configuration through to more advanced functionality.

A Basic ISDN Setup

This example illustrates the steps required to configure ISDN calls between two routers as in Figure 11-5 on page 11-49 and Table 11-20 on page 11-49.

Figure 11-5: Example configuration for a basic ISDN network.

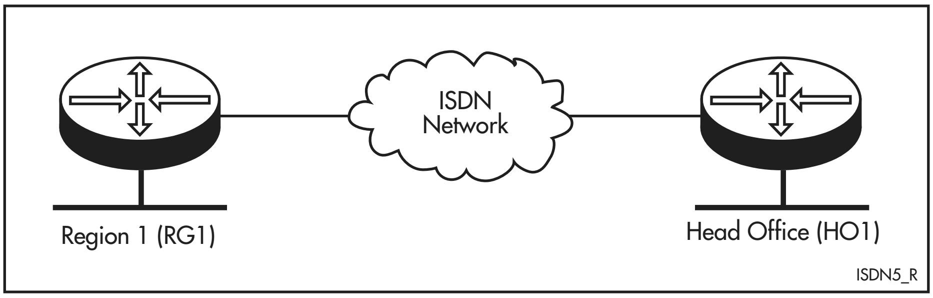


Table 11-20: Example configuration parameters for a basic ISDN network

Site	Region 1	Head Office
Router Name	RG1	HO1
ISDN Number	1234567	9876543
IP Address for PPP0	192.168.35.114	192.168.35.113
IP Address for Eth0	192.168.35.110	192.168.35.45
Subnet Mask	255.255.255.240	255.255.255.240

To configure a basic ISDN:

For BRI ISDN interfaces start at Step 1; for PRI ISDN interfaces start at Step 2.

ISDN on the router requires minimal user configuration, other than selecting a profile, and creating and enabling calls. The lower layers of the ISDN protocol stack (BRI, PRI, LAPD and Q.931) are automatically configured by the **set system territory** command on page 11-120 of Chapter 11, Integrated Services Digital Network (ISDN). Most of the commands associated with these layers are for testing purposes and **should not be used during normal operation** as they may interfere with the functioning of the router.

Caution The factory default hardware and software settings described here are correct for European Union (EU) countries. For other countries, contact your authorised distributor or reseller for details of local requirements.

1. **Check the BRI hardware configuration.**

   Routers and expansion boards with BRI hardware are shipped with the operation mode jumpers set to TE mode and the termination jumpers removed, which are the appropriate settings for normal operation. When the BRI hardware is to be operated as an NT or connected in a point-to-point configuration where termination resistors are not already provided in the building wiring, these jumpers must be changed. Contact your authorised distributor or reseller for details of how to set the jumpers.

   The commands:

   ```
   show bri state
   ```

   ```
   show bri configuration
   ```

   display the state of the BRI interface and the modules that have attached to the BRI interface. No other user configuration is required.

   If the interface is to be used to connect to a non-standard ISDN service, the **set bri** command on page 11-102 may be required to alter the mode of operation of the interface:

   ```
   set bri=instance [activation={normal|always}]
       [isdnslots=slot-list] [mode={isdn|tdm|mixed}]
       [tdmslots=slot-list]
   ```

   In this case the slots to be used for ISDN calls and TDM (Time Division Multiplexing) groups may need to be defined. See Chapter 12, Time Division Multiplexing (TDM) for a detailed description of how to configure TDM groups. Contact your authorised distributor or reseller for assistance with the configuration of the interface.

   Caution The mode parameter of the **set bri** command affects the way the router behaves when connected to a network to the extent that, if configured inappropriately for the network to which it is connected, it may not conform to the national standards applying to that network. Therefore care must be taken when using this command. Please seek the advice of your authorised distributor or reseller, or ISDN service provider when changing the mode of operation from the default, which is the correct mode for connecting to a standard ISDN network.

   Caution Semipermanent connections are not available in the USA and the router does not permit the mode of a BRI U interface to be set to **tdm** or **mixed** or the **activation** mode set to **always**.

   Go to Step 4.

2. **Check the PRI hardware configuration.**

   The jumper that selects E1 or T1 must be set appropriately for the service involved: installed for T1 and not installed for E1.

   The jumper that selects TE or NT mode should not normally be installed. When the jumper is not installed, TE mode is selected.

   For more detailed information about the jumpers, see the *Port Interface Card Hardware Reference*.

   Connect the cable from the NT/CSU to the socket on the rear panel of the router.

3. Check the PRI software configuration.

The commands:

```
show pri state

show pri configuration
```

may be used to display the state of the PRI interface and the modules that have attached to it. The factory default configuration should be satisfactory for most operational situations. If necessary, an E1 PRI interface can be modified using the command:

```
set pri=n mode={isdn|tdm|mixed} [isdnslots=slot-list]
    [tdmslots=slot-list] clock=source crc=mode
    idle=character interframe_flags=extra-flags
    error_threshold=error-frames
```

This command may be used to alter the clock source (**line** or **internal**), the CRC-4 mode (**off**, **checking** or **reporting**), the decimal value of the character transmitted in unused slots, the number of additional flags transmitted between HDLC frames and the CRC-4 error threshold for resynchronisation. See the description of the **set pri** command on page 11-113 for more information.

If necessary, a T1 PRI interface can be modified using the command:

```
set pri=n mode={isdn|tdm|mixed} [isdnslots=slot-list]
    [tdmslots=slot-list] clock=source code={standard|
    alternate} encoding={b8zs|b7zs|ami} framing={sf|esf}
    inbandloopback={line|payload} interframe_flags=extra-
    flags lbo={none|-7.5db|-15db|-22.5db}
    linelength=0..65535
```

This command may be used to alter the line encoding (B8ZS, B7ZS or AMI), the framing (SF or ESF), the line length for short haul lines and the line build out (NONE, - 7.5dB, -15dB or -22.5dB) for long haul lines. See the description of the **set pri** command on page 11-113 for more information.

Caution The **mode** parameter of the **set pri** command affects the way the router behaves when connected to a network to the extent that, if configured inappropriately for the network to which it is connected, it may not conform to the national standards applying to that network. Therefore care must be taken when using this command. Please seek the advice of your authorised distributor or reseller, or ISDN service provider when changing the mode of operation from the default, which is the correct mode for connecting to a standard ISDN network.

For connection to non-standard ISDN services the mode of operation may need to be set to other than ISDN, in which case the **isdnslots** and **tdmslots** parameters should be used to indicate which slots to use for ISDN calls and which to use for TDM (Time Division Multiplexing) groups. See Chapter 12, Time Division Multiplexing (TDM) for a detailed description of how to configure TDM groups. Contact your authorised distributor or reseller for assistance with the configuration of the interface.

For compliance with national and international standards, the CRC and **error_threshold** parameters of the **set pri** command on page 11-113 must be set to values specific to the country where the PRI interface is to be used. When the Q.931 profile for a PRI interface is changed with the **set q931** command on page 11-117 or the **set system territory** command on page 11-120 of Chapter 11, Integrated Services Digital Network (ISDN), the values of **crc** and **error_threshold** for the PRI interface are automatically set to the correct values for the Q.931 profile.

For this example, the PRI interface is set to **mixed** mode, using the following command:

```
set pri=0 mode=mixed isdnslots=1-16 tdmslots=18
```

4. **Check the LAPD configuration.**

The LAPD module is automatically configured when the router boots and does not require any user configuration. The LAPD parameters are specified by the LAPD standard and should not be changed without careful consideration. Contact your authorised distributor or reseller before using the **set lapd** command on page 11-111.

The command:

```
show lapd
```

can be used to display the state of the LAPD interface and each DLC.

Please note that there is no LAPD entity associated with an interface set to TDM mode.

5. **Select your territory or set a Q.931 profile, and set other Q.931 parameters.**

The **profile** determines the network that runs on the interface. The profile selected must match the characteristics of the ISDN network to which the router is to be connected (Table 11-21 on page 11-52).

To set the profile automatically, select the country in which the router is operated, by using the command:

```
set system territory={australia|china|europe|japan|korea|
    newzealand|usa}
```

The territory determines which Q.931 profile is used on the ISDN interface. For example, to select the Q.931 profile for the United States, enter the command:

```
set system territory=usa
```

The default territory is 'Europe', which sets the profile to ETSI.

Caution If you are not sure which territory to use, contact your authorised distributor or reseller. Failure to select the correct territory will invalidate the approval of this product with respect to the applicable national standards for the country in which the product is used.

Table 11-21: Q.931 Profiles

Profile Name	Country
5ESS	USA and Canada
AUS	Australia
CHINA	China
DMS-100	USA and Canada
ETSI	European Union countries (ETSI specification)
JAPAN	Japan
KOREA	Korea
NI1	USA and Canada
NZ	New Zealand

To select the Q.931 profile to be used on the ISDN interface, or to override the default set by the **set system territory** command on page 11-120 of Chapter 11, Integrated Services Digital Network (ISDN), use the command:

```
set q931=interface profile=profile
```

Please note that there is no Q.931 profile associated with an interface set to TDM mode.

The router's own ISDN numbers and subaddresses may be set with the command:

```
set q931=interface num1=number num2=number sub1=subaddress
    sub2=subaddress
```

The numbers and subaddresses must be set when the router is attached to a BRI S/T bus with other TEs, or when SPIDs are being used in this configuration. Two numbers and subaddresses may be defined, although both numbers are required only when two SPIDs are defined. See below for a description of SPIDs and how they interact with the ISDN numbers.

If the router is the only TE on the bus, all incoming calls are for the router so the router does not need its own ISDN number. If more than one TE exists on the bus, the incoming **setup** message is sent to all of them, and the called number (and optionally, subaddress) in the **setup** message must be matched with the TE's number before it may reply to the call. The number entered should be the one supplied by the carrier, without STD access codes or area codes. The incoming number and the router's number are compared from the right end and only as far as the shortest of the two numbers. The subaddress specified must not conflict with the subaddresses of other TEs on the bus.

In some networks the router must be configured with one or two *Service Profile Identifiers* (SPIDs). A SPID identifies the router to the network and must be correctly configured before calls can be made from the router. The ISDN service provider supplies the SPID(s) for the interface, which are entered with the command:

```
set q931=interface spid1=spid [spid2=spid]
```

Entry of SPID values is usually tied to entry of ISDN numbers. For two SPIDs, two numbers must be defined and the numbers must match the SPIDs. That is, **num1** must match **spid1** and **num2** must match **spid2**. In most circumstances, the **num** parameter is a substring of the **spid** parameter. When two SPIDs are defined, the router creates two DLCs in the LAPD module, one for each SPID. Calls are presented to the router on both DLCs, and the router determines, on the basis of the called number, the DLC on which to accept the call. When making outgoing calls, the router selects one of the DLCs. If one DLC already has an active call, the router selects the other DLC.

The SPID facility is available when the Q.931 profile is one of the Basic Rate profiles NI1, 5ESS, DMS-100 or AUS (Australian Basic Rate). SPIDs are required for the NI1, 5ESS and DMS-100 profiles. The AUS profile uses SPIDs when SPIDs are defined manually. SPIDs are not required for Primary Rate interfaces.

The command:

```
set q931 timer=value
```

may be used to set the timeout values for the Q.931 timers (T301, T302, T303, T304, T305, T308, T309, T310, T313, T314, T316, T317, T318, T319, T321 and T322). However, the defaults should be adequate for most situations. Contact your authorised distributor or reseller, or ISDN service provider before making any changes to the Q.931 timers.

The command:

```
show q931
```

can be used to display the Q.931 profile, the router's numbers and SPIDs, and timer values.

6. **Configure ISDN calls.**

This is the only step that has to be carried out in order to run ISDN on the router. An ISDN call definition must be created on any two routers that are to communicate with ISDN, using the command:

```
add isdn call=name number=number precedence={in|out}
    options...
```

As an example, Region 1 is to be connected to Head Office via ISDN. The ISDN number of the Region 1 router is 1234567. The ISDN number of the Head Office router is 9876543 (Figure 11-5 on page 11-49). The ISDN network being used allows the passage of called party subaddress, but CLI is not allowed because of privacy issues and user–user data can only be sent as a subscription option and the facility is not free.

Before a call can be made from one office to the other, call definitions must be created on both routers. In this example, the called party subaddress IE carries connection information, and PPP interfaces are created explicitly to use the ISDN calls. Either end can initiate the call but the call from Region 1 has precedence.

On the Head Office router, create a call to the Region 1 router:

```
add isdn call=region1 outsub=local searchsub=local
    number=1234567 prec=in
```

On the Region 1 router, create a call to the Head Office router:

```
add isdn call=region1 outsub=local searchsub=local
    number=9876543 prec=out
```

Note that each call has the same name, and that this name is passed via the *called subaddress Information Element* (IE) to provide identification for the remote end of the link. Each router searches for this call using the called subaddress IE.

Note that the BT implementation of the ETSI specification for European Union countries effectively limits the call name length to 5 characters, for interoperation with other national ISDN services.

The precedence on each call is set to ensure that in the event of a call collision (the same call being made and answered at the same time), the call from Region 1 to Head Office is completed and the reverse call cleared. The direction of precedence is not important, but it is essential the precedence is set to **in** at one end of the call and **out** at the other end of the call.

Note that the number entered is the exact sequence required to reach the remote router from the local router, including STD access codes and area codes. Note that the number can contain only decimal digits and the hash character; hyphens and other characters result in an error.

Check that the ISDN calls have been successfully added with the command:

```
show isdn call
```

which for the router at Head Office in the example, produces a display like that in Figure 11-6 on page 11-55.

Figure 11-6: Example output from the **show isdn call** command for Head Office.

```
ISDN call details
Name              Number            Remote call       State     Precedence
-----------------------------------------------------------------------
Region1           1234567           -                 IN & OUT    IN
-----------------------------------------------------------------------
```

The remote call has not been specified for the ISDN call. This is a change from previous versions of the call control software, which required that a remote name be specified. The extra control over the contents of the outgoing **setup** message and how the incoming **setup** message is used in searching for calls means that calls may now be configured in this simpler fashion.

7. Create PPP interfaces to use the ISDN calls.

PPP is used on the ISDN call just defined. PPP provides the link layer protocol and enables multiple network and transport layer protocols (such as IP, IPX and DECnet) to be carried over the same ISDN link. This is the first PPP instance we define, so we number it PPP0. We don’t wish to alter any of the default PPP configuration options for this example because this is covered in later examples.

On the Head Office router, create PPP0 to use the ISDN call Region1:

```
create ppp=0 over=isdn-region1
```

On the Region 1 router, create PPP0 to use the ISDN call Region1:

```
create ppp=0 over=isdn-region1
```

Setting up these PPP instances causes the ISDN calls to be activated. When the routers are connected to the ISDN at this stage, the call is connected and the PPP link is in the **opened** state.

8. Configure routing modules to use the PPP interfaces.

IP runs over the PPP instance just defined. The IP addresses are given in Table 11-20 on page 11-49. Since the Region 1 router is a stub router, we reduce use of the ISDN link by setting up static routes at both ends. This means that routing protocol traffic does not flow on the link.

Configure IP at the Head Office router:

```
enable ip

add ip int=ppp0 ip=192.168.35.113 mask=255.255.255.240

add ip route=192.168.35.96 int=ppp0 next=192.168.35.114
   met=2
```

Configure IP at the Region 1 router:

```
enable ip

add ip int=ppp0 ip=192.168.35.114 mask=255.255.255.240

add ip route=0.0.0.0 int=ppp0 next=192.168.35.113 met=7
```

9. Test the configuration.

At this stage the ISDN call should be connected and PPP should be open at both the link level and for IP. The configuration should be checked on each router, using the commands:

```
show isdn call
show ppp
show ip interface
show ip route
```

The expected output is shown in Figure 11-7 on page 11-56 for the Head Office router, and in Figure 11-8 on page 11-57 for the Region 1 router.

Figure 11-7: Example commands and output to test the configuration of the central site router in a basic ISDN network.

```
ISDN call details
Name              Number            Remote call       State     Precedence
-----------------------------------------------------------------------
Region1           1234567           -                 IN & OUT     IN
-----------------------------------------------------------------------

ISDN active calls
Index   Name               Interface    User      State  Prec
------------------------------------------------------------
   0    Region1              BRI0        03-00     ON      Yes
------------------------------------------------------------


Name             Enabled  ifIndex  Over                    CP           State
-----------------------------------------------------------------------------
ppp0               YES     4                               IP           OPENED
                                   isdn-Region1            PPP          OPENED
-----------------------------------------------------------------------------


Interface     Type     IP Address       Bc Fr PArp  Filt RIP Met.   SAMode  IPSc
Pri. Filt     Pol.Filt Network Mask     MTU   VJC   GRE  OSPF Met.  DBcast  Mul.
--------------------------------------------------------------------------------
LOCAL         -        Not Set          -  n  -     ---  -          -       --
---           ---      -                -     -     ---  -          -       ---
ppp0          Static   192.168.35.113   1  n  -     ---  01         Pass    ---
---           ---      255.255.255.240  1500  Off   ---  0000000001 None    ---
--------------------------------------------------------------------------------


IP Routes
-------------------------------------------------------------------------------
Destination       Mask              NextHop             Interface           Age
DLCI/Circ.        Type     Policy   Protocol            Metrics      Preference
-------------------------------------------------------------------------------
0.0.0.0           0.0.0.0           192.168.35.46       ppp0                756
-                 remote   0        rip                 6                     0
192.168.35.32     255.255.255.240   0.0.0.0             ppp0                780
-                 direct   0        static              1                     0
192.168.35.96     255.255.255.240   192.168.35.114      ppp0                715
-                 direct   0        static              2                     0
192.168.35.112    255.255.255.240   0.0.0.0             ppp0                780
-                 direct   0        static              1                     0
-------------------------------------------------------------------------------
```

Figure 11-8: Example commands and output to test the configuration of the regional site router in a basic ISDN network.

```
ISDN call details
Name             Number            Remote call      State    Precedence
-----------------------------------------------------------------------
Region1          9876543           -                IN & OUT    OUT
-----------------------------------------------------------------------

ISDN active calls
Index   Name              Interface    User     State  Prec
------------------------------------------------------------
   0    Region1             BRI0       03-00    ON     Yes
------------------------------------------------------------


Name            Enabled  ifIndex  Over                 CP           State
-----------------------------------------------------------------------------
ppp0              YES    4                             IP           OPENED
                                  ISDN-Region1         PPP          OPENED
-----------------------------------------------------------------------------


Interface     Type     IP Address       Bc Fr PArp  Filt RIP Met.   SAMode  IPSc
Pri. Filt     Pol.Filt Network Mask     MTU   VJC   GRE  OSPF Met.  DBcast  Mul.
--------------------------------------------------------------------------------
LOCAL         -        Not Set          -  n  -     ---  -          -       --
---           ---      -                -     -     ---  -          -       ---
ppp0          Static   192.168.35.114   1  n  -     ---  01         Pass    --
---           ---      255.255.255.240  1500  Off   ---  0000000001 None    ---
--------------------------------------------------------------------------------


IP Routes
-------------------------------------------------------------------------------
Destination       Mask              NextHop             Interface           Age
DLCI/Circ.        Type     Policy   Protocol            Metrics      Preference
-------------------------------------------------------------------------------
0.0.0.0           0.0.0.0           192.168.35.113      ppp0                697
-                 direct   0        static              7                     0
192.168.35.0      255.255.255.0     192.168.35.113      ppp0                708
-                 direct   0        static              2                     0
192.168.35.112    255.255.255.240   0.0.0.0             ppp0                726
-                 direct   0        static              1                     0
-------------------------------------------------------------------------------
```

Configuring ISDN Dial on Demand

A PPP interface that uses an ISDN call as its physical interface can be configured for dial-on-demand operation. The ISDN call is activated only when data is transmitted, and is disconnected when the link is idle for a period of time.

To configure ISDN dial-on-demand follow these steps

The following steps are required:

1. Configure BRI or PRI ISDN.
2. Create PPP interfaces.

1. Configure BRI or PRI ISDN.

2. Create PPP interfaces.

Create PPP interfaces to use the ISDN calls and enable the IDLE timer. On the Head Office router create PPP interface 0 to use the ISDN call ROHO, by using the command:

```
create ppp=0 over=isdn-roho idle=on
```

On the Remote Office router, to create PPP interface 0 to use the ISDN call ROHO, enter the command:

```
create ppp=0 over=isdn-roho idle=on
```

Setting the **idle** parameter to **on** enables the idle timer and sets the timeout period to 60 seconds. ISDN calls are disconnected no data is transmitted over the link for 60 seconds. To enable the idle timer with a different timeout period, specify a time in seconds instead of the value **on**.

PPP interface 0 is now configured for dial-on-demand operation and any routing protocols such as IP and IPX that are configured to use PPP interface 0 will automatically inherit the dial-on-demand functionality.

Configuring ISDN Bandwidth on Demand

You can configure a PPP interface to use up to two B channels on an ISDN Basic Rate interface to provide bandwidth on demand. PPP activates additional ISDN channels when the bandwidth exceeds an upper threshold, and deactivates ISDN channels as bandwidth falls below a lower threshold.

To configure an ISDN connection for bandwidth on demand follow these steps

The following steps are required:

1. Configure BRI or PRI ISDN.
2. Create a second ISDN call.
3. Create PPP interfaces.

1. Configure BRI or PRI ISDN.

2. Create a second ISDN call.

Create a second ISDN call on each router, identical to the call ROHO but with the name DEMAND.

3. Create PPP interfaces.

Create PPP interfaces to use the ISDN calls, enable the IDLE timer and add a second demand channel. On the Head Office router create PPP interface 0, by using the command:

```
create ppp=0 over=isdn-roho idle=on
add ppp=0 over=isdn-demand type=demand
```

On the Remote Office router, to create PPP interface 0, enter the command:

```
create ppp=0 over=isdn-roho idle=on
add ppp=0 over=isdn-demand type=demand
```

PPP interface 0 is now configured for bandwidth on demand operation and any routing protocols such as IP and IPX that are configured to use PPP interface 0 will automatically inherit the bandwidth on demand functionality.

Refining the ISDN Setup

This example builds on the previous example by adding some additional ISDN functionality, including call back facility, minimum call length and call tenacity.

Call Back Facility

The call back facility enables a router connected to an ISDN service to request a remote router to initiate a call to the local router—to "call back".

Tariffs for ISDN calls vary from country to country, and the cost of a call is determined by the tariffs applying in the country of origin. If a organisation's network spans more than one country, it may be cheaper to make calls in one direction than in the other direction. The call back facility provides the ideal mechanism to manage the cost of international ISDN calls.

The call back facility is enabled with the **callback** parameter of the **add isdn call** command on page 11-64 and the **set isdn call** command on page 11-104:

```
add isdn call=name number=number prec={in|out} callback={on|
    off|yes|no|true|false}
set isdn call=name callback={on|off|yes|no|true|false}
```

The **callback** parameter of an incoming call determines whether the call is answered (callback=off), or the call is refused and then a call is made to the originator (callback=on).

For example, assume that the Head Office router (HO1) and Region 1 router (RG1) are in different tariff zones, and that the tariffs applicable to calls made by the Region 1 router are lower. The call back facility can be enabled using the following command on the Region 1 router:

```
set isdn call=region1 callback=on
```

If the callback facility is required for specific calls (the normal case), it is necessary to configure the **outcli**, **outsub** and **outuser** parameters in the call definition on the calling router, and the **searchcli**, **searchsub** and **searchuser** parameters in the call definition on the receiving router, to ensure that incoming calls on the receiving router are matched to the call definition with the correct callback.

Minimum Call Length

Some tariff regimes include a base charge for a minimum call length, for example one minute. Calls with a duration of less than the minimum call length are charged for the minimum call length. In applications where ISDN is used to provide dial-on-demand facilities to other routing protocols (e.g. IPX) it may be advantageous for a call, once made, to be kept active for the minimum call length so that additional protocol exchanges can be "piggybacked" on to the call.

A minimum call length can be set with the **holdup** parameter of the **add isdn call** command on page 11-64 and the **set isdn call** command on page 11-104. For example, to set a minimum call length of one minute for calls from the Region 1 router to the Head Office router, on both routers use the command:

```
set isdn call=region1 holdup=60
```

Call Tenacity

Call tenacity refers to the concept of keeping an ISDN link as active as possible. When a call fails it is retried until the call is reactivated or for a specified number of attempts have been made. Retries are organised into retry groups. An ISDN call can be assigned one or more retry groups. The number of retries in a group, the number of retry groups, the time interval between retries in a group and the time interval between retry groups can be specified.

A retry regime is established with the RN1, RN2, RT1 and RT2 parameters of the **add isdn call** command on page 11-64 and the **set isdn call** command on page 11-104. For example, to set up retry regime to make five retries in the first minute after a call fails and a further five retries 300 seconds later, use the command:

```
set isdn call=headoffice rn1=5 rn2=1 rt1=12 rt2=300
```

Command Reference

This section describes the commands available on the router to configure and manage ISDN.

See "Conventions" on page lxv of About this Software Reference in the front of this manual for details of the conventions used to describe command syntax. See Appendix A, Messages for a complete list of messages and their meanings.

activate isdn call

Syntax

```
ACTivate ISDN CALL=name
```

where *name* is an ISDN call name 1 to 15 characters long that is not case-sensitive. Valid characters are uppercase and lowercase letters, decimal digits (0–9), and underscore ("_").

Description

This command activates an ISDN call, causing an outgoing ISDN call to be made, using the specified call definition. The call, if its user parameter is **attach**, must have an attached user module for the call to be made.

Examples

To activate the ISDN call "region1", use the command:

```
act isdn call=region1
```

Related Commands

add isdn call
deactivate isdn call
delete isdn call
disable isdn call
enable isdn call
show isdn call

activate q931 aspid

Syntax `ACTivate Q931=`*`interface`* `ASpid`

where *interface* is a slotted interface name or number. Interface names are formed by concatenating an interface type and instance (such as BRI0 or PRI1). Interface numbers are the decimal index of the slotted interface (0, 1, 2...).

Description This command re-initiates the auto-SPID process. Existing auto-SPID information is deleted, and the auto-SPID process is initiated with the transmission of an INFORMATION message containing the universal SPID ("01010101010101") to the network.

If the router has already successfully initialised with a manual or generic SPID, and the auto-SPID process is re-initiated with this command, a failure of the auto-SPID process results in the manual or generic SPID being retried.

This command can be used in a number of circumstances, for example, when the router is moved to a different ISDN interface or the SPID information on the ISDN switch changes to allow a new service on the interface.

Examples To manually activate the auto-SPID process for the Basic Rate interface BRI0, use the command:

```
act q931=bri0 as
```

Related Commands show q931 spid

activate q931 message

Syntax `ACTivate Q931=`*`interface`*` MESSage=`*`message`*` [DLC=`*`dlc-index`*`]`

where:

- *interface* is a slotted interface name or number. Interface names are formed by concatenating an interface type and instance (such as BRI0 or PRI1). Interface numbers are the decimal index of the slotted interface (0, 1, 2...).
- *message* is a sequence of hexadecimal digits, each pair of which specifies a single octet in the message. There must be an even number of hexadecimal digits.
- *dlc-index* is the index of a valid DLC on the Q.931 interface, and is one of 1 or 2.

Description This command creates and transmits a message to Q.931, as if it had been received on the Q.931 interface specified.

Caution This command is for debugging only. Use of this command in normal operation probably result in strange and unexpected behaviour in the Q.931 operations of the router.

The **message** parameter specifies a sequence of octets that form the message. Since each octet requires 2 hexadecimal digits, an even number of hexadecimal digits must be specified. The first octet in the message is the first octet of the Q.931 message, which is always the Q.931 protocol discriminator.

The **dlc** parameter specifies the DLC where the message is to be received. Valid DLCs are 1 and 2. If not specified, DLC 1 is used.

Examples To send the router an ALERTING message that tests the reception of an unexpected message, use the command:

```
act q931=0 mess=”08018301”
```

Related Commands **enable q931 debug**

add isdn call

Syntax ADD ISDN CALL=*name* NUMber=*number* PRECedence={IN|OUT} [ALTnumber=*number*] [BUMPdelay=0..100] [CALLBACK={ON|OFF|YES|NO|True|False}] [CALLINGNumber=*number*] [CALLINGSubaddress=*calling-subaddress*] [CBDelay=0..100] [CHECKCli={OFF|PRESent|REQuired}] [CHECKSub={OFF|LOCal|REMote}] [CHECKUser={OFF|LOCal|REMote}] [CLIList=0..99] [DIrection={IN|OUT|BOTH}] [DOV={ON|OFF|YES|NO|True|False}] [HOLDUP=0..7200] [INANY={ON|OFF|YES|NO|True|False}] [INTPRef={NONE|*interface*}] [INTREQ={NONE|*interface*}] [KEEPUP={ON|OFF|YES|NO|True|False}] [LOGIn={ALL|NONE|CHAP|PAP-Radius|PAP-Tacacs|RADius|TACAcs|USer}] [MAXDuration=0..36000] [OUTCLI={OFF|CALLIng|INTerface|NONUmber}] [OUTSUB={OFF|LOCal|REMote}] [OUTUSER={OFF|LOCal|REMote}] [PASSword={NONE|CLI|CALLEdsub|NAMe|USer}] [PPPTemplate=*template*] [PRIOrity=0..99] [RAte={56K|64K}] [REMotecall=*name*|*remote-number*] [RN1=0..10] [RN2=0..5] [RT1=5..120] [RT2=300..1200] [SEARCHCli={ON|OFF|YES|NO|True|False|CALled|0..99}] [SEARCHSub={OFF|LOCal|REMote}] [SEARCHUser={OFF|LOCal|REMote}] [SUBaddress=*number*] [USer={ATTach|PPP}] [USERName={NONE|CLI|CALLEdsub|NAMe|USer}]

where:

- *name* is an ISDN call name 1 to 15 characters long that is not case-sensitive. Valid characters are letters (a–z, A–Z), decimal digits (0–9), hyphen (“-”), and underscore (“_”).
- *number* is an ISDN phone number 1 to 31 characters long. Valid characters are decimal digits (0–9) and the hash character (“#”).
- *calling-subaddress* is a character string 1 to 31 characters long that is not case-sensitive. Valid characters are letters (a–z, A–Z), decimal digits (0–9), and underscore (“_”).
- *interface* is a slotted interface name or number. Interface names are formed by concatenating an interface type and instance (such as BRI0 or PRI1). Interface numbers are the decimal index of the slotted interface (0, 1, 2...).
- *template* is a number from 0 to 31.
- *remote-number* is a number 1 to 15 characters long. Valid characters are decimal digits (0–9).

Description This command creates a new ISDN call definition. The **call**, **number** and **precedence** parameters are required. Other parameters are probably required to actually get the call to work. Up to 1024 ISDN call definitions can be created.

The **call** parameter uniquely identifies this call in the router. All commands that affect ISDN call definitions must specify the call with this parameter. ISDN call names are **not** case-sensitive. The case of the ISDN call name as entered is saved, so case can be used to provide readable names. However, any form of the name can be used in subsequent commands, and no two calls can have the same name when case is ignored.

The **number** parameter specifies the number called when this call is activated. This is the number that Q.931 uses in the SETUP message passed to the network, so it must include all access and area codes required by the network and be formatted in the way required by the network. Spaces or other characters may not be entered in between the digits of the number. The only character that may be entered between the digits of the number is a hash (“#”).

The **precedence** parameter specifies the direction of precedence for the call in the event of call collision. Call collision occurs when a call is activated at the same time as an incoming call selects the same call. If precedence is **in**, the incoming call has precedence and the outgoing call is cleared. If precedence is **out**, the outgoing call has precedence and the incoming call is cleared.

The **altnumber** parameter specifies an alternate ISDN number for this call to ring if all retries and retry groups for the main number have failed. The ISDN call retry parameters (**rn1, rn2, rt1** and **rt2**) apply to the main ISDN number. The alternate number is tried only once. The **keepup** parameter, if set, forces ISDN call control to cycle repeatedly through the main number, all retries and retry groups for the main number, and then the alternate number, until a call succeeds.

The **bumpdelay** parameter specifies the time, in tenths of a second, that the router waits after bumping another call before initiating this call. Call bumping involves clearing a call and using the resulting free B channel for a new call. A delay is programmable with the **bumpdelay** parameter in order to give the network time to clear the bumped call’s B channel. The default is **5**, that is, 0.5s.

The **callback** parameter specifies whether this call, upon being selected by an incoming call, should clear the incoming call and call back or not. The values **on, true** and **yes** are equivalent and mean that a call back occurs. The values **off, false** and **no** are equivalent, and mean that the call back does not occur. The default is **no**.

The **callingnumber** parameter may be used in connecting this call to a remote call. Certain options for formatting the outgoing SETUP message allow the calling number to be specified.

The **callingsubaddress** parameter specifies a calling subaddress to be placed in the outgoing SETUP message. This value is placed in the outgoing SETUP message when the **outcli** parameter is set to **calling**.

The **cbdelay** parameter specifies the time, in tenths of a second, that the router waits after clearing a call before initiating a callback for the call. Call back involves clearing a call and using the resulting free B channel for the new call. A delay is programmable with the **cbdelay** parameter in order to give the network time to clear the B channel for the incoming call. The default is **41**, that is, 4.1s.

The **checkcli** parameter specifies how this call, if selected, is checked against the CLI IE in the incoming SETUP message. The check, if carried out, consists of verifying that the CLI number appears in the CLI list for this call. The default of OFF means that no check is carried out. The value **present** means that the check is carried out when the CLI IE is present, and contains calling number digits. The check passes if the CLI IE is not present, or does not contain calling number digits, or is present and contains a matching CLI number. The value **required** means that CLI must be present and must contain calling number digits. The check fails if the CLI IE is not present, or does not contain calling number digits, or does not contain a matching CLI number.

The **checksub** parameter specifies whether this call, when selected, should have the called party subaddress IE of the incoming SETUP message checked. The IE may be checked against the call name (parameter set to **local**) or the remote call name (parameter set to **remote**). The default is **off**, which means that no check is carried out.

The **checkuser** parameter specifies whether this call, when selected, should have the user–user data IE of the incoming SETUP message checked. The IE may be checked against the call name (parameter set to **local**) or the remote call name (parameter set to **remote**). The default is **off**, which means that no check is carried out.

The **clilist** parameter specifies the CLI list against which this call is checked when the check CLI parameter is either **present** or **required**. The default is a special value that means that the list is undefined.

The **direction** parameter specifies the directions for which the call is enabled. Calls may be enabled both for sending and receiving calls, or for either direction. The default is **both**.

The **dov** parameter specifies whether the outgoing call setup message for this call has data bearer capability or voice bearer capability. If **dov** is set to **on**, voice bearer capability is specified and the ISDN service treats the call as a voice call. If **dov** is set to **off**, data bearer capability is specified and the ISDN service treats the call as a data call. The values **on** and **true** are equivalent to **yes**. The values **off** and **false** are equivalent to **no**. The default is **no**. The **dov** parameter is used in conjunction with the **dovnumber** parameter on the **set q931** command on page 11-117 to configure data over voice (**dov**).

The **holdup** parameter specifies the minimum time, in seconds, that this call should be held up after activation. If the user of the ISDN call requests a deactivation, and the holdup time has not expired, the deactivation is ignored until the holdup time has expired. The default is 0 seconds.

The **inany** parameter specifies whether this call may be selected to match any incoming call. The search for calls with **inany** set to **yes** follows all other searches. Only one call should have **inany** set to **yes**, since otherwise a predictable response to incoming calls cannot be guaranteed. The default is **no**.

The **intreq** parameter specifies the ISDN interface that MUST be used for this call when the call is activated as an outgoing call. If no channel is available on the required interface, the call fails. The default is **none**, which means no required interface.

The **intpref** parameter specifies the ISDN interface that should preferentially be used for this call when the required interface is not specified. When activating this call, the preferred interface is checked first for a free channel. If no free channel is found, other interfaces may be checked. The default is **none**, which means no preferred interface.

The **keepup** parameter determines whether the call should be kept up at all costs or not. The **keepup** parameter for a call is inspected when all retries for the main number have failed and the alternate number (if defined) has also failed, and when the call is cleared for any reason other than explicit clearing by the user module or by manager command. If the **keepup** parameter has the value **yes**, the call is reactivated in these circumstances. The values **on** and **true** are equivalent to **yes**. The values **off**, **false** and **no** are equivalent for turning off the **keepup** parameter. The default is **no**.

The **login** parameter specifies the login procedure that this call must use when activated. If **chap** is specified, the call is accepted but creates a PPP interface that authenticates using CHAP. If **pap-radius** is specified, the call is accepted but creates a PPP interface that authenticates using PAP, and using RADIUS as the means of authenticating the PAP exchange. If **pap-tacacs** is specified, the call is accepted but creates a PPP interface that authenticates using PAP, and using TACACS as the means of authenticating the PAP exchange. If **radius** is specified, the router sends a request to the configured RADIUS server(s) to authenticate the call. If **tacacs** is specified, the User Authentication Database in the router is checked and if the call is not authenticated, the router sends a request to the configured TACACS server(s) to authenticate the call. If **user** is specified, the User Authentication Database in the router is checked. The default is **none**, which means that no login procedure is required.

The values **chap, pap-tacacs** and **pap-radius** are used when the ISDN call creates a dynamic PPP interface. Since these parameters can also be set by defining a PPP template with the appropriate authentication parameters, use of these values is for backward compatibility only. The value specified in the **login** parameter overrides the authentication settings in the PPP template.

The **maxduration** parameter specifies the maximum duration of the call. The default is 0, which means there is no maximum duration timeout of the call. The value specified is in seconds, and the router closes the call when the appropriate time has expired. Note that the time specified is the time from the activation of the call.

The **outcli** parameter specifies the format of the calling party number IE and calling subaddress IE (also known as CLI) in the outgoing SETUP message created when this call is activated. If **off** is specified, the CLI is not included in the SETUP message. If **calling** is specified, the calling number and calling subaddress values from the ISDN call definition are placed in the SETUP message. If the **callingsubaddress** parameter is not defined, the calling subaddress IE is not included in the SETUP message. If **interface** is specified, the number and subaddress values from the Q.931 interface (set with the **set q931** command on page 11-117) are placed in the SETUP message. If the Q.931 interface does not have a subaddress set, the calling subaddress IE is not included in the SETUP message. If **nonumber** is specified, an empty calling number IE and the calling subaddress from the Q.931 interface (if set) are included in the SETUP message. The ISDN itself can fill in the calling number IE in the SETUP message before sending the message to the remote end. The default is **off**.

The **outsub** parameter specifies the format of the called party subaddress IE in the outgoing SETUP message created when this call is activated. The default is **off**, which means that the called party subaddress IE is not included in the SETUP. The call name or remote call name may be specified.

The **outuser** parameter specifies the format of the user–user data IE in the outgoing SETUP message created when this call is activated. The default is **off**, which means that the user–user data IE is not included in the SETUP. The call name or remote call name may be specified.

The **password** parameter specifies the source of the password for login procedures. The default of **none** means that no password is specified. The values **cli, calledsub** and **user** mean that the password is drawn from, respectively, the CLI, called party subaddress and user–user data IE in the incoming SETUP message. The value of **name** means that the call name is used as the password.

The **ppptemplate** parameter specifies the PPP template to use when creating a dynamic PPP interface for this call. The specified template must exist. See “Templates” on page 15-18 of Chapter 15, Point-to-Point Protocol (PPP) for more information about creating PPP templates.

The **priority** parameter specifies the priority of this call for use by the call bumping facility. The value of this parameter is a number from 0 to 99. The default is 50. Table 11-18 on page 11-42 details how the different priority values affect the bumping of data calls.

The **rate** parameter specifies the rate of data transmitted and received on the B channel for this call. The rate can be either 64 kbps (the default), which is the full bandwidth of the B channel, or 56 kbps, which is specified by ITU-T standard V.110 (rate adaption). The data rate specified by this parameter is used when this call is used as an outgoing call. When the call is selected as an incoming call, the date rate is determined by the bearer capability in the SETUP message or the rate set for the entire Q.931 interface, as specified by the **set q931** command on page 11-117.

The **remotecall** parameter may be used in connecting this call to a remote call. Certain options for formatting the outgoing SETUP message and searching for calls allow the remote call to be specified. This parameter has the same syntax as the **call** parameter except that all numeric entries are allowed for interoperation with devices that can send only numeric subaddresses.

The **remotecall** parameter is used to connect this call to a remote call. Some options for formatting the outgoing SETUP message and searching for calls allow the remote call to be specified. The **remotecall** parameter can also be used with L2TP to specify the name of an ISDN or ACC call on a remote router. If the activation of the ISDN call triggers the creation of an L2TP tunnel, then the value of the **remotecall** parameter is passed across the tunnel to identify the call that the remote router should use to make the final connection to the remote destination of the L2TP tunnel. See Chapter 20, Layer Two Tunnelling Protocol (L2TP) for more information about the use of this parameter. This parameter has the same syntax as the **call** parameter.

The **rn1** parameter specifies how many times this call is retried in a single retry group. The default of 0 means that the call is not retried.

The **rn2** parameter specifies how many retry groups this call has after the first group. The default of 0 means that the first group only is tried.

The **rt1** parameter specifies the time in seconds between retries in the same retry group. The default is 30 seconds.

The **rt2** parameter specifies the time in seconds between retry groups. The default is 600 seconds.

The **searchcli** parameter specifies whether this call may be included in a search based on the CLI IE in the incoming SETUP message. If **on** is specified, the value of the CLI IE in the incoming SETUP message is compared with the called number (**number**) parameter of this call definition. The options **true**, **yes** and **called** are synonyms for **on**. If **off** is specified, there is no search based on the CLI IE. The options **false** and **no** are synonyms for **off**. If a number is specified it identifies an existing CLI list, and the value of the CLI IE is compared with all numbers in the specified CLI list. The default is **off**.

The **searchsub** parameter specifies whether this call may be included in a search based on the called party subaddress IE in the incoming SETUP message. In such a search, the called party subaddress IE may be compared with the call name (parameter set to **local**) or the remote call name (parameter set to **remote**). The default is **off**.

The **searchuser** parameter specifies whether this call may be included in a search based on the user–user data IE in the incoming SETUP message. In such a search, the user–user data IE may be compared with the call name (parameter set to **local**) or the remote call name (parameter set to **remote**). The default is **off**.

The **subaddress** parameter allows the specification of an entirely numeric subaddress to be placed in the outgoing SETUP message when this call is activated. The subaddress as specified by the **outsub** parameter has the limitation that it can only be the remote or local call name, which means that entirely numeric subaddresses cannot be specified with this parameter alone. However, in some cases, a numeric subaddress is required to satisfy network requirements when calling a router that shares an S/T bus with other ISDN devices. The default is a null (empty) string. If this parameter has a value, it overrides the **outsub** parameter when setting the called subaddress IE in the outgoing SETUP message.

The **user** parameter specifies how users of ISDN calls use this call. The value **attach**, the default, means that users must attach to this call before it can be used. The value PPP means that this call creates dynamic PPP interfaces when activated. The PPP value is most likely to be used for incoming ISDN calls, which use RADIUS or the user data base to set parameters for the PPP and IP interfaces dynamically created.

The **username** parameter specifies the source of the user name for login procedures. The default of **none** means that no user name is specified. The values **cli, calledsub** and **user** mean that the user name is drawn from, respectively, the CLI, called party subaddress and user–user data IE in the incoming SETUP message. The value of **name** means that the call name is used as the user name.

Examples

To create a call named “ROHO” to make a call from a Regional Office to the Head Office (number 9876543), with calls to Head Office taking precedence over calls from Head Office, use the command:

```
add isdn call=roho outsub=local inany=true searchsub=local
   number=9876543 prec=out
```

Related Commands

activate isdn call
add radius server in Chapter 41, User Authentication
deactivate isdn call
delete isdn call
delete radius server in Chapter 41, User Authentication
disable isdn call
enable isdn call
set isdn call
show isdn call
show radius in Chapter 41, User Authentication

add isdn clilist

Syntax `ADD ISDN CLIList=0..99 NUMber=`*`number`*

where *number* is an ISDN phone number 1 to 31 characters long. Valid characters are decimal digits (0–9).

Description This command adds a specified ISDN phone number to a specified CLI list. CLI lists are numbered from 0 to 99 inclusive.

The **number** parameter specifies the ISDN number to add to the CLI list. This number is used in comparisons with the number in the CLI information element (IE) in incoming SETUP messages, when the ISDN call selected has options set that required a search of a CLI list. The comparison takes place from the end of the numbers to the beginning, and stops when the shorter number has been checked. For example, the number 3432114 in an incoming CLI IE would match CLI list numbers 2114, 3432114 and 033432114.

Examples To add the number (412) 986-0117 to CLI list 1, use the command:

```
add isdn clilist=1 number=4129860117
```

Related Commands delete isdn clilist
show isdn clilist

add isdn domainname

Syntax `ADD ISDN DOmainname=`*`domain-name`*

where *domain-name* is a domain name

Description This command defines a domain name to be prepended to a login name for a DNS lookup to determine the IP address to be used for an ISDN call. Only one domain name may be defined.

Examples To specify the domain name “acc.newco.co.nz” for use with DNS lookups, use the command:

```
add isdn domainname=acc.newco.co.nz
```

Related Commands delete isdn domainname
set isdn domainname
show isdn domainname

add lapd tei

Syntax `ADD LAPD=`*`interface`* `TEI=`*`tei`*`...`

where:

- *interface* is the slotted interface number (0, 1, 2,...).
- *tei* is a TEI value from 0 to 63.

Description This command is used in non-automatic TEI assignment mode to add a TEI to the interface. It is not required for normal operation, and should be used only for a BRI interface in non-automatic TEI assignment mode.

Examples To add TEI 32 to LAPD interface 0, use the command:

```
add lapd=0 tei=32
```

Related Commands **delete lapd tei**
set lapd
show lapd

add lapd xspid

Syntax `ADD LAPD=`*`interface`* `XSPid=`*`spid-index`*

where:

- *interface* is the slotted interface number (0, 1, 2,...).
- *spid-index* is a SPID index, 1 or 2.

Description This command is used for packet mode (X.25 on the D channel) operations on Basic Rate interfaces to add a SPID index for the purposes of TEI assignment. This command identifies to LAPD which Q.931 SPID or SPIDs are valid for the packet mode. When LAPD allocates a TEI for packet mode connections, it assigns the same TEI as the Q.931 connection whose SPID index is specified with this command.

The **xspid** parameter specifies the valid Q.931 SPID indices being added. The valid SPID indices are 1 and 2.

The use of the **xspid** indices added with this command is overridden if fixed TEIs are defined for packet mode operations using the **add lapd xtei** command on page 11-72.

Examples To use SPID 2 for packet mode connections on LAPD interface 0, use the command:

```
add lapd=0 xspid=2
```

Related Commands **delete lapd xspid**
show lapd

add lapd xtei

Syntax `ADD LAPD=`*`interface`*` XTEi=`*`tei`*

where:

- *interface* is the slotted interface number (0, 1, 2,...).
- *tei* is a TEI value from 0 to 63.

Description This command is used for packet mode operations on Basic Rate interfaces to add a fixed TEI that can be used explicitly for packet mode operations. This command can be used regardless of whether the LAPD interface has been set for automatic or non-automatic TEI operation.

This command should be used where packet mode operations must use a fixed TEI. This fact should be made clear to the user when the packet mode service is ordered from the ISDN network supplier. Any TEI value can be used, but care must be taken that values are unique over all terminal equipment on the S/T bus.

Examples To assign a fixed TEI of 56 for packet mode connections on LAPD interface 1, use the command:

```
add lapd=1 xtei=56
```

Related Commands **delete lapd xtei**
show lapd

deactivate isdn call

Syntax `DEACTivate ISDN CALL={acnum|name}`

where:

- *acnum* is the index of an active ISDN call.
- *name* is an ISDN call name 1 to 15 characters long that is not case-sensitive. Valid characters are uppercase and lowercase letters, decimal digits (0–9), and underscore ("_").

Description This command deactivates either a particular ISDN active call, or all active calls tied to a particular call definition. If an active call index is specified, only that call is deactivated. If a call name is given, all calls for that call definition are deactivated.

The **show isdn call** command on page 11-139 can be used to determine the index of active calls.

Examples To deactivate the ISDN call "Region1", use the command:

```
deactivate isdn call="region1"
```

Related Commands
activate isdn call
add isdn call
delete isdn call
disable isdn call
enable isdn call
show isdn call

delete isdn call

Syntax `DELete ISDN CALL=name`

where *name* is an ISDN call name 1 to 15 characters long that is **not** case-sensitive. Valid characters are uppercase and lowercase letters, decimal digits (0–9), and underscore ("_").

Description This command deletes an ISDN call definition. The call definition is not deleted if there are active calls using this definition, or if there are users (such as PPP) attached to the call definition.

Examples To delete ISDN call "ROHO", use the command:

```
delete isdn call=roho
```

Related Commands
activate isdn call
add isdn call
deactivate isdn call
disable isdn call
enable isdn call
show isdn call

delete isdn clilist

Syntax `DELete ISDN CLIList=0..99 NUMber=`*`number`*

where *number* is an ISDN phone number 1 to 31 characters long. Valid characters are decimal digits (0–9).

Description This command removes a specified ISDN phone number from a specified CLI list. CLI lists are numbered from 0 to 99 inclusive.

The **number** parameter specifies the ISDN number to remove from the CLI list. The number must exactly match an existing number in the CLI list.

Examples To delete the number (412) 986-0117 from CLI list 1, use the command:

```
delete isdn clilist=1 number=4129860117
```

Related Commands **add isdn clilist**
show isdn clilist

delete isdn domainname

Syntax `DELete ISDN DOMainname[=`*`domain-name`*`]`

where *domain-name* is a domain name

Description This command deletes the ISDN domain name definition used for DNS lookups. Only one domain name may be defined.

Examples To delete the ISDN domain name, use the command:

```
delete isdn domainname
```

Related Commands **add isdn domainname**
set isdn domainname
show acc domainname in Chapter 19, Asynchronous Call Control

delete lapd tei

Syntax

```
DELete LAPD=interface TEI=tei
```

where:

- *interface* is the slotted interface number (0, 1, 2,...).
- *tei* is a TEI value from 0 to 63.

Description

This command is used in non-automatic TEI assignment mode to delete a TEI from the slotted interface. Any connections using the TEI are released. Any calls that use the DLC are halted.

This command is not required for normal operation. It should only be used for a BRI interface in non-automatic TEI assignment mode.

Caution This command may also be used in automatic TEI mode, but this is not recommended as it may confuse the ISDN switch.

Examples

To delete TEI 32 from LAPD interface 0, use the command:

```
delete lapd=0 tei=32
```

Related Commands

add lapd tei
set lapd
show lapd

delete lapd xspid

Syntax

```
DELete LAPD=interface XSPid=spid-index
```

where:

- *interface* is the slotted interface number (0, 1, 2,...).
- *spid-index* is a SPID index, 1 or 2.

Description

This command is used for packet mode (X.25 on the D channel) operations on Basic Rate interfaces to delete a SPID index for the purposes of TEI assignment. This command identifies to LAPD which Q.931 SPID or SPIDs are valid for the packet mode. When LAPD allocates a TEI for packet mode connections, it assigns the same TEI as the Q.931 connection whose SPID index is specified with this command.

The **xspid** parameter specifies the valid Q.931 SPID indices being added. The valid SPID indices are 1 and 2.

The use of the **xspid** indices added with this command is overridden if fixed TEIs are defined for packet mode operations using the **add lapd xtei** command on page 11-72.

Examples

To remove SPID 2 as the SPID for packet mode connections on LAPD interface 0, use the command:

```
delete lapd=0 xspid=2
```

Related Commands

add lapd xspid
show lapd

delete lapd xtei

Syntax `DELete LAPD=`*`interface`*` XTEi=`*`tei`*

where:

- *interface* is the slotted interface number (0, 1, 2,...).
- *tei* is a TEI value from 0 to 63.

Description This command is used for packet mode operations on Basic Rate interfaces to delete a fixed TEI for packet mode operations. To change the TEI used for packet mode operations, the existing TEI must be deleted and the new TEI added.

Examples To delete TEI 56 as the fixed TEI for packet mode connections on LAPD interface 1, use the command:

```
delete lapd=1 xtei=56
```

Related Commands **add lapd xtei**
show lapd

disable bri ctest

Syntax `DISable BRI=`*`instance`*` CTest`

where *instance* is the number of the BRI interface

Description This command disables the currently running conformance test on the BRI interface. Only one conformance test may be running at one time (Table 11-22 on page 11-84).

This command is required for conformance testing only, and should not be used for normal operation of the BRI interface.

Examples To disable the conformance test currently running on BRI interface 1, use the command:

```
disable bri=1 ctest
```

Related Commands **enable bri ctest**
disable bri test
enable bri test
show bri ctest
show bri test

disable bri debug

Syntax

```
DISable BRI[=instance] DEBug[={ERrors|Indications|States|
    Events|ALL}]
```

where *instance* is the number of the BRI interface

Description

This command disables the specified debug option on the BRI interface. If an interface is not specified, the debug option is disabled on all BRI interfaces. If a debug option is not specified, all debug options currently enabled on the interface are disabled (Table 11-23 on page 11-85). Only a single debug option can be disabled on each invocation. Successive commands can be used to disable any combination of debug options.

Examples

To enable the **state** and **event** debug options on all BRI interfaces, use the command sequence:

```
disable bri debug=all
enable bri debug=states
enable bri debug=events
```

Related Commands

enable bri debug
show bri debug

disable bri test

Syntax

```
DISable BRI=instance Test[=test-number]
```

where:

- *instance* is the number of the BRI interface.
- *test-number* is the number of the test to be disabled.

Description

This command disables the specified test on the BRI interface. It is required for testing only, and should not be used for normal operation of the BRI interface.

If a test is not specified, all tests currently running on the interface are disabled. Only a single test can be disabled on each invocation. Successive commands can be used to disable any combination of tests.

Examples

To enable tests 8 and 9 on interface BRI0, use the commands:

```
disable bri=0 test
enable bri=0 test=8
enable bri=0 test=9
```

Related Commands

disable bri ctest
enable bri ctest
enable bri test
show bri ctest
show bri test

disable isdn call

Syntax

```
DISable ISDN CALL=name
```

where *name* is an ISDN call name 1 to 15 characters long that is not case-sensitive. Valid characters are uppercase and lowercase letters, decimal digits (0–9), and underscore (“_”).

Description

This command disables an ISDN call definition. Existing active calls for this call are unaffected.

Examples

To disable ISDN call “ROHO”, use the command:

```
disable isdn call=roho
```

Related Commands

activate isdn call
add isdn call
deactivate isdn call
delete isdn call
enable isdn call
show isdn call

disable isdn log

Syntax `DISable ISDN LOG`

Description This command disables the ISDN call logging facility. The call logging facility records details of events associated with ISDN calls.

An entry is added to the log when a call is initiated. When the log exceeds a predefined maximum length, the oldest entry that is in the CLEARED state is removed from the log. If no entries qualify the log is allowed to grow larger than the maximum defined length. Log messages can be sent to an asynchronous port on the router when the log entry enters the CLEARED state. The maximum length of the log and the port where messages should be sent can be set with the **set isdn log** command on page 11-110.

The forwarding of ISDN log messages to the router's logging facility is not affected by the status of the ISDN call logging facility.

Examples To disable ISDN call logging, use the command:

```
disable isdn log
```

Related Commands
disable q931 debug
enable isdn log
enable q931 debug
set isdn log
show isdn log

disable pri ctest

Syntax `DISable PRI=`*`instance`*` CTest[=`*`test-number`*`]`

where:

- *instance* is the number of the PRI interface.
- *test-number* is the number of the conformance test to be disabled.

Description This command disables the specified conformance test on the PRI interface. This command is required for conformance testing only, and should not be used for normal operation of the BRI interface.

If a test is not specified, the currently enabled test is disabled (Table 11-26 on page 11-89).

Examples To disable conformance test 3 on PRI interface 0, use the command:

```
disable pri=0 ctest=3
```

Related Commands
enable pri ctest
disable pri test
enable pri test
show pri ctest
show pri test

disable pri debug

Syntax

```
DISable PRI[=instance] DEBug[={ERrors|Indications|States|
    EVents|ALL}]
```

where *instance* is the number of the PRI interface

Description

This command disables the specified debug option on the PRI interface. If an interface is not specified, the debug option is disabled on all PRI interfaces. If a debug option is not specified, all debug options currently enabled on the interface are disabled (Table 11-27 on page 11-90). Only a single debug option can be disabled on each invocation. Successive commands can be used to disable any desired combination of debug options.

Examples

To enable the **errors**, **indications** and **event** debug options on all PRI interfaces, use the command sequence:

```
disable pri debug=all
enable pri debug=errors
enable pri debug=indications
enable pri debug=events
```

Related Commands

enable pri debug
show pri debug

disable pri test

Syntax

```
DISable PRI=instance TEST[=test-number]
```

where:

- *instance* is the number of the PRI interface.
- *test-number* is the number of the test to be disabled.

Description

This command disables the specified test on the PRI interface. This command is required for testing only, and should not be used for normal operation of the BRI interface.

If a test is not specified, all tests currently running on the interface are disabled (Table 11-28 on page 11-91 and Table 11-29 on page 11-91). Only a single test can be disabled on each invocation. Successive commands can be used to disable any combination of tests.

Examples

To enable tests 8 and 9 on interface PRI0, use the command sequence:

```
disable pri=0 test
enable pri=0 test=8
enable pri=0 test=9
```

Related Commands

enable pri ctest
disable pri ctest
enable pri test
show pri ctest
show pri test

disable q931 debug

Syntax

```
DISable Q931=interface DEBug={MDECODE|MRAW|SDLC|
    SINTERFACE|SSPID|SSPIDFILE|STATE|TRACE}
```

where *interface* is a slotted interface name or number. Interface names are formed by concatenating an interface type and instance (such as BRI0 or PRI1). Interface numbers are the decimal index of the slotted interface (0, 1, 2...).

Description

This command disables the Q.931 debug option on the specified slotted interface.

The **mdecode** option displays each Q.931 message in a decoded format (Figure 11-9 on page 11-94, Table 11-30 on page 11-94). The message header is decoded, along with the type of each information element (IE) in the message. The octets of each IE are displayed in hexadecimal digit format, and for some IEs, a further decode is provided. If **mdecode** debugging is enabled on an interface on which **mraw** debugging is already enabled, then the MRAW display is turned off so that only decoded messages are displayed.

The **mraw** debug option displays, for each Q.931 message sent or received on the specified interface, a display of the octets in the message, with no interpretation (Figure 11-10 on page 11-95, Table 11-31 on page 11-95). Each octet is displayed as two hexadecimal digits.

The **sdlc** option displays all DLC state machine events and state changes, as they occur, for the given interface (Figure 11-11 on page 11-95, Table 11-32 on page 11-95). The DLC state machine controls the activation and deactivation of DLCs on the Q.931 interface.

The **sinterface** option displays all interface state machine events and state changes, as they occur, for the given interface. The interface state machine controls automatic ISDN switch detection as well as other procedures related to bringing an interface to a usable state.

The **sspid** option displays all SPID state machine events and state changes, as they occur, for the given interface (Figure 11-12 on page 11-96, Table 11-33 on page 11-96). The SPID state machine controls the initialisation of the DLC via the SPID procedures, as well as auto-SPID detection.

The **sspidfile** option displays all SPID file state machine events and state changes (Figure 11-13 on page 11-96, Table 11-34 on page 11-96). The SPID file state machine is concerned with controlling the SPID that is used (generic, manual, auto-SPID) in initialising.

The **state** option displays all call state events and state changes (Figure 11-14 on page 11-97, Table 11-35 on page 11-97). The call state machine takes an ISDN call from initiation through to establishment to disconnection.

The **trace** option displays all subroutine calls within the Q.931 module. This option is not related to a particular interface, so while the interface must be entered as part of the command, subroutine tracing for all interfaces is enabled.

Examples

To disable the display of decoded Q.931 messages sent and received via Q.931 interface 0, use the command:

```
disable q931=0 debug=mdecode
```

Related Commands

disable isdn log
enable isdn log
enable q931 debug
set isdn log
show isdn log

enable bri ctest

Syntax

```
ENAble BRI=instance CTest=test-number
```

where:

- *instance* is the number of the BRI interface.
- *test-number* is the number of the conformance test to be enabled.

Description

This command enables the specified conformance test on the BRI interface. This is required for conformance testing only, and should not be used for normal operation of the BRI interface.

Only one conformance test may be running at any one time. No other conformance test may be currently running on the interface (Table 11-22).

Table 11-22: ISDN Basic Rate Interface conformance tests

Test	Function
1	An activation request is issued to the transceiver that transmits INFO 1 in an attempt to activate the S/T loop. The status of the test is reset to "no" once the loop activates or when the activate timer times out. This conformance test has no effect if the loop is already activated.
2	Data received by the BRI module for both B channel and the D channel from the S/T loop is retransmitted on the same channel. This corresponds to loopback 4 defined in Appendix I of ITU-T Recommendation I.430.
3	HDLC frames containing all zeroes is transmitted continuously on both B channels.
4	High priority HDLC frames containing a fox message are transmitted on the D channel continuously.
5	Low priority HDLC frames containing a fox message are transmitted on the D channel continuously.
6	HDLC frames containing a fox message are transmitted on the B1 channel continuously.
7	HDLC frames containing a fox message are transmitted on the B2 channel continuously.
8	HDLC frames containing bytes with one zero and seven ones are transmitted on the D channel continuously.

Examples

To enable conformance test 8 on BRI interface 1, use the command:

```
enable bri=1 ctest=8
```

Related Commands

disable bri ctest
disable bri test
enable bri test
show bri ctest
show bri test

enable bri debug

Syntax

```
ENAble BRI[=instance] DEBug[={ERrors|Indications|States|
    EVents|ALL}]
```

where *instance* is the number of the BRI interface

Description

This command enables the specified debug option on the BRI interface. If an interface is not specified, the debug option is enabled on all BRI interfaces. If a debug option is not specified, all debug options are enabled on the interface(s) (Table 11-23 on page 11-85). Only a single debug option can be enabled on each invocation. Successive commands can be used to enable any desired combination of debug options.

Table 11-23: ISDN Basic Rate Interface debug options

Category	Meaning
Errors	A BRI software module internal error.
Indications	An indication from the layer 1 state machine to a higher layer or the management layer.
State changes	A change of state for the layer 1 state machine.
Events	An event that is an input to the layer 1 state machine.
All	All debug options

Examples

To enable the **errors**, **indications** and **event** debug options on all BRI interfaces, use the command sequence:

```
disable bri debug=all
enable bri debug=errors
enable bri debug=indications
enable bri debug=events
```

Related Commands

disable bri debug
show bri debug

enable bri test

Syntax `ENAble BRI=`*`instance`* `TEST=`*`test-number`*

where:

- *instance* is the number of the BRI interface.
- *test-number* is the number of the test to be enabled.

Description This command enables the specified test on the BRI interface. It is required for testing only, and should not be used for normal operation of the BRI interface.

Only one test can be enabled on each invocation. Successive commands can be used to enable any combination of tests. The tests available depend on whether the BRI interface uses an S/T transceiver (Table 11-24) or a U transceiver (Table 11-25 on page 11-87).

Table 11-24: ISDN Basic Rate Interface test modes for S/T interfaces

Test	Function
1	The transceiver loops B1 channel data from the router back to the router, and also transmits the B1 data on the S/T loop.
2	The transceiver loops B2 channel data from the router back to the router, and also transmits the B2 data on the S/T loop.
3	The transceiver loops all data (B1, B2, and D) from the router back to the router, and also transmits the data on the S/T loop.
4	The transceiver loops B1 channel data from the router back to the router, and transmits idles on the S/T loop in place of the B1 data.
5	The transceiver loops B2 channel data from the router back to the router, and transmits idles on the S/T loop in place of the B2 data.
6	The transceiver loops B1 channel data received from the S/T loop back to the S/T loop, and also passes the B1 data to the router.
7	The transceiver loops B2 channel data received from the S/T loop back to the S/T loop, and also passes the B2 data to the router.
8	The transceiver loops B1 channel data received from the S/T loop back to the S/T loop, and passes idles to the router in place of the B1 data.
9	The transceiver loops B2 channel data received from the S/T loop back to the S/T loop, and passes idles to the router in place of the B2 data.
10	The transceiver receives and demodulates its own transmitted data when the transmit pair is connected to the receive pair at the interface connector. Tests 12 and 15 do not have to be enabled.
11	A 96kHz test tone (continuous alternating pulses) is transmitted on the S/T loop.
12	The transceiver is forced into the highest INFO state, i.e. the transceiver transmits INFO 4 for a TE or INFO 3 for a NT.
13	The transceiver transmits without regard for the D channel contention procedures governing transmission. This test is applicable to a TE only.
14	The transceiver passes E channel data to the router in place of the D channel data received from the NT. This test is applicable to a TE only.
15	The transceiver clocks the GCI bus even if it is not able to derive a clock from the S/T loop. This test is applicable to a TE only.

Table 11-25: ISDN Basic Rate Interface test modes for U interfaces

Test	Function
1	Force a reset of the transceiver so that it enters quiet mode and does not transmit on the U loop.
2	Force the transceiver to transmit SN3 (standard framed, scrambled signal) on the U loop.
3	Enable an analogue loopback so that the router receives the data it transmits.
4	Enable the internal 2B + D test access port.
5	Enable a loopback of the B1 channel data on the U loop towards the U loop and data transmitted by the router back to the router.
6	Enable a loopback of the B2 channel data on the U loop towards the U loop and data transmitted by the router back to the router.
7	Enable a loopback of the B1, B2 and D channel data on the U loop towards the U loop and data transmitted by the router back to the router.
8	Turn the activated LED on as soon as SN3 is transmitted to the LT, rather than when "act"=1 is received.
9	The interface acts as if it is an LT.

Examples To enable tests 8 and 9 on interface BRI0, use the commands:

```
disable bri=0 test
enable bri=0 test=8
enable bri=0 test=9
```

Related Commands

disable bri ctest
enable bri ctest
disable bri test
show bri ctest
show bri test

enable isdn call

Syntax

```
ENAble ISDN CALL=name
```

where *name* is an ISDN call name 1 to 15 characters long that is not case-sensitive. Valid characters are uppercase and lowercase letters, decimal digits (0–9), and underscore (“_”).

Description

This command enables an ISDN call definition. Existing active calls for this call are unaffected.

Examples

To enable ISDN call “ROHO”, use the command:

```
enable isdn call=roho
```

Related Commands

activate isdn call
add isdn call
deactivate isdn call
delete isdn call
disable isdn call
set isdn call
show isdn call

enable isdn log

Syntax

```
ENAble ISDN LOG
```

Description

This command enables the ISDN call Logging facility. Call logging records details of events associated with ISDN calls.

When the ISDN logging facility is enabled, an entry is added to the log when a call is initiated. When the number of log entries reaches the user-defined limit, the oldest entry that represents a completed call is removed. If no entries represent completed calls, the log can grow beyond the limit.

When an ISDN call completes, either because the call was cleared in the setup phase, or because of normal call clearing, the log entry for the call is completed. At this time, a message similar to the message that appears in the ISDN log may be sent to an asynchronous port on the router. This port is user-definable.

The forwarding of ISDN log messages to the router’s logging facility is not affected by the status of the ISDN call logging facility.

Examples

To enable ISDN call logging, use the command:

```
enable isdn log
```

Related Commands

disable isdn log
disable q931 debug
enable q931 debug
set isdn log
show isdn log

enable pri ctest

Syntax `ENAble PRI=`*`instance`*` CTest=`*`test-number`*

where:

- *instance* is the number of the PRI interface.
- *test-number* is the number of the conformance test to be enabled.

Description This command enables the specified conformance test on the PRI interface (Table 11-26). This command is required for conformance testing only, and should not be used for normal operation of the BRI interface.

Table 11-26: ISDN Primary Rate Interface conformance tests

Test	Function
1	The HDLC controller hardware loops back all slots.
2	The data received by the PRI module via the HDLC controller on slots 1 to 31 is retransmitted.
3	The HDLC controller transmits HDLC frames of all zeroes on slots 1 to 31 (as a single channel).
4	The HDLC controller transmits HDLC frames of all ones on slots 1 to 31 (as a single channel).
5	The HDLC controller transmits HDLC frames of fox messages on slots 1 to 31 (as a single channel).

Examples To enable conformance test 2 on PRI interface 0, use the command:

```
enable pri=0 ctest=2
```

Related Commands disable pri ctest
disable pri test
enable pri test
show pri ctest
show pri test

enable pri debug

Syntax

```
ENAble PRI[=instance] DEBug[={ERrors|Indications|States|
    EVents|ALL}]
```

where *instance* is the number of the PRI interface

Description

This command enables the specified debug option on the PRI interface. If an interface is not specified, the debug option is enabled on all PRI interfaces. If a debug option is not specified, all debug options are enabled on the interface (Table 11-27). Only a single debug option can be enabled on each invocation. Successive commands can be used to enable any combination of debug options.

Table 11-27: ISDN Primary Rate Interface debug options

DEBUG Option	Meaning
Errors	A PRI software module internal error.
Indications	An indication from the layer 1 state machine to a higher layer or the management layer.
State changes	A change of state for the layer 1 state machine.
Events	An event that is an input to the layer 1 state machine.
All	All debug options.

Examples

To enable the **errors**, **indications** and **event** debug options on all PRI interfaces, use the command sequence:

```
disable pri debug=all
enable pri debug=errors
enable pri debug=indications
enable pri debug=events
```

Related Commands

disable pri debug
show pri debug

enable pri test

Syntax `ENAble PRI=`*`instance`*` TEST=`*`test-number`*

where:

- *instance* is the number of the PRI interface.
- *test-number* is the number of the test to be enabled.

Description This command enables the specified test on the PRI interface (Table 11-28 on page 11-91 and Table 11-29 on page 11-91). This command is required for testing only, and should not be used for normal operation of the PRI interface.

Only a single test can be enabled on each invocation. Successive commands can be used to enable any combination of tests.

Table 11-28: ISDN Primary Rate Interface test modes for an E1 interface with a Bt 8370 transceiver

Test	Function
1	A loopback of the entire framed 2048 kbit/s signal back towards the router from the transceiver near the analogue interface.
2	A loopback of the entire framed 2048 kbit/s signal back out the interface by the transceiver.
3	A payload loopback of all slots back out the interface.
4	Transmit a framed 2E15-1 Pseudo Random Bit Sequence and attempt to lock onto the received, looped-back signal (lock state and errors are displayed).
5	A frame resynchronisation is invoked.
6	The Alarm Indication Signal is sent to the network.
7	The Remote Alarm Indication bit is set in the transmitted data stream.

Table 11-29: ISDN Primary Rate Interface test modes for an T1 interface with a Bt 8370 transceiver

Test	Function
1	A loopback of the entire framed 1544 kbit/s signal back towards the router from the transceiver near the analogue interface.
2	A loopback of the entire framed 1544 kbit/s signal back out the interface by the transceiver.
3	A payload loopback of all slots back out the interface.
4	Transmit a framed 2E15-1 Pseudo Random Bit Sequence and attempt to lock onto the received, looped-back signal (lock state and errors are displayed).
5	A frame resynchronisation is invoked.
6	The Alarm Indication Signal is sent to the network.
7	The Remote Alarm Indication signal is sent to the network.
8	Transmit the “activate in-band loopback” signal.
9	Transmit the “deactivate in-band loopback” signal.

Examples To enable tests 8 and 9 on interface PRI0, use the command sequence:

```
disable pri=0 test
enable pri=0 test=8
enable pri=0 test=9
```

Related Commands
disable pri ctest
disable pri test
enable pri ctest
show pri ctest
show pri test

enable q931 aspid

Syntax ENAble Q931=*interface* ASPid=*index*[,*index*...]

where:

- *interface* is a slotted interface name or number. Interface names are formed by concatenating an interface type and instance (such as BRI0 or PRI1). Interface numbers are the decimal index of the slotted interface (0, 1, 2...).
- *index* is a decimal number.

Description This command enables one or more auto-SPID values for a given Q.931 interface. When the auto-SPID process discovers more than one auto-SPID value, it puts them in a list. This list can be displayed with the **show q931 spid** command on page 11-176. This command allows the user to select one or more of these values and enable them for use in the router.

The **aspid** parameter selects the auto-SPID values to be enabled. The numbers given in the **aspid** parameter are the indices of the auto-SPID entries displayed with the **show q931 spid** command on page 11-176.

Examples For the display shown in Figure 11-56 on page 11-178, to enable auto-SPID values whose indices are 1 and 2, enter the following:

```
enable q931=0 aspid=1,2
```

Related Commands
set q931
show q931 spid

enable q931 debug

Syntax

```
ENAble Q931=interface DEBug={MDECODE|MRAW|SDLC|SINTERFACE|
    SSPID|SSPIDFILE|STATE|TRACE}
```

where *interface* is a slotted interface name or number. Interface names are formed by concatenating an interface type and instance (such as BRI0 or PRI1). Interface numbers are the decimal index of the slotted interface (0, 1, 2...).

Description

This command enables the specified Q.931 debug option on the specified interface.

The **mdecode** option displays each Q.931 message in a decoded format (Figure 11-9 on page 11-94, Table 11-30 on page 11-94). The message header is decoded, along with the type of each information element (IE) in the message. The octets of each IE are displayed in hexadecimal digit format, and for some IEs, a further decode is provided. If MDECODE debugging is enabled on an interface where MRAW debugging is enabled, then the MRAW display is turned off so that only decoded messages are displayed.

The **mraw** debug option displays, for each Q.931 message sent or received on the specified interface, a display of the octets in the message, with no interpretation (Figure 11-10 on page 11-95, Table 11-31 on page 11-95). Each octet is displayed as two hexadecimal digits.

The **sdlc** option displays all DLC state machine events and state changes, as they occur, for the given interface (Figure 11-11 on page 11-95, Table 11-32 on page 11-95). The DLC state machine controls the activation and deactivation of DLCs on the Q.931 interface.

The **sinterface** option displays all interface state machine events and state changes, as they occur, for the given interface. The interface state machine controls automatic ISDN switch detection as well as other procedures related to bringing an interface to a usable state.

The **sspid** option displays all SPID state machine events and state changes, as they occur, for the given interface (Figure 11-12 on page 11-96, Table 11-33 on page 11-96). The SPID state machine controls the initialisation of the DLC via the SPID procedures, as well as auto-SPID detection.

The **sspidfile** option displays all SPID file state machine events and state changes (Figure 11-13 on page 11-96, Table 11-34 on page 11-96). The SPID file state machine is concerned with controlling the SPID information (generic, manual, auto-SPID) used in initialising.

The **state** option displays all call state events and state changes (Figure 11-14 on page 11-97, Table 11-35 on page 11-97). The call state machine takes an ISDN call from initiation through to establishment to disconnection.

The **trace** option displays all subroutine calls within the Q.931 module. This option is not related to a particular interface, so while the interface must be entered as part of the command, subroutine tracing for all interfaces is enabled.

Figure 11-9: Example output from the **enable q931 debug=mdecode** command for a call initiated by the router

```
2454.5479 : LAPD OUT(I): Int: 0, DLC: 0
Protocol        08
Call reference  01 05
Message type    05 (SETUP)
IEs:
04  Bearer capability          02 88 90
18  Channel identification     01 83
70  Called party number        05 81 32 32 32 32
71  Called party subaddress    07 80 50 74 65 73 74 31

2454.7941 : LAPD IN(I): Int: 0, DLC: 0
Protocol        08
Call reference  01 85
Message type    07 (CONNECT)
IEs:
18  Channel identification     01 89

2455.2822 : LAPD OUT(I): Int: 0, DLC: 0
Protocol        08
Call reference  01 05
Message type    0f (CONNECT ACK)
IEs:
```

Table 11-30: Parameters in the output of the **enable q931 debug=mdecode** command

Parameter	Meaning
Timestamp	The time in seconds since the router restarted. This value rolls over at 9999 seconds.
LAPD IN, LAPD OUT	The direction of the message, with respect to the router.
(I), (U)	The type of message, numbered or unnumbered.
Int	The index of the ISDN interface over which the message was sent or received.
DLC	The index of the DLC over which the message was sent or received. If the message is an incoming UI frame, the DLC is "BROADCAST".
Protocol	The protocol ID field.
Call reference	The call reference field.
Message type	The type of the message.
IEs	The information elements in the message, one per line.

Figure 11-10: Example output from the **enable q931 debug=mraw** command for a call initiated by the router

```
2454.5479 : LAPD OUT(I): Int: 0, DLC: 0
Data: 08 01 05 05 04 02 88 90 18 01 83 70 05 81 32 32 32 32 71 07 80 50 74 65
   73 74 31

2454.7941 : LAPD IN(I): Int: 0, DLC: 0
Data: 08 01 85 07 18 01 89

2455.2822 : LAPD OUT(I): Int: 0, DLC: 0
Data: 08 01 05 0f
```

Table 11-31: Parameters in the output of the **enable q931 debug=mraw** command

Parameter	Meaning
Timestamp	The time in seconds since the router restarted. This value rolls over at 9999 seconds.
LAPD IN, LAPD OUT	The direction of the message, with respect to the router.
(I), (U)	The type of message, numbered or unnumbered.
Int	The index of the ISDN interface over which the message was sent or received.
DLC	The index of the DLC over which the message was sent or received. If the message is an incoming UI frame, the DLC is “BROADCAST”.
Data	The data in the message.

Figure 11-11: Example output from the **enable q931 debug=sdlc** command

```
3997.1924 Q931: DLC event - int=bri0, DLC=1, event=<Release Indication>,
state=<Established>
3997.1924 Q931: DLC state change - int=bri0, DLC=1, <Established> -> <Released>
4004.0777 Q931: DLC event - int=bri0, DLC=1, event=<Establish Indication>,
state=<Released>
4004.0777 Q931: DLC state change - int=bri0, DLC=1, <Released> -> <Established>
4007.0014 Q931: DLC event - int=bri0, DLC=1, event=<Establish>, state=<Established>
```

Table 11-32: Parameters in the output of the **enable q931 debug=sdlc** command

Parameter	Meaning
Timestamp	The time in seconds since the router restarted. This value rolls over at 9999 seconds.
DLC event	A line of information about an event affecting the DLC state machine.
DLC state change	A line of information about a state change in the DLC state machine.
int	The name of the interface to which the event or state change applies.
DLC	The index of the DLC to which the event or state change applies.
event	The DLC event to which this message applies.
state	The DLC state when the event occurred.
<oldstate> -> <newstate>	The old and new states for a DLC state change.

Figure 11-12: Example output from the **enable q931 debug=sspid** command

```
7110.5651 Q931: SPID event - int=bri0, DLC=1, event=<RESET>, state=<OP>
7110.5651 Q931: SPID state change - int=bri0, DLC=1, <OP> -> <NULL>
7110.5663 Q931: SPID event - int=bri0, DLC=1, event=<INIT>, state=<NULL>
7110.5663 Q931: SPID state change - int=bri0, DLC=1, <NULL> -> <IWAIT1>
7110.6428 Q931: SPID event - int=bri0, DLC=1, event=<INFO>, state=<IWAIT1>
7110.6428 Q931: SPID state change - int=bri0, DLC=1, <IWAIT1> -> <OP>
```

Table 11-33: Parameters in the output of the **enable q931 debug=sspid** command

Parameter	Meaning
Timestamp	The time in seconds since the router restarted. This value rolls over at 9999 seconds.
SPID event	A line of information about an event that affects the SPID state machine.
SPID state change	A line of information about a state change in the SPID state machine.
int	The name of the interface to which the event or state change applies.
DLC	The index of the DLC to which the event or state change applies.
event	The SPID event to which this message applies.
state	The SPID state when the event occurred.
<oldstate> -> <newstate>	The old and new states for a SPID state change.

Figure 11-13: Example output from the **enable q931 debug=sspidfile** command

```
7380.2693 Q931: SPID file event: int=bri0, state=1, event=SetSPID
7380.2693 Q931: SPID file state change: int=bri0, state=1 -> 1
7380.4200 Q931: SPID file event: int=bri0, state=1, event=ConfSPIDPass
7380.4200 Q931: SPID file state change: int=bri0, state=1 -> 11
```

Table 11-34: Parameters in the output of the **enable q931 debug=sspidfile** command

Parameter	Meaning
Timestamp	The time in seconds since the router restarted. This value rolls over at 9999 seconds.
SPID file event	A line of information about an event that affects the SPID file state machine.
SPID file state change	A line of information about a state change in the SPID file state machine.
int	The name of the interface to which the event or state change applies.
state	The SPID file state when the event occurred.
event	The SPID file event to which the message applies.
state=n -> m	The old and new states for a SPID file state change.

Figure 11-14: Example output from the **enable q931 debug=state** command

```
7547.0903 Q931: Call event - int=bri0, call=1, state 0, event 77
7547.0903 Q931: Call state change - int=bri0, call=1, 0 -> 1
7547.1561 Q931: Call event - int=bri0, call=1, state 1, event 43
7547.1561 Q931: Call state change - int=bri0, call=1, 1 -> 2
7548.2902 Q931: Call event - int=bri0, call=1, state 2, event 71
7548.2902 Q931: Call state change - int=bri0, call=1, 2 -> 11
7548.3480 Q931: Call event - int=bri0, call=1, state 11, event 38
7548.3480 Q931: Call state change - int=bri0, call=1, 11 -> 0
```

Table 11-35: Parameters in the output of the **enable q931 debug=state** command

Parameter	Meaning
Timestamp	The time in seconds since the router restarted. This value rolls over at 9999 seconds.
Call event	A line of information about an event that affects the call state machine.
Call state change	A line of information about a state change in the call state machine.
int	The name of the interface to which the event or state change applies.
call	The index of the call to which the event or state change applies.
state	The call state when the event occurred.
event	The call event to which the message applies.
n -> m	The old and new states for a call state change.

Examples To enable the display of debugging information for auto-SPID detection and SPID initialisation on Q.931 interface 1, use the commands:

```
enable q931=1 debug=sspid
enable q931=1 debug=sspidfile
```

Related Commands

disable isdn log
disable q931 debug
enable isdn log
set isdn log
show isdn log

reset bri

Syntax

```
RESET BRI=instance
```

where *instance* is the number of the BRI interface

Description

This command resets the BRI interface. The hardware is reset but configuration information is retained. The S/T loop activation procedure is re-initiated.

At present there is no known circumstance where use of this command is required and it should be used only under advice from the manufacturer.

Examples

To reset BRI interface 0, use the command:

```
reset bri=0
```

Related Commands

reset bri counter
show bri state

reset bri counter

Syntax

```
RESET BRI[=instance] COUnters[={INTerface|BRI}]
```

where *instance* is the number of the BRI interface

Description

This command resets the BRI interface counters displayed by the **show bri counter** command on page 11-123. The counters are copied, and the values subtracted from the counter values whenever the counters are displayed by the **show bri counter** command. This gives the illusion of resetting the counters without affecting the MIB variables. If the BRI interface is not specified, the counters for all BRI interfaces are reset. If the counter category is not specified, all categories are reset.

Examples

To reset the interface counters for BRI interface 0, use the command:

```
reset bri=0 counter=interface
```

Related Commands

reset bri
show bri counter

reset pri

Syntax `RESET PRI=`*`instance`*

where *instance* is the number of the PRI interface

Description This command resets the PRI interface. The hardware and associated structures shall be reset but module configuration information shall not be lost. A resynchronisation to the received signal shall be invoked.

Examples To reset PRI interface 0, use the command:

```
reset pri=0
```

Related Commands **reset pri counter**
set pri
show pri counter

reset pri counter

Syntax

```
RESET PRI[=instance] COUnter[={DIAGnostic|INTerface|LINk|
    PRI|STAte}]
```

where *instance* is the number of the PRI interface

Description

This command resets the PRI counters displayed by the **show pri counter** command on page 11-153 and **show pri state** command on page 11-165. The counters are copied, and the values subtracted from the counter values whenever the counters are displayed by the **show pri counter** or **show pri state** command. This gives the illusion of resetting the counters without affecting the MIB variables. If the interfaces is not specified, the counters for all PRI interfaces are reset. If the counter category is not specified, all categories are reset.

If **link** is specified, only counters for the current interval and the total for the last 24 hours are reset. Counters for other intervals are not reset.

Examples

To reset the interface counters for PRI interface 0, use the command:

```
reset pri=0 counter=interface
```

Related Commands

reset pri
show pri counter

reset q931

Syntax `RESET Q931=`*`interface`* `[CALL={`*`call-index`*`|ALL}]`

where:

- *interface* is a slotted interface name or number. Interface names are formed by concatenating an interface type and instance (such as BRI0 or PRI1). Interface numbers are the decimal index of the slotted interface (0, 1, 2...).
- *call-index* is the Q.931 index of an active ISDN call.

Description This command resets the specified Q.931 interface or call(s). The reset occurs using special Q.931 reset procedures, rather than the call control procedures used to deactivate ISDN calls.

The **call** parameter specifies the index of a Q.931 call. This index can be read from the Index field of the output of the **show q931** command on page 11-173. The call index as obtained from the **show isdn call** command on page 11-139 should **not** be used in this command.

If a Q.931 call index is specified, a RESTART message specifying the channel used by the call is sent to the network, to reset that call only. If the call index ALL is specified, the RESTART message specifies all channels used by all calls. If the Q.931 call index is not specified, a RESTART message is sent to the network that indicates that the whole interface should be reset.

Examples To reset Q.931 interface 0, use the command:

```
reset q931=0
```

Related Commands **set q931**
show q931

set bri

Syntax

```
SET BRI=instance [ACtivation={NOrmal|ALways}]
    [ISDNSlots=slot-list] [MODe={ISDN|TDM|MIXed}]
    [TDMSlots=slot-list]
```

where:

- *instance* is the number of the BRI interface.
- *slot-list* is a character string defining a list of slots. It may include the numbers 1 and 2 corresponding to the BRI slots B1 and B2. If both are specified they should be separated by a comma or a dash.

Description

This command sets the values of the user-configurable BRI operational parameters.

The **activation** parameter controls the operation of the layer 1 state machine. If **normal** is specified, the state machine provides the standard mode of ISDN operation. If **always** is specified the interface is assumed to be connected to a link that is expected to be active at all times. When the link is not active, the router does not try to activate the link by sending INFO 1. The default is **normal**.

The **isdnslots** parameter specifies which slots are available for ISDN calls, and is allowed only when the **mode** parameter is set to **isdn** or **mixed**. It is not permitted when **mode** is set to TDM. The **isdnslots** parameter can disable some slots, providing support for non-standard ISDN services, such as German Monopol. Slot numbers 1 and 2 correspond to the B1 and B2 slots, respectively. The default is for all slots to be available for ISDN calls.

The **mode** parameter specifies the operational mode of the BRI interface. If **isdn** is specified, a corresponding LAPD and Q.931 instance exists and it is not possible to create TDM groups on the port. The port is managed by ISDN call control, and higher layer modules access the port via an ISDN call. If **tdm** is specified, there are no LAPD or Q.931 instances for the port. In this case, higher layer modules must access the port via a PPP interface configured directly to a TDM group that has been created to use some of the slots of the port. ISDN call control has no effect on the port when it is in TDM mode. If **mixed** is specified, there is an LAPD and Q.931 instance for the port and the port may be used for ISDN calls. However, some of the port slots are available for TDM groups. The slots (B1 and B2) are apportioned between ISDN calls and TDM groups using the **isdnslots** and **tdmslots** parameters. The default is ISDN.

Caution The mode parameter of the set bri command affects the way the router behaves when connected to a network to the extent that, if configured inappropriately for the network to which it is connected, it may not conform to the national standards applying to that network. Therefore care must be taken when using this command. Please seek the advice of your authorised distributor or reseller, or ISDN service provider when changing the mode of operation from the default, which is the correct mode for connecting to a standard ISDN network.

Caution Semipermanent connections are not available in the USA and the router does not permit the MODE of a BRI U interface to be set TDM or MIXED or the ACTIVATION mode set to ALWAYS.

The **tdmslots** parameter specifies the slots available for TDM groups, and is allowed only when the **mode** parameter is set to **tdm** or **mixed**. It is not permitted when **mode** is set to **isdn**. The **tdmslots** parameter can restrict the use of slots by TDM groups when the interface is used for semi-permanent connections. When the **mode** parameter is set to **mixed**, the default is for no slots to be available for TDM groups. When the **mode** parameter is set to **tdm**, the default is for all slots to be available for TDM groups.

Examples

To configure BRI interface 0 to use the B1 channel for ISDN calls and the B2 channel for a semipermanent connection, use the command:

```
set bri=0 mode=mixed isdnslots=1 tdmslots=2
```

Related Commands

reset bri
show bri state

set isdn call

Syntax

```
SET ISDN CALL=name [NUMber=number] [PRECedence={IN|OUT}]
    [ALTnumber=number] [BUMPdelay=0..100] [CALLBACK={ON|
    OFF|YES|NO|True|False}] [CALLINGNumber=number]
    [CALLINGSubaddress=calling-subaddress] [CBDelay=0..100]
    [CHECKCli={OFF|PRESent|REQuired}] [CHECKSub={OFF|LOCAL|
    REMote}] [CHECKUser={OFF|LOCal|REMote}] [CLIList=0..99]
    [DIrection={IN|OUT|BOTH}] [DOV={ON|OFF|YES|NO|True|
    False}] [HOLDUP=0..7200] [INANY={ON|OFF|YES|NO|True|
    False}] [INTPRef={NONE|interface}] [INTREQ={NONE|
    interface}] [KEEPUP={ON|OFF|YES|NO|True|False}]
    [LOGIn={ALL|NONE|CHAP|PAP-Radius|PAP-Tacacs|RADius|
    TACAcs|USER}] [MAXDuration=0..36000] [OUTCLI={OFF|
    CALLIng|INTerface|NONUmber}] [OUTSUB={OFF|LOCal|
    REMote}] [OUTUSER={OFF|LOCal|REMote}] [PASSword={NONE|
    CLI|CALLEdsub|NAMe|USer}] [PPPTemplate=template]
    [PRIOrity=0..99] [RAte={56K|64K}] [REMotecall=name|
    remote-number] [RN1=0..10] [RN2=0..5] [RT1=5..120]
    [RT2=300..1200] [SEARCHCli={ON|OFF|YES|NO|True|False|
    CALled|0..99}] [SEARCHSub={OFF|LOCal|REMote}]
    [SEARCHUser={OFF|LOCal|REMote}] [SUBaddress=number]
    [USer={ATTach|PPP}] [USERName={NONE|CLI|CALLEdsub|NAMe|
    USer}]
```

where:

- *name* is an ISDN call name 1 to 15 characters long that is not case-sensitive. Valid characters are uppercase and lowercase letters, decimal digits (0–9), hyphen (“-”), and underscore (“_”).
- *number* is an ISDN phone number 1 to 31 characters long. Valid characters are decimal digits (0–9) and the hash character (“#”).
- *calling-subaddress* is a character string 1 to 31 characters long that is not case-sensitive. Valid characters are uppercase and lowercase letters, decimal digits (0–9), and the underscore (“_”).
- *interface* is a slotted interface name or number. Interface names are formed by concatenating an interface type and instance (such as BRI0 or PRI1). Interface numbers are the decimal index of the slotted interface (0, 1, 2...).
- *template* is a number from 0 to 31.
- *remote-number* is a number 1 to 15 characters long. Valid characters are decimal digits (0–9).

Description

This command modifies an ISDN call definition. The call definition must already exist. Any active calls associated with this call definition are unaffected, but new calls made using this definition use the new parameters.

The **call** parameter uniquely identifies this call in the router. All commands that affect ISDN call definitions must specify the call with this parameter. ISDN call names are **not** case-sensitive. The case of the ISDN call name is saved, so case can be used to provide readable names. However, any form of the name can be used in subsequent commands, and no two calls can have the same name when case is ignored.

The **number** parameter specifies the number called when this call is activated. This is the number that Q.931 uses in the SETUP message passed to the network, so it must include all access and area codes required by the network and be formatted in the way required by the network. Spaces or other characters may not be entered in between the digits of the number. The only character that may be entered between the digits of the number is a hash (“#”).

The **precedence** parameter specifies the direction of precedence for the call in the event of call collision. Call collision occurs when a call is activated at the same time as an incoming call selects the same call. If precedence is **in**, the incoming call has precedence and the outgoing call is cleared. If precedence is **out**, the outgoing call has precedence and the incoming call is cleared.

The **altnumber** parameter specifies an alternate ISDN number for this call to ring if all retries and retry groups for the main number have failed. The ISDN call retry parameters (RN1, RN2, RT1 and RT2) apply only to the main ISDN number. The alternate number is tried only once. The **keepup** parameter, if set, forces ISDN call control to cycle repeatedly through the main number, all retries and retry groups for the main number, and then the alternate number, until a call succeeds.

The **bumpdelay** parameter specifies the time, in tenths of a second, the router waits after bumping another call before initiating this call. Call bumping involves clearing a call and using the resulting free B channel for a new call. A delay is programmable with the **bumpdelay** parameter in order to give the network time to clear the B channel for the bumped calls. The default is 5, which is 0.5s.

The **callback** parameter specifies whether this call, upon being selected by an incoming call, should clear the incoming call and call back or not. The values **on, true**, and **yes** are equivalent and mean that the call back occurs. The values **off, false**, and **no** are equivalent and mean that the call back does not occur. The default is **no**.

The **callingnumber** parameter may be used in connecting this call to a remote call. Certain options for formatting the outgoing SETUP message allow the calling number to be specified.

The **callingsubaddress** parameter specifies a calling subaddress to be placed in the outgoing SETUP message. This value is placed in the outgoing SETUP message only when the **outcli** parameter is set to **calling**.

The **cbdelay** parameter specifies the time, in tenths of a second, the router waits after clearing a call before initiating a callback. Call back involves clearing a call and using the resulting free B channel for the new call. A delay is programmable with the **cbdelay** parameter in order to give the network time to clear the B channel for incoming calls. The default is 41, which is 4.1s.

The **checkcli** parameter specifies how this call, if selected, is checked against the CLI IE in the incoming SETUP message. The check, if carried out, consists of verifying that the CLI number appears in the CLI list for this call. The default of **off** means that no check is carried out. The value **present** means that the check is carried out only if the CLI IE is present, and contains calling number digits. The check passes if the CLI IE is not present, or does not contain calling number digits, or is present and contains a matching CLI number. The value **required** means that CLI MUST be present, and must contain calling number digits. The check fails when the CLI IE is not present, does not contain calling number digits, or does not contain a matching CLI number.

The **checksub** parameter specifies whether this call, when selected, should have the called party subaddress IE of the incoming SETUP message checked. The IE may be checked against the call name (parameter set to **local**) or the remote call name (parameter set to **remote**). The default is **off**, which means that no check is carried out.

The **checkuser** parameter specifies whether this call, when selected, should have the user–user data IE of the incoming SETUP message checked. The IE may be checked against the call name (parameter set to **local**) or the remote call name (parameter set to **remote**). The default is **off**, which means that no check is carried out.

The **clilist** parameter specifies the CLI list against which this call is checked when the check **cli** parameter is either **present** or **required**. The default is a special value that means that the list is undefined.

The **direction** parameter specifies the directions for which the call is enabled. Calls may be enabled for sending and receiving calls, or for either direction. The default is **both**.

The **dov** parameter specifies whether the outgoing call setup message for this call has data bearer capability or voice bearer capability. If **dov** is set to **on**, voice bearer capability is specified and the ISDN service treats the call as a voice call. If **dov** is set to **off**, data bearer capability is specified and the ISDN service treats the call as a data call. The values **on** and **true** are equivalent to **yes**. The values **off** and **false** are equivalent to **no**. The default is **no**. The **dov** parameter is used with the **dovnumber** parameter on the **set q931** command on page 11-117 to configure data over voice (DOV).

The **holdup** parameter specifies the minimum time, in seconds, that this call should be held up after activation. If the user of the ISDN call requests a deactivation, and the holdup time has not expired, the deactivation is ignored until the holdup time has expired. The default is 0 seconds.

The **inany** parameter specifies whether this call may be selected to match any incoming call. The search for calls with **inany** set **yes** follows all other searches. Only one call should have **inany** set to **yes** or a predictable response to incoming calls cannot be guaranteed. The default is **no**.

The **intreq** parameter specifies the ISDN interface that MUST be used for this call when the call is activated as an outgoing call. If no channel is available on the required interface, the call fails. The default is **none**, which means no required interface.

The **intpref** parameter specifies the ISDN interface that should preferentially be used for this call when the required interface is not specified. When activating this call, the preferred interface is checked first for a free channel. If no free channel is found, other interfaces may be checked. The default is **none**, which means no preferred interface.

The **keepup** parameter determines whether the call should be kept up at all costs or not. The **keepup** parameter for a call is inspected when all retries for the main number have failed and the alternate number (if defined) has also failed, and when the call is cleared for any reason other than explicit clearing by the user module or by manager command. If the **keepup** parameter has the value **yes**, the call is reactivated in these circumstances. The values **on** and **true** are equivalent to **yes**. The values **off, false**, and **no** are equivalent for turning off the **keepup** parameter. The default is **no**.

The **login** parameter specifies the login procedure that this call must use when it is activated. If **chap** is specified, the call is accepted but creates a PPP interface that authenticates using CHAP. If **pap-radius** is specified, the call is accepted but creates a PPP interface that authenticate using PAP, and using RADIUS as the means of authenticating the PAP exchange. If **pap-tacacs** is specified, the call is accepted but creates a PPP interface that authenticates using PAP, and using TACACS as the means of authenticating the PAP exchange. If **radius** is specified, the router sends a request to the configured RADIUS server(s) to authenticate the call. If **tacacs** is specified, the User Authentication Database in the router is checked and if the call is not authenticated, the router sends a request to the configured TACACS server(s) to authenticate the call. If **user** is specified, the User Authentication Database in the router is checked. The default is **none**, which means that no login procedure is required.

The values **chap, pap-tacacs** and **pap-radius** are only used when the ISDN call creates a dynamic PPP interface. Since these parameters can also be set by defining a PPP template with the appropriate authentication parameters, use of these values is for backward compatibility only. The value specified in the **login** parameter overrides the authentication settings in the PPP template.

The **maxduration** parameter specifies the maximum duration of the call in seconds. The router closes the call when the appropriate time has expired. The default is 0, which means there is no maximum duration timeout of the call. The time specified is the time from the activation of the call.

The **outcli** parameter specifies the format of the calling party number IE and calling subaddress IE (also known as CLI) in the outgoing SETUP message created when this call is activated. If **off** is specified, the CLI is not included in the SETUP message. If **calling** is specified, the calling number and calling subaddress values from the ISDN call definition are placed in the SETUP message. If the **callingsubaddress** parameter is not defined, the calling subaddress IE is not included in the SETUP message. If **interface** is specified, the number and subaddress values from the Q.931 interface (set with the **set q931** command on page 11-117) are placed in the SETUP message. If the Q.931 interface does not have a subaddress set, the calling subaddress IE is not included in the SETUP message. If **nonumber** is specified, an empty calling number IE and the calling subaddress from the Q.931 interface (if set) are included in the SETUP message. The ISDN itself can fill in the calling number IE in the SETUP message before sending the message to the remote end. The default is **off**.

The **outsub** parameter specifies the format of the called party subaddress IE in the outgoing SETUP message created when this call is activated. The default is **off**, which means that the called party subaddress IE is not included in the SETUP. The call name or remote call name may be specified.

The **outuser** parameter specifies the format of the user–user data IE in the outgoing SETUP message created when this call is activated. The default is **off**, which means that the user–user data IE is not included in the SETUP. The call name or remote call name may be specified.

The **password** parameter specifies the source of the password for login procedures. The default of **none** means that no password is specified. The values **cli**, **calledsub** and **user** mean that the password is drawn from, respectively, the CLI, called party subaddress and user–user data IE in the incoming SETUP message. The value of **name** means that the call name is used as the password.

The **ppptemplate** parameter specifies the PPP template to use when creating a dynamic PPP interface for this call. The specified template must exist. This parameter is only valid if encapsulation is set to **auto, okppp** or **ppp**. See "Templates" on page 15-18 of Chapter 15, Point-to-Point Protocol (PPP) for more information about creating PPP templates.

The **priority** parameter specifies the priority of this call for use by the call bumping facility. The value of this parameter is a number from 0 to 99. The default is 50. Table 11-18 on page 11-42 details how the different priority values affect the bumping of data calls.

The **rate** parameter specifies the rate of data transmitted and received on the B channel for this call. The rate can be either 64 kbps (the default), which is the full bandwidth of the B channel, or 56 kbps, which is specified by ITU-T standard V.110 (rate adaption). The data rate specified by this parameter is used when this call is an outgoing call. When the call is selected as an incoming call, the date rate is determined by the bearer capability in the SETUP message or the rate set for the entire Q.931 interface, as specified by the **set q931** command on page 11-117.

The **remotecall** parameter is used to connect this call to a remote call. Some options for formatting the outgoing SETUP message and searching for calls allow the remote call to be specified. The **remotecall** parameter can also be used with L2TP to specify the name of an ISDN or ACC call on a remote router. If the activation of the ISDN call triggers the creation of an L2TP tunnel, then the value of the **remotecall** parameter is passed across the tunnel to identify the call that the remote router should use to make the final connection to the remote destination of the L2TP tunnel. See Chapter 20, Layer Two Tunnelling Protocol (L2TP) for more information about the use of this parameter. This parameter has the same syntax as the **call** parameter.

The **rn1** parameter specifies how many times this call is retried in a single retry group. The default of 0 means that the call is not retried.

The **rn2** parameter specifies how many retry groups this call has after the first group. The default of 0 means that the first group only is tried.

The **rt1** parameter specifies the time in seconds between retries in the same retry group. The default is 30 seconds.

The **rt2** parameter specifies the time in seconds between retry groups. The default is 600 seconds.

The **searchcli** parameter specifies whether this call may be included in a search based on the CLI IE in the incoming SETUP message. If **on** is specified, the value of the CLI IE in the incoming SETUP message is compared with the called number (**number**) parameter of this call definition. The options **true**, **yes** and **called** are synonyms for **on**. If **off** is specified, there is no search based on the CLI IE. The options **false** and **no** are synonyms for **off**. If a number is specified it identifies an existing CLI list, and the value of the CLI IE is compared with all numbers in the specified CLI list. The default is **off**.

The **searchsub** parameter specifies whether this call may be included in a search based on the called party subaddress IE in the incoming SETUP message. In such a search, the called party subaddress IE may be compared with the call name (parameter set to **local**) or the remote call name (parameter set to **remote**). The default is **off**.

The **searchuser** parameter specifies whether this call may be included in a search based on the user–user data IE in the incoming SETUP message. In such a search, the user–user data IE may be compared with the call name (parameter set to **local**) or the remote call name (parameter set to **remote**). The default is **off**.

The **subaddress** parameter allows the specification of an entirely numeric subaddress to be placed in the outgoing SETUP message when this call is activated. The subaddress as specified by the **outsub** parameter has the limitation that it can only be the remote or local call name, which means that entirely numeric subaddresses cannot be specified with this parameter alone. However, in some cases, a numeric subaddress is required to satisfy network requirements when calling a router that shares an S/T bus with other ISDN devices. The default is a null (empty) string. If this parameter has a value, it overrides the **outsub** parameter when setting the called subaddress IE in the outgoing SETUP message.

The **user** parameter specifies how users of ISDN calls use this call. The value **attach**, the default, means that users must attach to this call before it can be used. The value **ppp** means that this call creates dynamic PPP interfaces when activated. The **ppp** value is most likely to be used for incoming ISDN calls, which use RADIUS or the user data base to set parameters for the PPP and IP interfaces dynamically created.

The **username** parameter specifies the source of the user name for login procedures. The default of **none** means that no user name is specified. The values **cli, calledsub** and **user** mean that the user name is drawn from, respectively, the CLI, called party subaddress and user–user data IE in the incoming SETUP message. The value of **name** means that the call name is used as the user name.

Examples

To enable the callback option and set the delay between clearing the call and calling back to 2 seconds for ISDN call “Region-1”, use the command:

```
set isdn call=”region-1” callback=on cbdelay=20
```

Related Commands

activate isdn call
add isdn call
add radius server in Chapter 41, User Authentication
deactivate isdn call
delete isdn call
delete radius server in Chapter 41, User Authentication
disable isdn call
enable isdn call
show isdn call
show radius in Chapter 41, User Authentication

set isdn domainname

Syntax SET ISDN DOMainname=*domain-name*

where *domain-name* is a domain name

Description This command modifies the domain name to be prepended to a login name for a DNS lookup to determine the IP address to be used for an ISDN call. Only one domain name may be defined.

Examples To change the domain name “acc.newco.co.nz” to “sales.southern.com” for use with DNS lookups, use the command:

```
set isdn domainname=sales.southern.com
```

Related Commands
add isdn domainname
delete isdn domainname
show isdn domainname

set isdn log

Syntax SET ISDN LOG [POrt={0..23|NOne}] [LENgth=0..100]

Description This command sets parameters for the ISDN call logging facility. Call logging records details of events associated with ISDN calls.

The **port** parameter specifies the asynchronous port on the router to which ISDN log messages are sent. The messages are sent when the log entry reaches a completed state, which means that the call has been cleared, either in the setup phase, or as a result of normal call clearing. Setting the login port to the default **none**, disables the sending of messages to any asynchronous port on the router.

The **length** parameter specifies the maximum length, in number of entries, of the ISDN call log. The default is 25.

Examples To set the ISDN call log to its maximum length but not output any messages to a terminal, use the command:

```
set isdn log port=none length=100
```

To view the ISDN call log, use the command:

```
show isdn log
```

Related Commands
disable isdn log
disable q931 debug
enable isdn log
enable q931 debug
show isdn log

set lapd

Syntax

```
SET LAPD=interface DEBUg={OFF|STATE|PACKET}

SET LAPD=interface MODE={AUTOMATIC|NONAUTOMATIC}

SET LAPD=interface [NASMOde={NORMAL|MASTER|SLAVE}]
    [NASMAster=interface]

SET LAPD=interface SAP=sap K=value

SET LAPD=interface SAP=sap {N200|N201|N202}=time...

SET LAPD=interface SAP=sap {T200|T201|T202|T203}=time...
```

The following variants may be used for conformance testing only:

```
SET LAPD=interface {ATTACH=sap|CONNECT=sap|DATA=sap
   CES=ces|ESTABLISH=sap CES=ces|MDATA=sap CES=ces|
   MUNIT=sap CES=ces|RELEASE=sap CES=ces|UNIT=sap CES=ces}
```

where:

- *interface* is a slotted interface number (0, 1, 2...).
- *sap* is a SAP identifier.
- *ces* identifies a DLC within the SAP.
- *time* is a time value in tenths of a second.

Description

This command configures LAPD on an ISDN interface.

The **debug** parameter controls the display of debug messages. If **off** is specified, debug messages are not displayed. If **state** is specified, a message is displayed each time the LAPD interface experiences a state transition. If **packet** is specified, every LAPD packet received on the interface is decoded and displayed.

Caution The debug option is only required for testing, and should not be used in normal operation. Due to the volume of output, it may be difficult to turn off and also results in reduced router performance.

The **mode** parameter specifies the TEI assignment mode. If **automatic** or **nonautomatic** is specified, automatic TEI assignment is enabled or disabled, respectively. The default is **automatic**.

The **nasmode** parameter specifies the non-associated signalling mode for this interface. The value **normal** specifies that D channel signalling for the calls on this interface takes place on this interface's D channel, and this interface's D channel does not provide the signalling for any other ISDN interface. The value **master** specifies that D channel signalling for the calls on this interface takes place on this interface's D channel, and that this interface's D channel may provide signalling for other ISDN interfaces. The value **slave** specifies that D channel signalling for the calls on this interface takes place on the D channel of another ISDN interface. If the value **slave** is specified, the **nasmaster** parameter must be present on the same command line. The default is **normal**.

The **nasmaster** parameter specifies the ISDN interface whose D channel provides signalling for calls on this interface when the NASMODE for this interface is **slave**. The **nasmode** of the interface specified with the **nasmaster** parameter must be **master**. There is no default since the default **nasmode** is **normal**.

The **sap** parameter specifies the SAP identifier of the SAP to be modified.

The **k** parameter specifies the number of outstanding I frames allowed.

The **n200**, **n201**, **n202**, **t200**, **t201**, **t202**, and **t203** parameters specify the value (in tenths of a second) of the respective timer.

The **k**, **N2xx** and **T2xx** parameters must conform to the LAPD standard.

The **attach, connect, establish, release, data, mdata, unit** and **munit** options are required for conformance testing and should not be used in normal operation.

The **attach** parameter adds a SAP to a LAPD interface. The **connect** parameter adds a DLC to a SAP. The **establish** parameter attempts to establish a DLC using the value *ces* returned from a previous ATTACH command. The **release** parameter de-establishes a DLC. The **data** parameter sends an I frame. The **mdata** parameter sends 16 I frames. The **unit** parameter sends a UI frame. The **munit** parameter sends 16 UI frames.

Only one of these options should be entered per command.

Examples To enable debugging of all LAPD packets on LAPD interface 0, use the command:

```
set lapd=0 debug=packet
```

Related Commands show lapd

set pri

Syntax

```
SET PRI=instance [CLock={INTernal|LIne}] [CODe={STAndard|
   ALTernate}] [CRC={OFF|CHEcking|REPorting}]
   [ENCoding={B8zs|B7zs|AMi}]
   [ERRor_threshold=error-frames] [FRAming={ESF|SF}]
   [IDle=character] [INBandloopback={LIne|PAYload}]
   [INTerframe_flags=extra-flags] [ISDNslots=slot-list]
   [LBO={NONE|-7.5db|-15db|-22.5db}] [LINelength=0..65535]
   [MODe={ISDN|TDM|MIXed}] [TDMslots=slot-list]
```

where:

- *instance* is the number of the PRI interface.
- *error-frames* is the threshold for triggering a CRC-4 resynchronisation.
- *character* is decimal value of the character to be transmitted in idle slots.
- *extra-flags* is the number of extra flags to be transmitted per slot between HDLC frames.
- *slot-list* is a character string defining a list of slots. It may include the numbers 1 to 31 to indicate a time slot, commas to separate individual time-slots and dashes to indicate an inclusive range.

Description

This command sets the values of the user-configurable PRI operational parameters.

The **clock** parameter determines the clock source for the PRI interface. The default is the transmit clock signal from the received signal (line), and is correct for a TE. An internal clock is used when the PRI interface is emulating a NT during manufacturer testing, or when the PRI interface is used on a non-ISDN dedicated link.

The **code** parameter (T1 only) specifies the code recognised as the activate in-band loopback signal. The signal is a repeated 5-bit pattern transmitted towards the interface for at least 5 seconds. If **standard** is specified then the pattern recognised is “00001”. If **alternate** is specified then the pattern recognised is “11110” (the code used in Canada). The default is **standard**.

The **crc** parameter (E1 only) defines the CRC procedure implemented by the interface. If **off** is specified, CRC-4 multiframing is not used and the international bit is always set to one. This mode may be selected when the PRI interface is being used for a non-ISDN application. The **checking** option enables CRC-4 multiframing. In the receive direction, the CRC for the frame is calculated and compared with CRC bits in the next sub-multiframe; and in the transmit direction, the CRC for a sub-multiframe is calculated and transmitted in the next sub-multiframe. The **reporting** option implements the same procedure as the **checking** option, and in addition a frame received with a sub-multiframe error causes the corresponding E bit in the next multiframe to be transmitted as a zero. That is, receive errors are reported to the other end of the primary rate link. The default is **checking**. Whether **checking** or **reporting** should be selected depends on the implementation of ISDN in the country where the PRI interface is being used. Refer to your network hardware or telecommunications service providers. Currently, the correct setting is **checking** for Australia and **reporting** for other territories.

The **encoding** parameter specifies the encoding used when the link type is T1. The parameter is not allowed when the link type is E1 as an encoding of HDB3 is used in all circumstances. If **b8zs** is specified then the encoding is bipolar with 8-zero substitution, which is an AMI line code with the substitution of a unique code to replace occurrences of eight consecutive zero signal elements. The unique code includes bipolar violations and may only be used with transmission systems that recognise this unique code and do not regard it as an error. This is the case with most modern systems. If **b7zs** is specified then the encoding is bipolar with bit seven zero substitution, which is a method for enforcing a minimum ones density on an AMI encoded line. With this encoding bit, seven of an all-zero time-slot octet is replaced with a one. Use of this encoding may be necessary where the transmission system does not tolerate bipolar violations. This encoding is useful when it can be guaranteed that slots containing data can never be all zero or where it does not matter if bit seven is changed to a one. When this encoding is selected, the polarity of HDLC data signals sent over time-slots is automatically inverted. HDLC bit stuffing ensures that eight consecutive zeros are never transmitted. If a time-slot contains voice traffic, then the replacement of bit seven with a one causes an error imperceptible to the human ear. If AMI is specified, then the interface inverts HDLC data signals to ensure the minimum ones density in data slots but will do no other ones substitution. The idle character should not be set to 0. It is essential that the encoding be the same at both ends of the T1 link. The default encoding is **b8zs**.

The **error_threshold** parameter (E1 only) specifies how many incoming multiframes with CRC-4 errors may be counted in one second without forcing a new search for CRC-4 synchronisation. If the number of CRC-4 errors is greater than the number specified, then a new search is invoked. The ITU-T Recommendation specifies a value of 914 whereas the Australian Standard TS014.2 specifies 830. The default is **830**.

The **framing** parameter specifies the multiframe format when the link type is T1. The parameter is not allowed when the link type is E1 as G.704 CRC-4 multiframing is used in all circumstances. When **esf** is specified the multiframe format is Extended Superframe, which has 24 basic frames in each multiframe. This frame format supports the Data Link for performance monitoring and maintenance and CRC-6 bits for error detection. When **sf** is specified, the multiframe format is Superframe (also known as D4), which has 12 basic frames in each multiframe. The default is **esf**.

The **idle** parameter specifies the character transmitted in slots that are not assigned to any module. The value is the desired 8-bit character in decimal. The default is 255, i.e. all ones; this is the usual value for a TE.

The **inbandloopback** parameter specifies the type of loopback to be activated upon receipt of an in-band loopback activation signal. The parameter is not allowed when the link type is E1 as no in-band loopback activation signal is recognised. When **line** is specified then a line loopback is activated and the entire received signal is transmitted. If **payload** is specified, then a payload loopback is activated and the contents of the received time-slots are transmitted but the framing is regenerated, including performance monitoring messages. This parameter is ignored when the framing is SF/D4 as line loopback is the only loopback mode possible. The default is **line**.

The **interframe_flags** parameter specifies the minimum number of extra flags transmitted between HDLC frames being sent over a PRI channel. There must be at least one flag between HDLC frames. The value is the number of extra flags transmitted per slot, i.e. if the value is 1 then one extra flag is transmitted between HDLC frames on a 64 kbit/s channel and 30 extra flags between

HDLC frames on a 1920 kbit/s channel (30 slots). One extra flag per slot corresponds to an extra delay of 125 microseconds for any number of slots. This parameter applies to every channel operating over the PRI interface and may be useful if the device at the other end of a channel is unable to handle back-to-back frames. The minimum value is 0, in which case two consecutive HDLC frames may “share” a single flag transmitted between them. The maximum value is 1024, which corresponds to a minimum interframe delay of 4 milliseconds. The default is **0**.

The **isdnslots** parameter specifies the slots available for ISDN calls, and is allowed when the **mode** parameter is set to **isdn** or **mixed**. It is not permitted when **mode** is set to TDM. The **isdnslots** parameter can disable some slots, providing support for non-standard ISDN services, such as PRI-6 services. The default is for all slots to be available for ISDN calls.

The **lbo** parameter specifies the Line Build Out setting for the interface. This takes effect when the line length indicates a long haul T1 installation. The **linelength** parameter must be set to a value greater than 655. It is used where the line length is significantly less than the maximum possible physical line section length and specifies a degree of attenuation of the transmitted signal. This ensures that the receiver at the other end of the line is not over-driven by a full strength signal. Four line build out parameter values are available: **none**, **-7.5db, -15db** and **-22.5db**. The default is **none**.

The **linelength** parameter specifies the length of the line connecting the interface to the other end of the physical line section—the CSU in a short haul installation or the nearest repeater or far end CSU in a long haul installation. This parameter is not allowed for E1 interfaces. The line length is specified in feet and although any number between 0 and 65535 may be entered, only five different length settings are supported for short haul installations, corresponding to the length ranges 0–132, 133–265, 266–398, 399–531 and 532–655 feet. If a value greater than 655 is specified the interface is configured for long haul operation. The Line Build Out is not altered by the line length setting. The default is 0.

The **mode** parameter specifies the operational mode of the PRI interface. If **isdn** is specified, a corresponding LAPD and Q.931 instance will exist and it will not be possible to create TDM groups on the port. The port is managed by ISDN call control, and higher layer modules access the port via an ISDN call. If **tdm** is specified, there will be no LAPD or Q.931 instances for the port. In this case, higher layer modules must access the port via a PPP interface configured directly to a TDM group that has been created to use some of the slots of the port. ISDN call control has no effect on the port when it is in TDM mode. If **mixed** is specified then there will be LAPD and Q.931 instance for the port and the port may be used for ISDN calls. However, some of the port slots are available for TDM groups. The slots are apportioned between ISDN calls and TDM groups using the **isdnslots** and **tdmslots** parameters. The default is **isdn**.

Caution The **mode** parameter of the **set pri** command affects the way the router behaves when connected to a network to the extent that, if configured inappropriately for the network to which it is connected, it may not conform to the national standards applying to that network. Therefore care must be taken when using this command. Please seek the advice of your authorised distributor or reseller, or ISDN service provider when changing the mode of operation from the default, which is the correct mode for connecting to a standard ISDN network.

The **tdmslots** parameter specifies the slots that are available for TDM groups, and is allowed when the **mode** parameter is set to **tdm** or **mixed**. It is not permitted when **mode** is set to ISDN. The **tdmslots** parameter can restrict the use of slots by TDM groups when the interface is used for semi-permanent connections. When the **mode** parameter is set to **mixed**, the default is for no slots to be available for TDM groups. When the **mode** parameter is set to **tdm**, the default is for all slots to be available for TDM groups.

Examples

To configure an PRI interface 0 (type E1) for mixed mode operation with slots 1 to 15 used for ISDN calls and slots 16 to 31 used for TDM, use the command:

```
set pri=0 mode=mixed isdnslots=1-15 tdmslots=16-31
```

To configure PRI interface 1 (type T1) for TDM operation in a short haul installation where the router is 15 feet from the CSU/NT1, use the command:

```
set pri=1 mode=tdm linelength=15
```

Related Commands

reset pri
show pri state

set q931

Syntax

```
SET Q931=interface [DOVnumber=number] [INTid=[hex-string]]
    [NONum={ACCept|REJect}] [NOSub={ACCept|REJect}]
    [NUM1=number] [NUM2=number] [PROfile={5ESS|AUS|CHINA|
    DMS-100|ETSI|JAPAN|KOREA|NI1|NZ}] [RAte={56K|64K}]
    [SPID1=spid] [SPID2=spid] [SUB1=subaddress]
    [SUB2=subaddress] [timer={OFF|time}]
```

where:

- *interface* is a slotted interface name or number. Interface names are formed by concatenating an interface type and instance (such as BRI0 or PRI1). Interface numbers are the decimal index of the slotted interface (0, 1, 2...).
- *hex-string* is an string 1 to 16 characters long. Valid characters are decimal digits (0–9) and the letters a–f or A–F.
- *number* is an ISDN phone number 1 to 39 characters long. Valid characters are decimal digits (0–9).
- *spid* is an ISDN Service Provider Identifier 1 to 20 characters long. Any character is valid, although decimal digits (0–9) are typically used.
- *subaddress* is an ISDN subaddress 1 to 39 characters long that is not case-sensitive. Valid characters are decimal digits (0–9), and uppercase and lowercase letters.
- *timer* is the name of a Q.931 timer, and must be one of T301, T302, T303, T304, T305, T308, T309, T310, T313, T314, T316, T317, T318, T319, T321, or T322.
- *time* is the timeout value for the timer.

Description

This command configures the Q.931 module on an ISDN interface.

The **dovnumber** parameter specifies an ISDN number for the interface. If a call is received on this interface with a voice bearer capability and a called number matching the value specified for **dovnumber**, the call is treated as a data call, not a voice call.

The **intid** parameter specifies an interface identifier for use in non-associated signalling. Non-associated signalling is configured with the **set lapd** command on page 11-111; this parameter just sets the identifier the network and router use to distinguish between the interfaces sharing a common D channel for signalling purposes. The parameter is a sequence of hexadecimal digits that give the hexadecimal representation of the interface identifier. Since the interface identifier is given by the ISDN network provider as part of the subscription process to the non-associated signalling feature, the provider must have made clear the exact format of the interface identifier. Entry as a hexadecimal string allows any sequence of bits to be specified as an interface identifier, but some conversion may be required. For example, if the interface identifier is given as the sequence of characters, “I1”, it must be converted to hexadecimal and entered as **intid=4931**.

The **nonum** parameter specifies the behaviour of the router towards an incoming call that does not contain a called number. The router can be set up to reject these calls, or accept them, given that other conditions allow the call to be accepted. In most ISDNs there is always a called number present in an incoming call. The default is **accept**.

The **nosub** parameter specifies the behaviour of the router towards an incoming call that does not contain a called subaddress. The router can be set up to either reject these calls, or accept them, given that other conditions allow the call to be accepted. Most ISDNs present a called subaddress in an incoming call when the remote user sent a called subaddress, so setting this parameter to **reject** could have undesirable results. The default is **accept**.

The **num1** and **num2** parameters assign the router's own ISDN phone numbers. These parameters are required when the router is attached to a BRI S/T bus with other TEs, or if SPIDS have been defined. When the router is the only TE on the bus, all incoming calls are for the router. When more than one TE exists on the bus, the incoming setup message is sent to all of them, and the called number in the setup message must be matched with the TE's number before it may reply to the call. The number entered should be the number as supplied by the carrier, without STD access codes or area codes. The incoming number and the router's number are compared from the right end and only as far as the shortest of the two.

The **profile** parameter determines the network that is running on the interface (Table 11-36 on page 11-118). The profile is set automatically whenever the router territory is changed by the **set system territory** command on page 11-120 of Chapter 11, Integrated Services Digital Network (ISDN). The default territory is 'Europe', which sets the profile to ETSI.

Table 11-36: Q.931 Profiles

Profile Name	Access Mode	Country
5ESS	Basic Rate	5ESS custom, USA
AUS	Basic or Primary Rate	Australian Telecom
CHINA	Basic or Primary Rate	China Telecom
DMS-100	Basic rate	DMS-100 custom, USA.
ETSI	Basic or Primary Rate	European Union (EU) and European Free Trade Association (EFTA) countries—ETSI specification
JAPAN	Basic or Primary Rate	Japan
KOREA	Basic or Primary Rate	Korea
NI1	Basic Rate	National ISDN, USA
NZ	Basic or Primary Rate	New Zealand Telecom

If you are not sure which profile to use, contact your authorised distributor or reseller, or ISDN service provider.

Caution Failure to select the correct profile invalidates the approval of this product with respect to the applicable national standards for the country where the product is used.

The **rate** parameter specifies the rate of data transmitted and received on the B channel for all calls in this interface. The rate can be either 64 kbps (the default), which is the full bandwidth of the B channel, or 56 kbps, which is specified by ITU-T standard V.110 (rate adaption). All calls made and received on this interface use the rate specified by this parameter.

The **spid1** and **spid2** parameters specify Service Provider Identifiers for the router. These is not needed in most cases but where required, the ISDN service provider supplies the values.

The **sub1** and **sub2** parameters specify the router's ISDN subaddresses. These parameters are required when the router is attached to a BRI S/T bus with other TEs. When the router is the only TE on the bus, all incoming calls are for the router. When more than one TE exists on the bus, the incoming setup message is sent to all of them, and the subaddress in the SETUP message must match the TE's subaddress before it may reply to the call. If neither subaddress of a Q931 interface is set, the subaddress in the SETUP message is passed to call control for processing as part of an ISDN call. The subaddresses as set by this command can match the subaddress set by an **add isdn call** command on page 11-64. In this case the subaddress is checked twice, once by Q.931 and once at the ISDN call level.

The **num1**, **num2**, **sub1**, **Sub2**, **spid1**, and **spid2** parameters may all be specified without a value to clear the current value for the respective parameter.

The **t3xx** parameters set timeout values for their respective timer, whether the timer is valid for a particular profile or not. Setting a timer to **off** disables the use of the timer.

Examples

To use the 5ESS profile at 56K on interface BRI1, use the command:

```
set q931=bri1 profile=5ess rate=56k
```

Related Commands

set system territory
show q931
show q931 spid

set system territory

Syntax

```
SET SYStem TERritory={AUStralia|CHIna|EURope|JAPan|KORea|
    NEWZealand|USA}
```

Description

This command assigns a territory identifier for the router. The territory identifier is used by the Q.931, PRI, and PBX modules to set defaults that are appropriate for the territory in which the router is being operated. The default territory is **europe**.

If the router territory identifier is changed, parameters in the Q.931, PRI, and PBX modules that are influenced by the territory in which the router is being operated are automatically changed to values appropriate for the new territory setting. If the current territory value is specified, i.e. the territory is unchanged, then the module parameters are restored to the defaults for that territory.

In Australia only: to use the Micro service, set the territory to **australia**; to use the OnRamp service, set the territory to **europe**.

Examples

To set the name for this router to Australia, use the command:

```
set sys ter=aus
```

Related Commands

set pri
set q931
set system contact in Chapter 4, Configuring and Monitoring the System
set system country in Chapter 10, ATM over xDSL
set system location in Chapter 4, Configuring and Monitoring the System
set system name in Chapter 4, Configuring and Monitoring the System
show pri configuration
show pri state
show q931
show system in Chapter 4, Configuring and Monitoring the System

show bri configuration

Syntax `SHow BRI[=instance] CONfiguration`

where *instance* is the number of the BRI interface

Description This command displays information about the modules attached to the BRI interface (Figure 11-15 on page 11-121, Table 11-37 on page 11-121).

This example shows that the LAPD module is attached to the D channel and the PPP module to channel 0 that is using slot B1. The address referred to is the 16-bit field of the layer 2 frame that contains the SAPI and TEI for a D channel frame. The BRI hardware in the router can filter received frames based on a list of up to four addresses and an address mask. This reduces the loading on the BRI software module by not interrupting it for frames intended for other TEs.

The address mask indicates the bits of a frame's address field that are significant when a comparison with each of the four addresses is made. A one bit in the address mask denotes a significant bit. As the B slots are not shared with other TEs the address filtering features of the hardware are not used for channels other than the D channel.

Figure 11-15: Example output from the **show bri configuration** command

```
Configuration for BRI instance 0:


  D Channel:
Module ......... LAPD
Address mask ... fdff
Addresses:
00ff
fcff

  Channel 0:   Slots: B1
Module ......... PPP
Rate ........... 64kbps
Address mask ... 0000
Addresses:
  none
```

Table 11-37: Parameters in the output of the **show bri configuration** command

Parameter	Meaning
Channel	The channel to which the information applies.
Module	The module attached to the channel.
Rate	The bandwidth of the channel.
Address Mask	A mask used to determine the bits of a frame's address field that are significant for filtering purposes.
Addresses	Addresses used for filtering incoming layer 2 frames. The frame's address field is ANDed with the address mask and then compared with this list of addresses. If a match is not found, the frame is ignored.

In the example shown above, the mask indicates that all bits of the address are significant except for the command/response field bit. The first address value shown corresponds to a SAPI of 0 (call control procedures) and a TEI of 127 (broadcast TEI), and the second address to a SAPI of 63 (layer 2 management procedures) and a TEI of 127.

If it becomes necessary for the D channel to accept frames with more than four addresses then the address mask is adjusted (fewer one bits) so that four addresses are sufficient to select all required frames.

Examples To display the configuration of BRI interface 0, use the command:

```
show bri=0 configuration
```

Related Commands **show bri counter**
show bri state

show bri counter

Syntax

```
SHow BRI[=instance] COUnter[={INTerface|BRI}]
    [CHANnel={B1|B2|D|0|1|2}]
```

where *instance* is the number of the BRI interface

Description

This command displays the MIB counters associated with the BRI interface. If an interface is not specified, the MIB counters for all BRI interfaces are displayed. If a counter category is not specified, all categories are displayed. If a BRI channel is not specified, all channels are displayed.

The **counter** parameter specifies the category of counters to display. The **interface** option displays counters from the interfaces table of the interfaces MIB relating to the BRI interface (Figure 11-16, Table 11-38 on page 11-124). The **bri** option displays counters from the enterprise MIB specific to a Basic Rate interface. The BRI output is divided into sections, one for the BRI as a whole and one for each D, B1 and B2 channel. See the following for example output from:

- an S/T interface (Figure 11-17 on page 11-125, Table 11-39 on page 11-127)
- a U interface (Figure 11-18 on page 11-126, Table 11-39 on page 11-127)

The IOM counters shown in Figure 11-17 on page 11-125 relate to the operation of the IOM bus used for communication between the HDLC controller and the transceiver, and apply only to S/T interfaces.

The **channel** parameter specifies which of the B1, B2, and D channels to include in the display of BRI counters. Specifying B1 or 0 displays the B1 channel counters. Specifying B2 or 1 displays the B2 channel counters. Specifying D or 2 displays the D channel counters. Not specifying a channel displays the counters for all channels as well as the counters for the BRI as a whole.

Figure 11-16: Example output from the **show bri counter=interface** command

```
BRI instance 0:        522 seconds    Last change at:          0 seconds

Interface MIB Counters

    Receive:                                Transmit:
ifInOctets                   91192     ifOutOctets                483455
ifInUcastPkts                    0     ifOutUcastPkts                150
ifInNUcastPkts                   0     ifOutNUcastPkts                 0
ifInDiscards                     0     ifOutDiscards                   0
ifInErrors                       0     ifOutErrors                     0
ifInUnknownProtos                0     ifOutQLen                       0
```

Table 11-38: Parameters in the output of the **show bri counter=interface** command

Parameter	Meaning
ifInOctets	The number of octets received on this interface.
ifInUcastPkts	The number of unicast frames delivered to a higher layer protocol.
ifInNUcastPkts	The number of non-unicast frames delivered to a higher-layer protocol.
ifInDiscards	The number of inbound frames discarded though no errors were detected to prevent them being delivered to higher-layer protocols.
ifInErrors	The number of inbound frames that contained errors preventing them being delivered to a higher-layer protocol.
ifInUnknownProtos	The number of frames discarded because they were for an unconfigured protocol.
ifOutOctets	The number of octets transmitted, including framing.
ifOutUcastPkts	The number of unicast frames transmitted or discarded.
ifOutNUcastPkts	The number of non-unicast frames transmitted or discarded.
ifOutDiscards	The number of frames discarded though no errors had been detected preventing their being transmitted.
ifOutErrors	The number of frames not transmitted because of errors.
ifOutQLen	Length of output frame queue.

Figure 11-17: Example output from the **show bri counter=bri** command for an S/T interface

```
BRI instance 1:       2681 seconds      Last change at:          0 seconds

BRI Counters
ActivationRequests              0     Activations                     0
  IOM Counters
    Receive:                               Transmit:
Bytes                           0     Bytes                           0
Messages                        0     Messages                        0
Overlength messages             0     Overlength messages             0
Zero length messages            0     Zero length messages            0
Indication changes              0     Aborts                          0
                                      Excessive retries               0
Recovers                        0     Lost interrupts                 0
  Channel 0:   Slots: B1
    Receive:                              Transmit:
Frames                          0     Frames                          0
OverlengthFrames                0     Underruns                       0
UnderlengthFrames               0     LostInterrupts                  0
CRCErrors                       0     DescriptorErrors                0
Aborts                          0     QueueLength                     0
NonOctetAligneds                0
Overruns                        0         Controller:
NonmatchAddresses               0     CommandFaileds                  0
TooFewBuffers                   0     CommandTimeouts                 0
FrameEndNotSets                 0     LastCommand                     0
UnknownErrors                   0     Recovers                        0
QueueLength                     0
  Channel 1:   Slots: B2
    Receive:                              Transmit:
Frames                          0     Frames                          0
OverlengthFrames                0     Underruns                       0
UnderlengthFrames               0     LostInterrupts                  0
CRCErrors                       0     DescriptorErrors                0
Aborts                          0     QueueLength                     0
NonOctetAligneds                0
Overruns                        0         Controller:
NonmatchAddresses               0     CommandFaileds                  0
TooFewBuffers                   0     CommandTimeouts                 0
FrameEndNotSets                 0     LastCommand                     0
UnknownErrors                   0     Recovers                        0
QueueLength                     0
  D Channel:
    Receive:                              Transmit:
Frames                          0     Frames                          0
OverlengthFrames                0     Underruns                       0
UnderlengthFrames               0     LostInterrupts                  0
CRCErrors                       0     DescriptorErrors                0
Aborts                          0     QueueLength                     0
NonOctetAligneds                0
Overruns                        0         Controller:
NonmatchAddresses               0     CommandFaileds                  0
TooFewBuffers                   0     CommandTimeouts                 0
FrameEndNotSets                 0     LastCommand                     0
UnknownErrors                   0     Recovers                        0
QueueLength                     0
                                      HighPriorityFrames              0
                                      Collisions                      0
```

Figure 11-18: Example output from the **show bri counter=bri** command for a U interface

```
BRI instance 0:          3 seconds      Last change at:          0 seconds

Interface MIB Counters

    Receive:                                Transmit:
ifInOctets                        0     ifOutOctets                      0
ifInUcastPkts                     0     ifOutUcastPkts                   0
ifInNUcastPkts                    0     ifOutNUcastPkts                  0
ifInDiscards                      0     ifOutDiscards                    0
ifInErrors                        0     ifOutErrors                      0
ifInUnknownProtos                 0     ifOutQLen                        0

BRI Counters

IntActivationRequests             0     ExtActivationRequests            0
Activations                       0     ActivationFailures               1
TransparencyLosses                0     SynchronisationLosses            0
NetworkDeactivations              0     UnexpectedDeactivations          0
NearEndBlockErrors                0     FarEndBlockErrors                0

  Channel 0:   Slots: B1
    Receive:                                Transmit:
Frames                            0     Frames                           0
OverlengthFrames                  0     CTSLosts                         0
UnderlengthFrames                 0     Underruns                        0
CRCErrors                         0     LostInterrupts                   0
Aborts                            0     DroppedFrames                    0
NonOctetAligneds                  0     NoPackets                        0
Overruns                          0     QueueLength                      0
NonmatchAddresses                 0     Recovers                         0
Misseds                           0     SDMABusErrors                    0
TooFewBuffers                     0     CommandTimeouts                  0
QueueLength                       0     LastCommand                      0

  Channel 1:   Slots: B2
    Receive:                                Transmit:
Frames                            0     Frames                           0
OverlengthFrames                  0     CTSLosts                         0
UnderlengthFrames                 0     Underruns                        0
CRCErrors                         0     LostInterrupts                   0
Aborts                            0     DroppedFrames                    0
NonOctetAligneds                  0     NoPackets                        0
Overruns                          0     QueueLength                      0
NonmatchAddresses                 0     Recovers                         0
Misseds                           0     SDMABusErrors                    0
TooFewBuffers                     0     CommandTimeouts                  0
QueueLength                       0     LastCommand                      0

  D Channel:
    Receive:                                Transmit:
Frames                            0     Frames                           0
OverlengthFrames                  0     CTSLosts                         0
UnderlengthFrames                 0     Underruns                        0
CRCErrors                         0     LostInterrupts                   0
Aborts                            0     DroppedFrames                    0
NonOctetAligneds                  0     NoPackets                        0
Overruns                          0     QueueLength                      0
NonmatchAddresses                 0     Recovers                         0
Misseds                           0     SDMABusErrors                    0
TooFewBuffers                     0     CommandTimeouts                  0
QueueLength                       0     LastCommand                      0
HighPriorityFrames                0
```

Table 11-39: Parameters in the output of the **show bri counter=bri** command

Parameter	Meaning
BRI instance	The instance number of the BRI interface.
seconds	The current value of *sysUpTime*.
Last change at	The value of *sysUpTime* at which the interface was last initialised.
Interface MIB counters	**Counters from the interfaces table of the interfaces MIB**
ifInOctets	The number of octets received on this interface.
ifInUcastPkts	The number of unicast frames delivered to a higher layer protocol.
ifInNUcastPkts	The number of non-unicast frames delivered to a higher-layer protocol.
ifInDiscards	The number of inbound frames discarded though no errors were detected to prevent them being delivered to higher-layer protocols.
ifInErrors	The number of inbound frames that contained errors preventing them being delivered to a higher-layer protocol.
ifInUnknownProtos	The number of frames discarded because they were for an unconfigured protocol.
ifOutOctets	The number of octets transmitted, including framing.
ifOutUcastPkts	The number of unicast frames transmitted or discarded.
ifOutNUcastPkts	The number of non-unicast frames transmitted or discarded.
ifOutDiscards	The number of frames discarded though no errors had been detected preventing their being transmitted.
ifOutErrors	The number of frames not transmitted because of errors.
ifOutQLen	Length of output frame queue.
BRI counters	**Counters for the Basic Rate interfaces as a whole.**
ActivationRequests	The number of valid activation requests.
FramingViolations	The number of framing violations seen by the transceiver.
Activations	The number of S/T or U loop activations.
UnbalancedFrames	The number of unbalanced frames seen by the transceiver.
IntActivationRequests	The number of internally generated activation requests.
TransparencyLosses	The number of times data transparency through the U interface controller has been lost.
NetworkDeactivations	The number of times the U loop has been deactivated by the network.
NearEndBlockErrors	The number of U loop frame CRC errors detected.
ExtActivationRequests	The number of network generated activation requests.
ActivationFailures	The number of times an activation attempt has failed.
SynchronisationLosses	The number of times synchronisation with the network over the U loop has been lost.
UnexpectedDeactivations	The number of times the U interface has been deactivated without being initiated by the network.
FarEndBlockErrors	The number of CRC errors in U loop frames transmitted by the router and reported by the network.

Table 11-39: Parameters in the output of the **show bri counter=bri** command (cont.)

Parameter	Meaning
IOM Counters	**Counters for the IOM controller. Not displayed for U interfaces.**
Bytes	The number of bytes transmitted/received over the IOM bus.
Messages	The number of messages transmitted/received over the IOM bus.
Overlength messages	The number of overlength messages transmitted/received over the IOM bus.
Zero length messages	The number of zero length messages received over the IOM bus, or the number of zero length messages queued for transmission.
Protocol errors	The number of handshaking errors detected by the IOM bus controller while receiving a message.
Data buffer fulls	The number of times the buffer for characters received over the IOM bus has filled.
Message buffer fulls	The number of times the buffer for messages received over the IOM bus has filled.
Indication changes	The number of times the activation state of the transceiver has changed.
Excessive retries	The number of times a message has been retransmitted 8 times without success.
Internal errors	The number of times an attempt was made to transmit an IOM bus message while a transmission was already in progress.
Not readys	The number of times an attempt was made to transmit an IOM bus message but the IOM bus controller was not ready.
Aborts	The number of times the transceiver requested that the transmission of an IOM bus message be aborted.
Timeouts	The number of times the transmission of an IOM bus message failed because of a timeout.
D Channel, Channel *n*	**Counters for the D, B1 and B2 channels.**
Slots	The slot used by the associated channel.
Frames	The number of frames received/transmitted.
OverlengthFrames	The number of overlength frames received.
UnderlengthFrames	The number of frames discarded because they were too short.
CRCErrors	The number of frames received with a CRC error.
Aborts	The number of received frames terminated with an abort.
NonoctetAligneds	The number of non-octet aligned frames received.
Overruns	The number of frames lost due to a receive overrun.
NonmatchAddresses	The number of incoming frames rejected due to a non-matching address.
Misseds	The number of receive frames lost because lack of receive buffers.
TooFewBuffers	The number of received frames discarded because the number of buffers in the router had reached a critical level.

Table 11-39: Parameters in the output of the **show bri counter=bri** command (cont.)

Parameter	Meaning
FrameEndNotSets	The number of times a receive interrupt was signalled, but it was not for the Frame End condition. This indicates a hardware malfunction.
UnknownErrors	The number of times a receive error was signalled but the cause could not be determined. This indicates a hardware malfunction.
QueueLength	The length of the channel's receive/transmit queue.
Collisions	The number of times a frame had to be retransmitted on the D channel due to a collision.
CTSLosts	The number of frames during which the CTS input was negated.
Underruns	The number of times a frame had to be retransmitted due to a transmitter underrun.
LostInterrupts	The number of times the transmission or reception of a frame on the indicated channel had to be aborted due to no transmit/receive interrupt being received.
DroppedFrames	The number of frames discarded because the maximum transmit queue length was exceeded.
NoPackets	The number of times the 68302 or 68360 reported a transmit error, but there was no packet being transmitted or the packet in error could not be identified.
DescriptorErrors	The number of times a transmit descriptor error was signalled. This indicates a hardware malfunction.
Recovers	The number of times the HDLC or IOM controller was reset due to a serious error or a **reset bri** command on page 11-98.
SDMABusErrors	The number of bus errors experienced by the HDLC controller.
CommandTimeouts	The number of times a command to the Ethernet hardware did not complete before the timeout timer expired.
LastCommand	The code of the command that was to be issued when a command timeout was detected.
HighPriorityFrames	The number of D channel high priority frames transmitted.

Examples To display the interface counters for BRI interface 0, use the command:

```
show bri=0 counter=interface
```

Related Commands **reset bri counter**
show bri configuration

show bri ctest

Syntax `SHow BRI[=instance] CTest`

where *instance* is the number of the BRI interface

Description This command displays the settings of the conformance test switches. If the interface is not specified, the settings for all BRI interfaces are displayed (Figure 11-19 on page 11-130, Table 11-40 on page 11-130).

Figure 11-19: Example output from the **show bri ctest** command

```
CTest switches for BRI instance 0:

Number     Action                                  Status
-----------------------------------------------------
  1     Activation Request ....................... no
  2     Digital Loop ( loopback 4 ) ............. no
  3     B1, B2 channels transmit all zeroes ...... no
  4     D channel transmit high priority frames .. no
  5     D channel transmit low priority frames ... no
  6     B1 channel transmit fox frames ........... no
  7     B2 channel transmit fox frames ........... no
  8     D channel transmit single zero frames .... no
```

Table 11-40: Parameters in the output of the **show bri ctest** command

Test	Function
1	An activation request is issued to the transceiver that transmits INFO 1 to activate the S/T loop. The status of the test is reset to "no" once the loop activates or when the activate timer times out. This conformance test has no effect when the loop is already activated.
2	Data received by the BRI module for both B channel and the D channel from the S/T loop is retransmitted on the same channel. This corresponds to loopback 4 defined in Appendix I of ITU-T Recommendation I.430.
3	HDLC frames containing all zeroes is transmitted continuously on both B channels.
4	High priority HDLC frames containing a fox message are transmitted on the D channel continuously.
5	Low priority HDLC frames containing a fox message are transmitted on the D channel continuously.
6	HDLC frames containing a fox message are transmitted on the B1 channel continuously.
7	HDLC frames containing a fox message are transmitted on the B2 channel continuously.
8	HDLC frames containing bytes with one zero and seven ones are transmitted on the D channel continuously.

Examples To display the conformance tests current running on BRI interface 0, use the command:

```
show bri=0 ctest
```

Related Commands
disable bri ctest
enable bri ctest
disable bri test
enable bri test
show bri test

show bri debug

Syntax `SHow BRI[=`*`instance`*`] DEBug`

where *instance* is the number of the BRI interface

Description This command displays the settings of the debug switches. If the interface is not specified, the settings for all BRI interfaces are displayed (Figure 11-20 on page 11-131, Table 11-41 on page 11-131).

Figure 11-20: Example output from the **show bri debug** command

```
Debug switches for BRI instance 0:

Errors .......... no
Indications ..... no
State changes ... no
Events .......... no
```

Table 11-41: Parameters in the output of the S**how bri debug** command

Parameter	Meaning
Errors	A BRI software module internal error.
Indications	An indication from the layer 1 state machine to a higher layer or the management layer.
State changes	A change of state for the layer 1 state machine.
Events	An event that is an input to the layer 1 state machine.

Examples To display the state of debugging options for BRI interface 0, use the command:

```
show bri=0 debug
```

Related Commands
disable bri debug
enable bri debug

show bri state

Syntax `SHow BRI[=instance] STate`

where *instance* is the number of the BRI interface

Description This command displays information about the current state of the BRI interface. If the interface is not specified, the state of all BRI interfaces is displayed. The output varies depending on whether the BRI interface is an S/T interface (Figure 11-21 on page 11-132, Table 11-42 on page 11-132) or a U interface (Figure 11-22 on page 11-134, Table 11-44 on page 11-134).

Figure 11-21: Example output from the **show bri state** command for an S/T interface

```
State for BRI instance 0:

Interface type ..... TE
State .............. Activated
Rx INFO ............ INFO 4
Tx INFO ............ INFO 3
Activate request ... no
Activated .......... yes
Synchronised ....... yes
Activation mode .... normal
Mode ............... mixed
ISDN slots ......... B1
TDM slots .......... B2
D channel class .... high
B1 channel user..... PBX
B2 channel user..... PPP HDLC
B1, B2 aggregated... no
Rx multiframing .... no
```

Table 11-42: Parameters in the output of the **show bri state** command for an S/T interface

Parameter	Meaning
Interface type	The operational mode for the interface: TE or NT. The interface should be configured as an NT for manufacturers testing.
State	The state of the physical layer state machine. See Table 11-43 on page 11-133 for a list of valid states.
Rx INFO	The INFO signals currently being received from the NT by the interface. In normal operation the BRI transceiver receives INFO 4.
Tx INFO	The INFO signals currently being transmitted to the NT by the interface. In normal operation the BRI transceiver transmits INFO 3.
Activate request	Whether an activation request has been received from a higher layer and is being processed.
Activated	Whether the loop is activated.
Synchronised	Whether the TE is synchronised to the NT.

Table 11-42: Parameters in the output of the **show bri state** command for an S/T interface (cont.)

Parameter	Meaning
Activation mode	The activation mode of the interface; one of "normal" or "always". The latter may be required for semipermanent connections.
Mode	The mode of the interface; one of "ISDN", "TDM" or "mixed".
ISDN slots	The list of slots reserved for ISDN calls. Valid when the interface is not in TDM mode.
TDM slots	The list of slots reserved for TDM groups. Valid when the interface is not in ISDN mode.
D channel class	The current D channel priority class. This may vary from one D channel frame to the next.
B1/B2 channel user	The name of the higher layer module using the channel (or "none" if no higher layer module is using the channel), and for non-voice calls the layer 1 protocol in use (one of "HDLC" or "transparent").
B1, B2 aggregated	Whether the B channels are aggregated.
Rx multiframing	Whether the transceiver has detected multiframing in the data stream from the NT. The router does not currently support multiframing.

Table 11-43: States of the physical layer state machine for an ISDN Basic Rate S/T Interface

State	Meaning
Inactive	Power has not been applied to the interface. This state should never be seen.
Sensing	The initial state at power-on, before the S/T transceiver has determined what signal it is receiving.
Deactivated	The transceiver is receiving INFO 0 from the NT.
Awaiting Signal	A transitory state entered when the transceiver has been given an activation request.
Identifying Input	This state is entered from Awaiting Signal when the transceiver has detected a signal but has not yet determined the INFO signal.
Synchronized	This state is entered when the transceiver is receiving INFO 2 from the NT, i.e. it has synchronised to the NT.
Activated	This is the normal operational state. The transceiver is receiving INFO 4 from the NT.
Lost framing	This state is entered if the transceiver loses synchronisation with the signal transmitted by the NT.

Figure 11-22: Example output from the **show bri state** command for a U interface

```
State for BRI instance 0:

Interface type ..... TE
State .............. Active
Activate request ... no
Activated .......... yes
Synchronised ....... yes
Transparent ........ yes
Activation mode .... normal
EOC message ........ broadcast command - return to normal
Maintenance mode ... none
Mode ............... mixed
ISDN slots ......... B1
TDM slots .......... B2
D channel class .... high
B1 channel user..... PBX
B2 channel user..... PPP HDLC
B1, B2 aggregated... no
```

Table 11-44: Parameters in the output of the **show bri state** command for a U interface

Parameter	Meaning
Interface type	The operational mode for the interface; one of "TE" or "LT". The LT option appears for a special test mode of some hardware models.
State	The state of the physical layer state machine. See Table 11-45 on page 11-135 for a list of valid states.
Activate request	Whether an activation request has been received from a higher layer and is being processed; one of "yes" or "no".
Activated	Whether the loop is activated; one of "yes" or "no".
Synchronised	Whether the TE is synchronised to the LT; one of "yes" or "no".
Transparent	Whether the U interface transceiver is passing data between the router and the network; one of "yes" or "no".
Activation mode	The activation mode of the interface; always "normal".
EOC message	The message most recently received over the Embedded Operations Channel from the network.
Mantenance mode	The maintenance mode of the interface; one of "none", "Quiet", or "Insertion Loss Test Mode".
Mode	The mode of the interface; always "ISDN" (TDM mode is not available on U interfaces).
ISDN slots	The list of slots reserved for ISDN calls.
B1/B2 channel user	The name of the higher layer module using the channel (or "none" if no higher layer module is using the channel), and for non-voice calls the layer 1 protocol in use (one of "HDLC" or "transparent").
B1, B2 aggregated	Whether the B channels are aggregated; one of "yes" or "no".

Table 11-45: States of the physical layer state machine for an ISDN Basic Rate U Interface

State	Meaning
Deactivated	The U loop is idle, no signals are being received or transmitted.
Activating	The U loop is in the process of activation, this may take up to 15 seconds.
Pending active	The router and the LT have synchronised to one another, the router is waiting to receive “act”=1 from the LT.
Active	The U loop is active, the normal operational state.
Pending deactivated	The router has received “dea”=0 from the LT and is waiting for the U loop to be completely deactivated (no signal received).

Examples To display information about the current state of BRI interface 0, use the command:

```
show bri=0 state
```

Related Commands **show bri configuration**
show bri counter

show bri test

Syntax `SHow BRI[=`*`instance`*`] TEst`

where *instance* is the number of the BRI interface

Description This command displays the settings of the test switches. If the interface is not specified, the settings for all BRI interfaces are displayed. See the following for example output from:

- an S/T interface (Figure 11-23, Table 11-23)
- a U interface (Figure 11-24, Table 11-47 on page 11-137).

Figure 11-23: Example output from the **show bri test** command for an S/T interface

```
Test switches for BRI instance 0 (MC145574 transceiver):

Number     Action                                     Status
------------------------------------------------------------
  1     Transceiver B1 GCI Transp Loop ........... no
  2     Transceiver B2 GCI Transp Loop ........... no
  3     Transceiver 2B+D GCI Transp Loop ......... no
  4     Transceiver B1 GCI Non-Transp Loop ....... no
  5     Transceiver B2 GCI Non-Transp Loop ....... no
  6     Transceiver B1 S/T Transp Loop ........... no
  7     Transceiver B2 S/T Transp Loop ........... no
  8     Transceiver B1 S/T Non-Transp Loop ....... no
  9     Transceiver B2 S/T Non-Transp Loop ....... no
 10     Transceiver External S/T Loop ............ no
 11     Transceiver 96kHz Test Tone .............. no
 12     Transceiver Force Activation ...... ...... no
 13     Transceiver Ignore D Channel Procs ....... no
 14     Transceiver Map E Channel to GCI ......... no
 15     Transceiver GCI Free Run ................. no
```

Table 11-46: ISDN Basic Rate Interface test modes for S/T interfaces

Test	Function
1	The transceiver loops B1 channel data from the router back to the router, and also transmits the B1 data on the S/T loop.
2	The transceiver loops B2 channel data from the router back to the router, and also transmits the B2 data on the S/T loop.
3	The transceiver loops all data (B1, B2, and D) from the router back to the router, and also transmits the data on the S/T loop.
4	The transceiver loops B1 channel data from the router back to the router, and transmits idles on the S/T loop in place of the B1 data.
5	The transceiver loops B2 channel data from the router back to the router, and transmits idles on the S/T loop in place of the B2 data.
6	The transceiver loops B1 channel data received from the S/T loop back to the S/T loop, and also passes the B1 data to the router.
7	The transceiver loops B2 channel data received from the S/T loop back to the S/T loop, and also passes the B2 data to the router.
8	The transceiver loops B1 channel data received from the S/T loop back to the S/T loop, and passes idles to the router in place of the B1 data.

Table 11-46: ISDN Basic Rate Interface test modes for S/T interfaces

Test	Function
1	The transceiver loops B1 channel data from the router back to the router, and also transmits the B1 data on the S/T loop.
9	The transceiver loops B2 channel data received from the S/T loop back to the S/T loop, and passes idles to the router in place of the B2 data.
10	The transceiver receives and demodulates its own transmitted data when the transmit pair is connected to the receive pair at the interface connector. Tests 12 and 15 do not have to be enabled.
11	A 96kHz test tone (continuous alternating pulses) is transmitted on the S/T loop.
12	The transceiver is forced into the highest INFO state, i.e. the transceiver transmits INFO 4 for a TE or INFO 3 for a NT.
13	The transceiver transmits without regard for the D channel contention procedures governing transmission. This test is applicable to a TE only.
14	The transceiver passes E channel data to the router in place of the D channel data received from the NT. This test is applicable to a TE only.
15	The transceiver clocks the GCI bus even if it is not able to derive a clock from the S/T loop. This test is applicable to a TE only.

Figure 11-24: Example output from the **show bri test** command for a U interface

```
Test switches for BRI instance 0(MC145572 rev 03 transceiver):

Number     Action                               Status
------------------------------------------------------
  1     Force reset ............................ no
  2     Force SN3 .............................. no
  3     Enable analogue loopback ................ no
  4     Enable 2B+D test access port ............ no
  5     B1 both direction loopbacks ............. no
  6     B2 both direction loopbacks ............. no
  7     2B+D both direction loopbacks ........... no
  8     Activated LED on tx SN3 ................. no
  9     Simulate LT mode ........................ no
```

Table 11-47: ISDN Basic Rate Interface test modes for U interfaces

Test	Function
1	Force a reset of the transceiver so that it enters quiet mode and does not transmit on the U loop.
2	Force the transceiver to transmit SN3 (standard framed, scrambled signal) on the U loop.
3	Enable an analogue loopback so that the router receives the data it transmits.
4	Enable the internal 2B + D test access port.
5	Enable a loopback of the B1 channel data on the U loop towards the U loop and data transmitted by the router back to the router.
6	Enable a loopback of the B2 channel data on the U loop towards the U loop and data transmitted by the router back to the router.
7	Enable a loopback of the B1, B2 and D channel data on the U loop towards the U loop and data transmitted by the router back to the router.

Table 11-47: ISDN Basic Rate Interface test modes for U interfaces (cont.)

Test	Function
8	Turn the activated LED on as soon as SN3 is transmitted to the LT, rather than when "act"=1 is received.
9	The interface acts as if it is an LT.

Examples To display the tests running on BRI interface 0, use the command:

```
show bri=0 test
```

Related Commands

disable bri ctest
enable bri ctest
disable bri test
enable bri test
show bri ctest

show isdn call

Syntax `SHow ISDN CALL[={acnum|name}]`

where:

- *acnum* is the index of an active ISDN call.
- *name* is an ISDN call name 1 to 15 characters long that is not case-sensitive. Valid characters are uppercase and lowercase letters, decimal digits (0–9), and underscore ("_"). It is **not** case-sensitive.

Description This command displays information about ISDN call definitions and active calls. If an active call number or call name is not specified, summary details of all ISDN call definitions and active calls are displayed (Figure 11-25 on page 11-139, Table 11-48 on page 11-139). If an active call number or call name is specified, detailed information about the particular active call or call definition is displayed (Figure 11-26 on page 11-140, Table 11-49 on page 11-140).

Figure 11-25: Example output from the **show isdn call** command

```
ISDN call details
Name              Number             Remote call       State          Precedence
----------------------------------------------------------------------------
HeadOffice        3432114            Regional          (E) IN & OUT   IN
----------------------------------------------------------------------------

ISDN active calls
Index   Name                 Interface    User      State  Prec
------------------------------------------------------------
   0    HeadOffice              BRI0       03-00     ON     No
------------------------------------------------------------
```

Table 11-48: Parameters in the output of the **show isdn call** command

Parameter	Meaning
ISDN call details	Information about all defined ISDN calls.
Name	The name of the ISDN call.
Number	The number to call.
Remote call	The remote call name.
State	The state of this call definition; one of "(E)" (enabled) or "(D)" (disabled), and the directions for which the call is enabled.
Precedence	For call definitions, the direction of precedence of the call.
ISDN active calls	Information about active ISDN calls.
Index	A number identifying an active ISDN call.
Interface	The ISDN interface used for the call.
User	The module and instance of the higher layer module using the call.
State	The state of the active call; one of "ON", "TRY" or "WAIT".
Prec	For active calls, whether this call actually has precedence.

Figure 11-26: Example output from the **show isdn call** command for a specific call name

```
Call name ................. HeadOffice
Enabled ................... Yes
Remote call ............... Regional
Called number ............. 3432114
Calling number ............ -
Calling subaddress ........ -
Direction ................. IN & OUT
Precedence ................ IN
Required interface ........ NONE
Preferred interface ....... NONE
Data rate ................. 64k
Use Data Over Voice ....... No
Priority .................. 50
Bump delay ................ 5
Holdup time ............... 0s
Max call duration ......... 241s
Keep call up .............. No
Call back ................. No
Call back delay ........... 41
RN1 (retries per group) ... 0
RT1 (between retries) ..... 30s
RN2 (retry groups) ........ 0
RT2 (between groups) ...... 600s
Alternate number .......... -
Out called subaddress ..... Remote name
Out user data ............. -
Out CLI ................... -
In called sub search ...... Local name
In called sub check ....... -
In user data search ....... -
In user data check ........ -
In CLI search ............. No
In CLI check .............. -
In CLI list ............... none
Match any call ............ No
User type ................. ATTACH
  PPP template ............ Default
Login type ................ RADIUS server
Login user name ........... none
Login password ............ none

Number of attachments ..... 1
User module ............... PPP
Attachment ................ 0
```

Table 11-49: Parameters in the output of the **show isdn call** command for a specific call name

Parameter	Meaning
Call name	The name of the ISDN call.
Enabled	Whether the call is enabled; one of "Yes" or "No".
Remote call	The remote call for this call.
Called number	The number called for this call.
Calling number	The number called from for this call.
Calling subaddress	The subaddress called from for this call.
Direction	The directions for which the call is enabled.

Table 11-49: Parameters in the output of the **show isdn call** command for a specific call name (cont.)

Parameter	Meaning
Precedence	The direction of precedence for this call.
Required interface	The required interface for this call.
Preferred interface	The preferred interface for this call.
Data rate	The data rate to use when making an outgoing call with this call; one of “56K” or “64K”.
Use Data Over Voice	Whether the call setup message for this call specifies voice bearer capability or data bearer capability; one of “Yes” (voice bearer) or “No” (data bearer).
Priority	The priority of this call.
Bump delay	The delay, in tenths of a second, between a call being initiated and the required Q.931 response, if another call must be bumped to allow this call to proceed.
Holdup time	The minimum time, in seconds, that the call is held up before being dropped.
MaxDuration time	The maximum time/duration in seconds that the call exists before being terminated.
Keep call up	Whether this call is to be kept up always.
Call back	Whether the router should hang up the incoming call and call back when this call is selected.
Call back delay	The delay, in tenths of a second, before calling back, if call back is enabled.
RN1	The number of retries in a retry group.
RT1	The time, in seconds, between retries in a retry group.
RN2	The number of time the retry group is repeated.
RT2	The time, in seconds, between repeats of the retry group.
Alternate number	The alternate number dialled when retries have failed.
Out called subaddress	The format of the called party subaddress IE in the outgoing SETUP message. This is set to the call's name or remote call name with the OUTSUB parameter, or set to an arbitrary sequence of digits with the SUBADDRESS parameter.
Out user data	The format of the user–user data IE in the outgoing SETUP message.
Out CLI	The format of the calling party number IE (CLI) in the outgoing SETUP message.
In called sub search	How to use the called party subaddress IE in incoming SETUP messages in searching for this call.
In called sub check	How to use the called party subaddress IE in incoming SETUP messages in checking this call.
In user data search	How to use the user–user data IE in incoming SETUP messages in searching for this call.
In user data check	How to use the user–user data IE in incoming SETUP messages in checking this call.
In CLI search	Whether to use the CLI in incoming SETUP messages to search for this call.

Table 11-49: Parameters in the output of the **show isdn call** command for a specific call name (cont.)

Parameter	Meaning
In CLI check	How to use the CLI in incoming SETUP messages to check this call.
In CLI list	The index of the CLI list to use, if required, for checking CLI against this call.
Match any call	Whether this call can be used to answer any incoming call, if no other call has already been found to match the incoming call.
User type	The way that users attach to this ISDN call. One of "ATTACH" (users attach explicitly) or "PPP" (a dynamic PPP interface is created).
PPP template	The PPP template to use when creating a dynamic PPP interface, or "Default" if the default PPP template is used.
Login type	The method of authentication for incoming calls.
Login username	The source of the username in login procedures.
Login password	The source of the password in login procedures.
Number of attachments	The number of attachments from higher layer modules for this call.
User module	The higher layer module that is attached to this call.
Attachment	The instance number (for the higher layer module) for this attachment. This line may be repeated.

Examples To display the configuration of ISDN call "Region-1", use the command:

```
show isdn call="region-1"
```

Related Commands

activate isdn call
add isdn call
deactivate isdn call
delete isdn call
disable isdn call
enable isdn call
set isdn call

show isdn clilist

Syntax SHow ISDN CLIList[=0..99]

Description This command displays a specified CLI list or all CLI lists, if no list is specified (Figure 11-27 on page 11-143, Table 11-50 on page 11-143). The numbers in CLI lists are ordered as they are added to the list, a fact reflected in the display of the list.

Figure 11-27: Example output from the **show isdn clilist** command

```
ISDN CLI list 0
Total fails: 5
Number                                  Matches
--------------------------------------------
045660234                                    12
3432115                                       1
--------------------------------------------

ISDN CLI list 1
Total fails: 104
Number                                  Matches
--------------------------------------------
3430803                                     124
3430804                                      59
--------------------------------------------
```

Table 11-50: Parameters in the output of the **show isdn clilist** command

Parameter	Meaning
ISDN CLI list	The index of the ISDN CLI list being displayed.
Total fails	The number of times a number being checked against this list was not matched by any number in the list.
Number	The ISDN phone number for this entry in the CLI list.
Matches	The number of times a number being checked against this CLI list matched this number.

Examples To display all CLI lists, use the command:

```
show isdn clilist
```

Related Commands **add isdn clilist**
delete isdn clilist

show isdn domainname

Syntax SHow ISDN DOMainname

Description This command displays the domain name to be used for ISDN DNS lookups. Only one ISDN domain name may be defined (Figure 11-28 on page 11-144).

Figure 11-28: Example output from the **show isdn domainname** command

```
The ISDN default domain name is: sales.southern.com
```

Related Commands

add isdn domainname
delete isdn domainname
set isdn domainname

show isdn log

Syntax SHow ISDN LOG

Description This command displays the current contents of the call log (Figure 11-29 on page 11-145, Table 11-51 on page 11-145). The call logging facility records details of events associated with ISDN calls. Log entries are sorted according to the time the call was initiated. An entry is added to the log when a call is initiated. When the log exceeds a predefined maximum length, the oldest entry that is in the CLEARED state is removed from the log. If no entries qualify the log is allowed to grow larger than the maximum defined length. Log messages can be sent to an asynchronous port on the router when the log entry enters the CLEARED state.

The Q.931 cause code displayed in the *Cause* field of the output is returned by the ISDN network to the router each time a call is cleared, and can be used in debugging ISDN interconnection problems. See "ISDN Q.931 Call Clearance Cause Codes" on page B-9 of Appendix B, Reference Tables for a list of cause codes and their meanings for Q.931 call control profiles currently supported by the router. Not all cause codes are supported by all ISDN service providers.

Figure 11-29: Example output from the **show isdn log** command

```
Call Name         Start Time               Duration Dir Number           Cause
-------------------------------------------------------------------------------
HeadOffice        02-Mar-1995 17:46:38     CLEARED  OUT 3432114         N34,-
HeadOffice        02-Mar-1995 17:46:38     CLEARED  OUT 3432114         N34,-
HeadOffice        02-Mar-1995 17:46:38     CLEARED  IN                  U88,113
HeadOffice        02-Mar-1995 17:46:38     CLEARED  IN                  U88,113
HeadOffice        02-Mar-1995 17:48:22     0:03:25  OUT 3432114         U16,-
HeadOffice        02-Mar-1995 17:55:18     0:05:06  IN                  U16,-
HeadOffice        02-Mar-1995 17:55:18     0:05:06  IN                  U16,-
HeadOffice        02-Mar-1995 18:02:08     0:01:13  IN                  U16,-
HeadOffice        02-Mar-1995 18:02:08     0:01:13  IN                  U16,-
HeadOffice        02-Mar-1995 18:16:56     0:01:49  OUT 3432114         U16,-
HeadOffice        02-Mar-1995 18:16:56     0:01:49  OUT 3432114         U16,-
HeadOffice        03-Mar-1995 08:55:54     0:03:30  OUT 3432114         U16,-
HeadOffice        03-Mar-1995 08:55:54     0:03:30  OUT 3432114         U16,-
-------------------------------------------------------------------------------
No ISDN logging port defined.
```

Table 11-51: Parameters in the output of the **show isdn log** command

Parameter	Meaning
Call Name	The name of the call.
Start Time	The date and time the call was initiated.
Duration	The length of the call for a call that has been completed, or one of "INITIAL" (the call is being set up), "ACTIVE" (the call is still active), "DISCONNECT" (the call is being disconnected) or "CLEARED" (the call was cleared before becoming active).
Dir	The direction of the call; one of "OUT" or "IN".
Number	The number being called.
Cause	The reason the call was disconnected. The first character is a "U" (disconnected by user) or an "N" (disconnected by network), followed by the Q.931 cause code and (for some causes) Q.931 diagnostic code.

Examples To display the ISDN call log, use the command:

```
show isdn log
```

Related Commands

disable isdn log
disable q931 debug
enable isdn log
enable q931 debug
set isdn log

show lapd

Syntax `SHow LAPD[=interface]`

where *interface* is a slotted interface number (0, 1, 2,...)

Description This command displays general information about LAPD interfaces (Figure 11-30 on page 11-147 and Figure 11-31 on page 11-148, Table 11-52 on page 11-148).

Figure 11-30: Example output from the **show lapd** command for a Basic Rate Interface

```
Interfaces:
ISDN    Type    TEI Mode    Debug    TEI    NAS mode    NAS master
----------------------------------------------------------------------
BRI0      TE   automatic      off    066    Normal      -
                                     064
----------------------------------------------------------------------

SAPs:
ISDN    SAPI    T200   T201   T202   T203   N200   N201   N202   k
--------------------------------------------------------------------
BRI0     063   000010 000010 000020 000100 000003 000260 000003 001
         000   000010 000010 000020 000100 000003 000260 000003 001
--------------------------------------------------------------------

DLCs:
ISDN  SAPI  CES  TEI  State   V(S)   V(A)  rxN(S)  V(R)  rxN(R)
--------------------------------------------------------------------
BRI0   063  000  127  bcast     -      -      -      -      -
       000  000  127  bcast     -      -      -      -      -
            001  066  ALIVE   0038   0038   0002   0003   0038
            002  064  ALIVE   0039   0039   0000   0001   0039
--------------------------------------------------------------------

Packet parameters:
--------------------------------------------------------------------
BRI0
    Packet mode TEIs:  1
    Packet mode SPIDs: -
--------------------------------------------------------------------
```

Figure 11-31: Example output from the **show lapd** command for a Primary Rate Interface

```
Interfaces:
ISDN    Type    TEI Mode    Debug    TEI    NAS mode    NAS master
----------------------------------------------------------------------
PRI0      TE     nonAuto      off    000    Normal      -
PRI0      TE     nonAuto      off    000    Normal      -
----------------------------------------------------------------------
SAPs:
ISDN    SAPI    T200   T201   T202   T203   N200   N201   N202   k
--------------------------------------------------------------------
PRI0     063  000010     -      -  000100 000003 000260     -  007
         000  000010     -      -  000100 000003 000260     -  007
PRI1     063  000010     -      -  000100 000003 000260     -  007
         000  000010     -      -  000100 000003 000260     -  007
--------------------------------------------------------------------
DLCs:
ISDN  SAPI  CES  TEI  State   V(S)   V(A) rxN(S)   V(R) rxN(R)
--------------------------------------------------------------------
PRI0   063  000  127  bcast      -      -      -      -      -
       000  000  000  ALIVE   0021   0021   0076   0077   0021
PRI0   063  000  127  bcast      -      -      -      -      -
       000  000  000  ALIVE   0014   0014   0051   0052   0014
--------------------------------------------------------------------
Packet parameters:
--------------------------------------------------------------------
PRI0
Packet mode TEIs:  -
Packet mode SPIDs: -
PRI1
Packet mode TEIs:  -
Packet mode SPIDs: -
--------------------------------------------------------------------
```

Table 11-52: Parameters in the output of the **show lapd** command

Parameter	Meaning
ISDN	The name of the ISDN interface.
Type	The operating mode of the interface; one of "TE" or "NT". The normal operating mode is TE, so NT should not appear.
TEI Mode	The TEI assignment mode; one of "Automatic" or "nonAuto".
Debug	The state of debugging; one of "off", "state", "pkt" or "st+pkt".
TEI	The Terminal Endpoint Identifier.
NAS mode	Non-associated signalling mode or common D channel mode. One of "Normal" (this interface's D channel does the signalling for this interface and no other interface), "Master" (this interface's D channel does the signalling for this interface and other interfaces) or "Slave" (another interface's D channel does the signalling for this interface).
NAS master	Non-associated signalling or common D channel master interface. If this interface's NAS mode is "Slave", the NAS master gives the interface whose D channel provides the signalling channel for this interface. If the NAS mode is "Normal" or "Master", this field contains "-".
SAPI	The Service Access Point Identifier.
T20x	The value of timer T20x (in tenths of a second).
N20x	The value of counter N20x.
k	The value for K.

Table 11-52: Parameters in the output of the **show lapd** command (cont.)

Parameter	Meaning
CES	The Connection Endpoint Suffix.
State	The state of the DLC; one of “ALIVE”, “DEAD” or “bcast”. bcast links have only a single state. For other links the state is ALIVE if the link can be used by higher protocol layers, or DEAD if it cannot be used by higher protocol layers.
V(S)	The value of the internal V(S) count.
V(A)	The value of the internal V(A) count.
rxN(S)	The Number Sent count in the last received packet.
V(R)	The value of the internal V(R) count.
rxN(R)	The Number Received count in the last received packet.
Packet parameters	Parameters for X.25 packet mode operation
Packet mode TEIs	TEIs that have been configured for the use of X.25 over LAPD.
Packet mode SPIDs	Indices of SPIDs that are available for use by X.25 over LAPD.

Examples To display the configuration of LAPD interface 0, use the command:

```
show lapd=0
```

Related Commands show lapd count
show lapd state

show lapd count

Syntax SHow LAPD[=*interface*] COUnt

where *interface* is a slotted interface number (0, 1, 2,...)

Description This command displays the LAPD MIB counters for the ISDN interface and for each DLC of each SAP. If the interface is not specified, the MIB counters for all ISDN interfaces are displayed (Figure 11-32 on page 11-150, Table 11-53 on page 11-150).

Figure 11-32: Example output from the **show lapd count** command

```
ISDN    BRI0

Total Receive                   Total Transmit
  InOctets:        0000091114     OutOctets:         0000483389
  InUcastPkts:     0000000000     OutUcastPkts:      0000000150
  InNUcastPkts:    0000000000     OutNUcastPkts:     0000000000
  InDiscards:      0000000000     OutDiscards:       0000000000
  InErrors:        0000000000     OutErrors:         0000000000
  InUnknownProtos: 0000000000

ISDN    BRI0
SAPI    063
CES     000

Receive                         Transmit
  I Frames:        0000000000     I Frames:          0000000000
  UI Frames:       0000000002     UI Frames:         0000000001
  RR Frames:       0000000000     RR Frames:         0000000000
  RNR Frames:      0000000000     RNR Frames:        0000000000
  REJ Frames:      0000000000     REJ Frames:        0000000000
  SABME Frames:    0000000000     SABME Frames:      0000000000
  DM Frames:       0000000000     DM Frames:         0000000000
  DISC Frames:     0000000000     DISC Frames:       0000000000
  UA Frames:       0000000000     UA Frames:         0000000000
  FRMR Frames:     0000000000     FRMR Frames:       0000000000
  XID Frames:      0000000000     XID Frames:        0000000000

Errors
  ?:  00000000    A:  00000000    B:  00000000    C:  00000000
  D:  00000000    E:  00000000    F:  00000000    G:  00000000
  H:  00000000    I:  00000000    J:  00000000    K:  00000000
  L:  00000000    M:  00000000    N:  00000000    O:  00000000
```

Table 11-53: Parameters in the output of the **show lapd count** command

Parameter	Meaning
ISDN	The name of the ISDN interface.
SAPI	The Service Access Point Identifier.
CES	The Connection Endpoint Suffix.
Total Receive	Number of frames received by the LAPD interface.
Total Transmit	Number of frames transmitted by the LAPD interface.
Receive	Number of frames received by the DLC.
Transmit	Number of frames transmitted by the DLC.
Errors	The number of times each error type has occurred.

Examples To display the counters for LAPD interface 0, use the command:

```
show lapd=0 count
```

Related Commands show lapd
show lapd state

show lapd state

Syntax `SHow LAPD[=`*`interface`*`] STAte`

where *interface* is a slotted interface number (0, 1, 2,...)

Description This command displays the current and previous state of each DLC on the ISDN interface (Figure 11-33 on page 11-151, Table 11-54 on page 11-151).

Figure 11-33: Example output from the **show lapd state** command

```
lapdCount 25045

ISDN  SAPI  CES  TEI   state  -  oldState
------------------------------------------------------------------------------
BRI0   063  000  127   bcast(1 - 1)
       000  000  127   bcast(1 - 1)
            001  064   LAPD_ESTABLISHED(7) - LAPD_TIMER_RECOV(8)
------------------------------------------------------------------------------
```

Table 11-54: Parameters in the output of the **show lapd state** command

Parameter	Meaning
ISDN	The name of the ISDN interface.
SAPI	The Service Access Point Identifier.
CES	The Connection Endpoint Suffix.
TEI	The Terminal Endpoint Identifier.
State	The current state of the DLC state machine.
oldState	The previous state of the DLC state machine.

Examples To display state information for LAPD interface 0, use the command:

```
show lapd=0 state
```

Related Commands show lapd
show lapd count

show pri configuration

Syntax `SHow PRI[=`*`instance`*`] CONfiguration`

where *instance* is the number of the PRI interface

Description This command shows the higher layer modules (if any) that have been attached to the PRI interface (Figure 11-34 on page 11-152, Table 11-55 on page 11-152).

Figure 11-34: Example output from the **show pri configuration** command

```
Configuration for PRI instance 0:


  Channel 1:   Slots: 1
Module ...................... PPP
Module instance identifier .. 00000000
Bandwidth .................. 64 kbits/s


  D Channel:   Slot: 16
Module ...................... LAPD
Module instance identifier .. 00000001
Bandwidth .................. 64 kbits/s

  Unused slots: 2-15,17-31
```

Table 11-55: Parameters in the output of the **show pri configuration** command

Parameter	Meaning
Channel	The channel identifier.
Slot	The slots assigned to the channel.
Module	The module attached to the channel.
Module instance identifier	The module instance identifier is used to relate the channel number to a higher layer module instance.
Bandwidth	The effective bandwidth of the channel.
Unused slots	The slots that have not being assigned to any channel.

Examples To display the configuration of PRI interface 0, use the command:

```
show pri=0 configuration
```

Related Commands show pri counter
show pri state

show pri counter

Syntax

```
SHow PRI[=instance] COUnter[={DIAGnostic|INTerface|LINk|
    PRI}] [CHANnel=channel] [HIStory[=interval]] [{NEAR|
    FAR|BOTH}]
```

where:

- *instance* is the number of the PRI interface.
- *channel* is a channel identifier, either "D" or a number from 0 to 31.
- *interval* is a number from 1 to 96 identifying a 15 minute time interval from the past 24 hours. If the router has been rebooted within the last 24 hours, then not all interval numbers are valid.

Description

This command displays the MIB counters associated with the PRI interface. If the interface is not specified, the MIB counters for all PRI interfaces are displayed. If a counter category is not specified, all counters except the link history counters are displayed.

If **diagnostic** is specified, hardware error counters and diagnostic information relevant to the operation of the PRI software module are displayed. The output varies depending on whether the interface uses a SCC- or QMC-type HDLC controller (Figure 11-36 on page 11-155, Table 11-57 on page 11-155). The SCC- and QMC-type HDLC controllers do not maintain diagnostic counters for each channel. If a channel is also specified, diagnostic counters for the specified channel are displayed. For a T1-ESF interface with the Data Link operating in message oriented mode counters relevant to the Data Link are displayed (Figure 11-35 on page 11-153, Table 11-56 on page 11-154).

Figure 11-35: Example output from the **show pri counter=diagnostic** command for a T1-ESF interface operating in message-oriented mode

```
PRI instance 0:       1544 seconds      Last change at:       1499 seconds

Interface-global Diagnostic Counters

  Device Independent Diagnostic Counters

EventQueueFulls                  0

Data Link counters

    Receive:                                Transmit:
Bytes                         10439     Bytes                     260
Messages                         19     Messages                   20
FIFOOverflows                     0     FIFOUnderruns               0
UnderlengthMessages               0     DiscardedMessages           0
OverlengthMessages                0
UnrecognisedMessages              0
Aborts                            0
Errors                            0
```

Table 11-56: Parameters in the output of **show pri counter=diagnostic** command for a T1-ESF interface operating in message-oriented mode

Parameter	Meaning
PRI instance	The instance number of the PRI interface.
seconds	The current value of sysUpTime.
Last change at	The value of sysUpTime at the time the interface entered its current operational state.
EventQueueFulls	The number of times the queue of events for the layer 1 state machine has become full. This could occur if very many events are occurring in a short time period due to an unstable link.
Bytes	The number of bytes received/transmitted over the T1-ESF Data Link.
Messages	The number of messages received/transmitted over the T1-ESF Data Link.
FIFOOverflows	The number of messages lost due to a receiver overrun, possibly due to router overload.
UnderlengthMessages	The number of received messages discarded because they were less than 6 bytes long, possibly an artifact of changing from bit-patterned to message oriented mode.
OverlengthMessages	The number of received messages discarded because they were longer than a receive buffer, possibly an artifact of changing from bit-patterned to message oriented mode.
UnrecognisedMessages	The number of received messages discarded because they were neither a T1.403 Performance Report Message nor a AT&T 54016 request.
Aborts	The number of received messages terminated in an abort, possibly due to noise on the line.
Errors	The number of received messages discarded due to a FCS error or because they were not an integral number of octets, possibly due to noise on the line.
FIFOUnderruns	The number of times a message had to be retransmitted due to a transmitter underrun, possibly due to router overload.
DiscardedMessages	The number of messages waiting to be transmitted that were discarded when the interface was reset.

If **interface** is specified, the counters from the interfaces table of the interfaces MIB relating to the PRI are displayed (Figure 11-37 on page 11-156, Table 11-58 on page 11-156).

The **channel** parameter is not valid for the **interface** category as the counters refer to the interface as a whole.

If **link** is specified, the counters stored in the enterprise MIBs related to the performance of the link during the current 15 minute interval and over the past 24 hours are displayed (Figure 11-38 on page 11-157, Figure 11-39 on page 11-157, Figure 11-40 on page 11-158, Table 11-59 on page 11-158). If **near, far**, or **both** is specified, then the link counters for this end, the far end, or both ends of the link respectively, are displayed. These parameters can be specified with the **link** parameter. Counters for the far end of the link are not available for T1-SF and E1-noCRC framing options or if the T1-ESF Data Link is operating in the AT&T 54016 or bit-patterned modes. The default is **both**.

If **pri** is specified, the counters stored in the enterprise MIB that are relevant to the channels of a Primary Rate interface are displayed. If a channel is also specified, PRI counters for the specified channel are displayed (Figure 11-41 on page 11-160, Table 11-60 on page 11-160).

If **history** is specified then the link counters for the preceding 96 15-minute intervals are displayed. If an interval is specified, then counters for that interval are displayed. Only the **link** counter category may be specified with the **history** parameter. If the router has been rebooted within the last 24 hours, then counters for fewer than 96 time intervals are displayed. If a time interval number is specified, then counters for that interval are displayed (Figure 11-42 on page 11-161, Figure 11-43 on page 11-162, Figure 11-44 on page 11-162, Table 11-59 on page 11-158).

Figure 11-36: Example output from the **show pri counter=diagnostic** command for an interface using an SCC- or QMC-type HDLC controller

```
PRI instance 0:          69 seconds      Last change at:          0 seconds

Interface-global Diagnostic Counters

  Device Independent Diagnostic Counters

EventQueueFulls                   0


Channel Counters

Channel 1:   Slots: 1

  No Device Dependent Diagnostic Counters for this channel
```

Table 11-57: Parameters in the output of the **show pri counter=diagnostic** command for an interface using an SCC- or QMC-type HDLC controller

Counter	Meaning
PRI instance	The instance number of the PRI interface.
seconds	The current value of sysUpTime.
Last change at	The value of sysUpTime at the time the interface entered its current operational state.
EventQueueFulls	The number of times the queue of events for the layer 1 state machine has become full.
Channel	The channel number allocated by the driver for the channel to which the counters apply; channel number 0 is used for the ISDN D channel.
Slot	The number/s of the slot/s in use by the channel.

Figure 11-37: Example output from the **show pri counter=interface** command

```
PRI instance 0: Time:        308 seconds    Last change at:          0 seconds

Interface MIB Counters

    Receive:                                    Transmit:
ifInOctets                        0     ifOutOctets                       0
ifInUcastPkts                     0     ifOutUcastPkts                    0
ifInNUcastPkts                    0     ifOutNUcastPkts                   0
ifInDiscards                      0     ifOutDiscards                     0
ifInErrors                        0     ifOutErrors                       0
ifInUnknownProtos                 0     ifOutQLen                         0
```

Table 11-58: Parameters in the output of the **show pri counter=interface** command

Counter	Meaning
PRI instance	The instance number of the PRI interface.
seconds	The current value of sysUpTime.
Last change at	The value of sysUpTime at the time the interface entered its current operational state.
ifInOctets	The number of octets received on this interface.
ifInUcastPkts	The number of unicast frames delivered to a higher-layer protocol.
ifInNUcastPkts	The number of non-unicast frames delivered to a higher-layer protocol.
ifInDiscards	The number of inbound frames discarded, though no errors had been detected to preventing them from being deliverable to higher-layer protocol. This may be due to the interface being reset by command, or a hardware overload or malfunction.
ifInErrors	The number of inbound frames that contained errors preventing them from being deliverable to a higher-layer protocol.
ifInUnknownProtos	The number of frames discarded because they were for an unconfigured protocol.
ifOutOctets	The number of octets transmitted, including framing.
ifOutUcastPkts	The number of unicast frames transmitted or discarded.
ifOutNUcastPkts	The number of non-unicast frames transmitted or discarded.
ifOutDiscards	The number of frames discarded, though no errors had been detected preventing their being transmitted. This is usually due to output queue limiting.
ifOutErrors	The number of frames not transmitted because of errors. This is usually due to a channel reset or shutdown, or a hardware malfunction.
ifOutQLen	The length of the output frame queue.

Figure 11-38: Example output from the **show pri counter=link near** command for an E1 or T1 interface with a Bt 8370 transceiver

```
PRI instance 0:       5319 seconds      Last change at:       4058 seconds

Near End Event Counters (current interval)
  PathFailures                  0     SeverelyErroredFrames           0
  LineCodeViolations            0     ControlledSlips                 0
  PathCodingViolations          0

Near End Time Counters (current interval)
  TotalSecs                   465     PercentageErrorFreeSecs    100.00%
  UnavailableSecs               0     SeverelyErroredSecs             0
  SeverelyErroredFSecs          0     SeverelyErroredLSecs            0
  ErroredSecs                   0     LineErroredSecs                 0
  SingleErroredSecs             0     BurstyErroredSecs               0
  LossOfSignalSecs              0     AISSecs                         0
  ControlledSlipSecs            0     DegradedMins                    0

Near End Event Counters (last 24 hours)
  PathFailures                  0     SeverelyErroredFrames          17
  LineCodeViolations         1348     ControlledSlips                 3
  PathCodingViolations          0

Near End Time Counters (last 24 hours)
  TotalSecs                  4849     PercentageErrorFreeSecs     99.79%
  UnavailableSecs               2     SeverelyErroredSecs             8
  SeverelyErroredFSecs          6     SeverelyErroredLSecs            0
  ErroredSecs                   8     LineErroredSecs                 4
  SingleErroredSecs             0     BurstyErroredSecs               0
  LossOfSignalSecs              2     AISSecs                         0
  ControlledSlipSecs            3     DegradedMins                    0
```

Figure 11-39: Example output from the **show pri counter=link far** command for a T1 interface with a Bt 8370 transceiver and using ESF framing

```
PRI instance 0:       5139 seconds      Last change at:       4058 seconds

Far End Event Counters (current interval)
  PathFailures                  0     PathCodingViolations            0

Far End Time Counters (current interval)
  TotalSecs                     0     PercentageErrorFreeSecs    100.00%
  UnavailableSecs               0     SeverelyErroredSecs             0
  SeverelyErroredFSecs          0
  ErroredSecs                   0     LineErroredSecs                 0
  SingleErroredSecs             0     BurstyErroredSecs               0
  ControlledSlipSecs            0     DegradedMins                    0

Far End Event Counters (last 24 hours)
  PathFailures                  0     PathCodingViolations            0

Far End Time Counters (last 24 hours)
  TotalSecs                     0     PercentageErrorFreeSecs    100.00%
  UnavailableSecs               0     SeverelyErroredSecs             0
  SeverelyErroredFSecs          0
  ErroredSecs                   0     LineErroredSecs                 0
  SingleErroredSecs             0     BurstyErroredSecs               0
  ControlledSlipSecs            0     DegradedMins                    0
```

Figure 11-40: Example output from the **show pri counter=link far** command for a E1 interface with a Bt 8370 transceiver

```
PRI instance 0:       5165 seconds      Last change at:       4058 seconds

Far End Event Counters
  CRC4ErrorsReported            0
```

Table 11-59: Parameters in the output of the **show pri counter=link** command

Counter	Meaning
PathFailures	The number of times received framing has been lost for at least 2.5 seconds (receive line failure), including reception of AIS (upstream failure).
LineCodeViolations	The total number of bipolar violations and excessive zero errors encountered in the received signal. This indicates noise on the line or incorrect T1 line encoding.
PathCodingViolations	The number of frame synchronisation bit errors in the SF and E1-noCRC formats, or the total number of CRC and frame synchronisation bit errors in the ESF and E1-CRC formats. This indicates noise on the line.
SeverelyErroredFrames	The number of severely errored frame defects as defined by ANSI I.231 for T1 SF/ESF or 2 or more framing bit errors out of six frames for E1. This indicates a very noisy or faulty line.
ControlledSlips	The number of replications or deletions of a frame due to a difference between the timing of the transceiver and the received signal. This indicates a hardware malfunction.
TotalSecs	The total number of seconds in the interval to which the counters pertain.
UnavailableSecs	The number of one second intervals during which the link was unavailable. The link becomes unavailable at the onset of 10 contiguous Severely Errored Seconds (SESs) and becomes available again at the onset of 10 contiguous seconds with no SESs.
SeverelyErroredFSecs	The number of one second intervals with one or more loss of framing defects or AIS defects.
ErroredSecs	The number of one second intervals with one or more of the following: PathCodingViolations, SeverelyErroredFrames, ControlledSlips and AISSecs.
SingleErroredSecs	The number of one second intervals with only one PathCodingViolation and no SeverelyErroredFrames and no AIS defects.
LossOfSignalSecs	The number of one second intervals with one or more loss of signal defects.
ControlledSlipSecs	The number of one second intervals with one or more controlled slip defects.
PercentageErrorFreeSecs	The percentage of one second intervals in the relevant interval when there were no errors.

Table 11-59: Parameters in the output of the **show pri counter=link** command (cont.)

Counter	Meaning
SeverelyErroredSecs	The number of one second intervals with one or more SeverelyErroredFrames or AIS defects OR the following errors depending on the interface and framing type: for T1-ESF 320 or more CRC4 errors, for T1-SF 8 or more F bit errors, for E1-CRC 832 or more CRC6 errors and for E1-noCRC 4 or more framing alignment signal errors.
SeverelyErroredLSecs	The number of one second intervals with one or more loss of signal OR the following errors depending on the interface type: for T1 1544 or more LCVs and for E1 2048 or more LCVs.
LineErroredSecs	The number of one second intervals with one or more loss of signal or LCV errors.
BurstyErroredSecs	The number of one second intervals with no SeverelyErroredFrames and no AIS defects AND the following errors depending on the interface and framing type: for T1-ESF 2-319 (inclusive) CRC6 errors and for E1-CRC 2-832 CRC4 errors. This counter is never incremented for T1-SF and E1-noCRC.
AISSecs	The number of one second intervals containing one or more AIS defects.
DegradedMins	The number of one minute groups of 60 available seconds in which the estimated error rate exceeds 1E-6 but does not exceed 1E-3. Available seconds are those that are not unavailable and not severely errored.
CRC4ErrorsReported	The number of CRC4 errors reported by the far end of the link. Applicable to E1-CRC only.
Interval	The history interval number. Interval 1 is the oldest interval and interval 96 the most recent. If the router has been rebooted within the last 24 hours then there may be fewer than 96 intervals. The intervals are also labelled with the time range to which they refer.

Figure 11-41: Example output from the **show pri counter=pri** command for a single channel

```
PRI instance 0:        288 seconds      Last change at:          0 seconds

Channel 1:   Slots: 1

  PRI Counters

    Receive:                                Transmit:
Frames                           39964     Frames                          39965
OverlengthFrames                     0     CTSLosts                            0
UnderlengthFrames                    0     Underruns                           0
CRCErrors                            0     LostInterrupts                      0
Aborts                               0     DroppedFrames                       0
NonOctetAligneds                     0     NoPackets                           0
Overruns                             0     HighPriorityFrames                  0
NonmatchAddresses                    0     QueueLength                         0
Misseds                              0     Recovers                            0
TooFewBuffers                        0     SDMABusErrors                       0
QueueLength                          0     CommandTimeouts                     0
                                           LastCommand                         0
```

Table 11-60: Parameters in the output of the **show pri counter=pri** command for a single channel

Parameter	Meaning
PRI instance	The instance number of the PRI interface.
seconds	The current value of sysUpTime.
Last change at	The value of sysUpTime at the time the interface entered its current operational state.
Channel	The channel number allocated by the driver for the channel to which the counters apply, channel number 0 is used for the ISDN D channel.
Slot	The number/s of the slot/s in use by the channel.
Frames	The number of frames received/transmitted.
OverlengthFrames	The number of overlength frames received.
UnderlengthFrames	The number of frames discarded because they were too short.
CRCErrors	The number of frames received with a CRC error.
Aborts	The number of received frames terminated with an abort, possibly due to noise on the line.
NonoctetAligned	The number of non-octet aligned frames received, possibly due to noise on the line.
Overruns	The number of frames lost due to a receive overrun, possibly due to HDLC controller or router bus overload.
NonmatchAddresses	The number of incoming frames rejected due to a non-matching address.
Misseds	The number of receive frames lost because lack of receive buffers, possibly due to HDLC controller or router overload.
TooFewBuffers	The number of received frames discarded because the number of buffers in the router had reached a critical level.
QueueLength	The length of the channel’s receive/transmit queue.

Table 11-60: Parameters in the output of the **show pri counter=pri** command for a single channel (cont.)

Parameter	**Meaning**
CTSLosts	The number of frames during which the CTS input was negated.
Underruns	The number of times a frame had to be retransmitted due to a transmitter underrun, possibly due to HDLC controller or router overload.
LostInterrupts	The number of times the transmission or reception of a frame on the indicated channel had to be aborted due to no transmit/receive interrupt being received. This indicates a hardware malfunction.
DroppedFrames	The number of frames discarded because the maximum transmit queue length was exceeded.
NoPackets	The number of times the 68302 or 68360 reported a transmit error, but there was no packet being transmitted or the packet in error could not be identified. This indicates a hardware malfunction.
HighPriorityFrames	The number of D channel frames transmitted with a high priority, usually call signalling frames.
Recovers	The number of times the HDLC controller was reset due to a serious error or a **reset pri** command on page 11-99.
SDMABusErrors	The number of bus errors experienced by the HDLC controller. This indicates a hardware malfunction.
CommandTimeouts	The number of times a command to the Ethernet hardware did not complete before the timeout timer expired. This indicates a hardware overload or malfunction.
LastCommand	The code of the command that was to be issued when a command timeout was detected.

Figure 11-42: Example output from the **show pri counter=link near history=1** command for an E1 or T1 interface with a Bt 8370 transceiver

```
PRI instance 0:       5555 seconds      Last change at:       4058 seconds

Interval 1: 13:54:01 - 15:26:41

Near End Event Counters
  PathFailures                  0     SeverelyErroredFrames            1
  LineCodeViolations          809     ControlledSlips                  1
  PathCodingViolations          0

Near End Time Counters
  TotalSecs                   351     PercentageErrorFreeSecs     99.15%
  UnavailableSecs               2     SeverelyErroredSecs              1
  SeverelyErroredFSecs          0     SeverelyErroredLSecs             0
  ErroredSecs                   1     LineErroredSecs                  1
  SingleErroredSecs             0     BurstyErroredSecs                0
  LossOfSignalSecs              0     AISSecs                          0
  ControlledSlipSecs            1     DegradedMins                     0
```

Figure 11-43: Example output from the **show pri counter=link far history=1** command for a T1 interface with a Bt 8370 transceiver and using ESF framing.

```
PRI instance 0:       5139 seconds      Last change at:       4058 seconds

Interval 1: 09:00 - 09:14:59

Far End Event Counters
  PathFailures                    0     PathCodingViolations             0

Far End Time Counters
  TotalSecs                       0     PercentageErrorFreeSecs    100.00%
  UnavailableSecs                 0     SeverelyErroredSecs              0
  SeverelyErroredFSecs            0
  ErroredSecs                     0     LineErroredSecs                  0
  SingleErroredSecs               0     BurstyErroredSecs                0
  ControlledSlipSecs              0     DegradedMins                     0
```

Figure 11-44: Example output from the **show pri counter=link far history=1** command for an E1 interface with a Bt 8370 transceiver

```
PRI instance 0:       5165 seconds      Last change at:       4058 seconds

Interval 1: 09:00 - 09:14:59

Far End Event Counters
  CRC4ErrorsReported              0
```

Examples To display the interface counters for PRI interface 0, use the command:

```
show pri=0 counter=interface
```

Related Commands reset pri counter
show pri configuration

show pri ctest

Syntax SHow PRI[=*instance*] CTest

where *instance* is the number of the PRI interface

Description This command displays the settings of the conformance test switches. If the interface is not specified, the settings for all PRI interfaces are displayed (Figure 11-45 on page 11-163, Figure 11-46 on page 11-163, Table 11-61 on page 11-163).

The **test** and **ctest** modes are required for manufacturer testing only and should not be activated while the system is in normal use because they interfere with the functioning of the router.

Figure 11-45: Example output from the **show pri ctest** command for a E1 type interface

```
CTest switches for PRI instance 0:
Number Action Status
------------------------------------------------------
1 Slots 1 to 31 hardware digital loop ...... no
2 Slots 1 to 31 software digital loop ...... no
3 Slots 1 to 31 transmit all zeroes ........ no
4 Slots 1 to 31 transmit all ones .......... no
5 Slots 1 to 31 transmit fox frames ........ no
```

Figure 11-46: Example output from the **show pri ctest** command for a T1 type interface

```
CTest switches for PRI instance 0:
Number Action Status
------------------------------------------------------
1 Slots 1 to 24 hardware digital loop ...... no
2 Slots 1 to 24 software digital loop ...... no
3 Slots 1 to 24 transmit all zeroes ........ no
4 Slots 1 to 24 transmit all ones .......... no
5 Slots 1 to 24 transmit fox frames ........ no
```

Table 11-61: ISDN Primary Rate Interface conformance tests

Test	Function
1	The HDLC controller hardware loops back all slots.
2	The data received by the PRI module via the HDLC controller on all slots is retransmitted.
3	The HDLC controller transmits HDLC frames of all zeroes on all slots (as a single channel).
4	The HDLC controller transmits HDLC frames of all ones on all slots (as a single channel).
5	The HDLC controller transmits HDLC frames of fox messages on all slots (as a single channel).

Examples To display the conformance tests current running on PRI interface 0, use the command:

```
show pri=0 ctest
```

Related Commands

disable pri ctest
enable pri ctest
disable pri test
enable pri test
show pri test

show pri debug

Syntax

```
SHow PRI[=instance] DEBug
```

where *instance* is the number of the PRI interface

Description This command displays the settings of the debug switches. If the interface is not specified, the settings for all PRI interfaces are displayed (Figure 11-47 on page 11-164, Table 11-62 on page 11-164).

Figure 11-47: Example output from the **show pri debug** command

```
Debug switches for PRI instance 0:

Errors .......... no
Indications ..... no
State changes ... no
Events .......... no
```

Table 11-62: ISDN Primary Rate Interface debug options

Parameter	Meaning
Errors	A PRI software module internal error.
Indications	An indication from the layer 1 state machine to a higher layer or the management layer.
State changes	A change of state for the layer 1 state machine.
Events	An event that is an input to the layer 1 state machine.

Examples To display the state of debugging options for PRI interface 0, use the command:

```
show pri=0 debug
```

Related Commands

disable pri debug
enable pri debug

show pri state

Syntax `SHow PRI[=`*`instance`*`] STATe`

where *instance* is the number of the PRI interface

Description This command displays information about the current state of the PRI interface. If the interface is not specified, the state of all PRI interfaces is displayed (Figure 11-48 on page 11-165, Figure 11-49 on page 11-166, Table 11-63 on page 11-166, Table 11-64 on page 11-168).

Figure 11-48: Example output from the **show pri state** command for an E1 interface with a Bt 8370 transceiver

```
State for PRI instance 0:

Interface type .......... E1
ISDN interface type ..... TE
HDLC controller type .... SCC
Mode .................... ISDN
ISDN slots .............. 1-31
State ................... Operational
Clock source ............ line
Termination impedance ... 120 ohms
CRC-4 mode .............. checking
CRC-4 error threshold ... 830
Idle character .......... 255
Interframe flags/slot ... 1
                                                      --- Occurrences ---
Receive Error Conditions                              Momentary   Lasting
  Loss Of Signal .............................. no            0         0
  Loss of Synchronisation ..................... no            0         0
  Loss of CRC-4 synchronisation ............... no
Error Indications Received
  Remote Alarm Indication (RAI) ............... no            0         0
  Alarm Indication Signal (AIS) ............... no            0         0
  Continuous Tx path CRC-4 errors ............. no            0
Error Indications Transmitted
  Remote Alarm Indication (RAI) ............... no                      0
  Alarm Indication Signal (AIS) ............... no                      0
```

Figure 11-49: Example output from the **show pri state** command for a T1 interface with a Bt 8370 transceiver

```
State for PRI instance 0:

Interface type .......... T1
ISDN interface type ..... TE
HDLC controller type .... SCC
Mode .................... ISDN
ISDN slots .............. 1-24
State ................... Operational
Clock source ............ line
Line length ............. 0 ft
Line build out .......... none
Encoding ................ B8ZS
HDLC data polarity ...... normal
Framing ................. ESF
DL signal format ........ message oriented
DL mode ................. T1.403
In-band loopback type ... line
In-band loopback code ... standard
Idle character .......... 255
Interframe flags/slot ... 1
                                                     --- Occurrences ---
Receive Error Conditions                             Momentary   Lasting
  Loss Of Signal .............................. no           0         0
  Loss Of Framing ............................. no           0         0
Error Indications Received
  Remote Alarm Indication (Yellow Alarm) ....... no           0         0
  Alarm Indication Signal (Blue Alarm) ......... no           0         0
Error Indications Transmitted
  Remote Alarm Indication (Yellow Alarm) ....... no                     0
  Alarm Indication Signal (Blue Alarm) ......... no                     0
```

Table 11-63: Parameters in the output of the **show pri state** command

Parameter	Meaning
Interface type	The standard to which the interface adheres; one of “E1” or “T1”. This is set by a hardware jumper.
ISDN interface type	The type of the ISDN interface; one of “TE” or “NT”. The normal mode of operation is “TE”.
HDLC controller type	The type of hardware used to implement the HDLC controllers for D and B channels; one of “SCC” or “QMC”.
Mode	The mode of the interface; one of “ISDN”, “TDM” or “mixed”.
ISDN slots	The list of slots reserved for ISDN calls. Valid when the interface is not in TDM mode.
TDM slots	The list of slots reserved for TDM groups. Valid when the interface is not in ISDN mode.
State	The state of the E1 physical layer state machine. See Table 11-64 on page 11-168 for a list of valid states.
Clock source	The clock source for the interface; one of “LINE” or “INTERNAL”. A PRI interface configured as an ISDN TE derives its transmit clock signal from the receive line. A PRI interface configured as a NT or for use on a non-ISDN dedicated line may use an internal clock.

Table 11-63: Parameters in the output of the **show pri state** command (cont.)

Parameter	Meaning
Line length	The length of the line connecting the interface to the other end of the physical line section (the CSU in a short haul installation or the nearest repeater or far end CSU in a long haul installation).
Line build out	The line build out used to reduce the strength of the transmitted signal; one of “none”, “-7.5dB”, “-15dB” or “-22.5dB”.
Encoding	The T1 parameter that sets the data encoding used on the line; one of “B8ZS”, “B7ZS” or “AMI”.
HDLC data polarity	For T1 this indicates when the HDLC data has been inverted to ensure adequate ones density on the link; one of “normal” or “inverted”.
Framing	The T1 parameter that sets the framing type used on the link; one of “SF/D4” or “ESF”.
DL signal format	The format of signals on the Data Link; one of “bit-patterned” or “message oriented”.
DL mode	The autoselected Data Link mode; one of “not applicable”, “T1.403” or “AT&T 54016".
In-band loopback type	The type of loopback that is activated on a T1 link upon receipt of an in-band loopback request; one of “line” or “payload”.
In-band loopback code	The in-band loopback activation code; one of “standard” or “alternate”.
Termination impedance	The termination impedance of an E1 line, for some interfaces this may be changed with a rear panel switch; one of “120 ohms” or “75 ohms”.
CRC-4 mode	The CRC procedure implemented by the interface; one of “OFF”, “CHECKING” or “REPORTING”.
CRC-4 error threshold	The number of multiframes received with CRC-4 errors in one second that triggers a search for frame alignment.
Idle character	The decimal value of the character transmitted in an idle slot.
Interframe flags/slot	The minimum number of flags per slot transmitted between frames.
Analog loss of signal (ALOS)	There is no signal being received by the interface.
Loss of signal (LOS)	For E1(T1), more than 32(100) contiguous zeroes have been received.
Loss of synchronisation	For E1 the receiver has lost synchronisation with the framing bits of the received signal.
Loss of CRC-4 synchronisation	For E1 the receiver has lost synchronisation with the CRC-4 multiframing bits of the received signal.
Loss of Frame (LOF)	For T1 the receiver has lost synchronisation with the framing bits of the received signal.
Remote Alarm Indication (RAI)	The signal transmitted in the outgoing direction when a terminal determines that it has lost the incoming signal, called yellow alarm in T1 parlance.

Table 11-63: Parameters in the output of the **show pri state** command (cont.)

Parameter	Meaning
Alarm Indication Signal (AIS)	The signal transmitted in lieu of the normal signal to indicate to the receiving equipment that there is a transmission interruption located at the equipment originating the AIS signal or upstream of that equipment.
Continuous Tx path CRC-4 errors	Applicable to E1 only. When the NT is not receiving a good signal from the router it continuously transmits operational frames with CRC-4 error report bits set to the router.
Remote Alarm Indication (Yellow Alarm)	The signal transmitted in the outgoing direction when a terminal determines that it has lost the incoming signal, called yellow alarm in T1 parlance.
Alarm Indication Signal (Blue Alarm)	The signal transmitted in lieu of the normal signal to indicate to the receiving equipment that there is a transmission interruption located at the equipment originating the AIS signal or upstream of that equipment, called blue alarm in T1 parlance.
Occurrences	The number of occasions when the condition has arisen.
Momentary	An occurrence of the condition that lasted for less than approximately 2.5 seconds.
Lasting	An occurrence of the condition that lasted for more than approximately 2.5 seconds.
Total seconds	The total number of seconds when the condition occurred.
errors in last sec	The number of times a particular error occurred in the preceding second.
FramingErrors	The number of errors detected in the frame alignment signal.
FrameSlips	The number of times a difference between the clock rate of the line and a clock rate of the router has caused a frame to be lost due to slip buffer overflow or underflow.
CRC4Errors	The number of E1 CRC-4 errors detected.
CRC4ErrorReports	The number of CRC-4 errors reported by the other end of an E1 link.

Table 11-64: States of the physical layer state machine for an ISDN Primary Rate Interface

State	Meaning
Operational	Normal operational state.
FC1	Fault condition 1, Network outbound fault. A fault in the network between the NT and the exchange, in the direction towards the exchange, has been detected (RAI received by TE).
FC2	Fault condition 2, Local inbound fault. A fault between the NT and the TE, in the direction towards the TE, has been detected (loss of signal and/or synchronisation at the TE receiver).
FC3	Fault condition 3, Network inbound fault. A fault in the network between the NT and the exchange, in the direction towards the NT, has been detected (AIS received by TE).
FC4	Fault condition 4, Local outbound fault. A fault between the TE and the NT, in the direction towards the NT, has been detected (RAI received by TE).

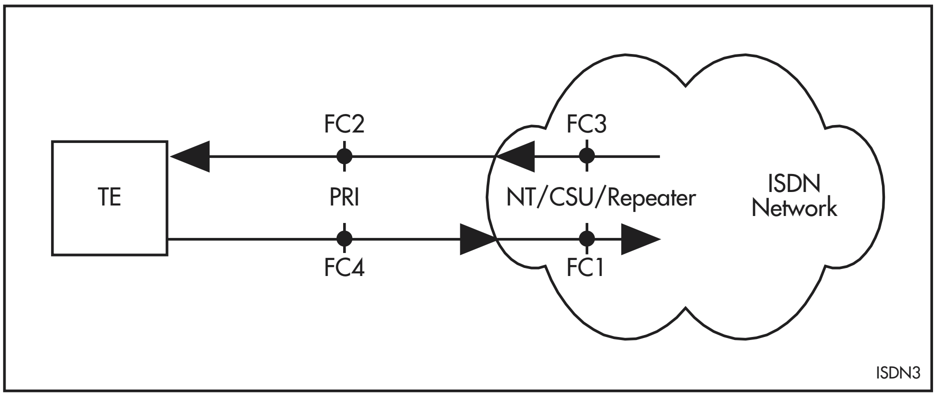
The current state of the receive path is shown in the *Receive error conditions* section of the output, by indicating if each of the possible conditions is present or not (the *no/yes* column). The *Occurrences* column is incremented each time the condition occurs and the *Total seconds* column indicates how long the PRI interface has experienced that condition.

For E1 there are two stages of synchronisation (frame alignment) to be achieved by a PRI interface. The first is frame synchronisation and the second is CRC-4 multiframe synchronisation. Once frame synchronisation is achieved, a search for CRC-4 synchronisation commences automatically. False frame synchronisation may be detected in two ways. The first is by the reception of three consecutive incorrect frame alignment signals; this automatically causes another search for frame synchronisation (and consequently for CRC-4 multiframe synchronisation). The second way that false synchronisation is detected is by the presence of an excessive number of CRC-4 errors on the receive path. In this context excessive is interpreted as greater than the number of CRC errors in one second defined by the **set pri** command on page 11-113. Note that there are 1000 sub-multiframes (CRC-4 blocks) received in one second. The occurrence of excessive CRC-4 errors also causes a new search for frame synchronisation. The *Occurrences* column gives the number of times an excessive number of CRC-4 errors was counted and consequently the number of times a resynchronisation was forced. CRC-4 errors cannot be detected, and are not counted, while the receiver is resynchronising.

For T1 synchronisation is carried out as a single stage process, though for ESF framing the presence/absence of CRC-6 errors is used to distinguish between possible framing candidates. Loss of framing (Out Of Frame) is indicated by detection of 2 errors out of five consecutive framing bits.

Error indications are also received from the network (shown in the *Error indications received* section of the output). The four identifiable fault locations and their designations are shown in Figure 11-50 on page 11-169. Note that although the router is represented as a "TE" and the network is shown as ISDN, the diagram applies equally well to a non-ISDN installation.

Figure 11-50: Identifiable fault locations in a Primary Rate link between a TE and an NT



If the TE suffers *Loss Of Signal (LOS)* this indicates there is an error between the nearest repeater or the NT and the TE in the direction of the TE (FC2). If the TE detects *Alarm Indication Signal (AIS)* this indicates that there is a failure in the same direction but it is beyond the repeater/NT (FC3). Faults in the other direction (from the TE towards the network) are indicated by *Remote Alarm Indication (RAI)*. For E1 it is possible for the TE to determine whether the fault is on the link from the TE to the NT or beyond the NT. This requires the NT to implement the CRC-4 error reporting procedure (options 2 and 3 of Annex A to ITU-T recommendation I.604). The distinction is then based on whether continuous or temporary CRC-4 errors are being reported to the TE (via the E bits). If continuous CRC-4 errors are being reported this implies that the NT has lost synchronisation with the signal from the TE, i.e. the fault is between the TE and the NT (FC4). If RAI is associated with a low number of reported CRC-4 errors then the fault is beyond the NT (FC1). If the NT does not implement the CRC-4 error reporting procedure, or the network does not support CRC-4 error reporting at all (as is the case with T1), then the TE is unable to distinguish between FC1 and FC4. Moreover, the condition of RAI with continuous reported CRC-4 errors never occurs and the state machine never enters state FC4.

The PRI module notifies the other end of the primary rate link about any receive error condition that it is experiencing. This is shown in the *Error indications transmitted* section of the output. When the TE is in states FC2 or FC3 it transmits RAI to indicate to the network that it is not receiving a correct signal. A TE never transmits AIS, but it is transmitted by a NT that is not receiving a valid signal from the network.

For T1 interface states are not defined but RAI and AIS have similar meanings as for E1.

If the **crc-4** mode is **off**, then CRC-4 synchronisation is never sought and the counters relating to CRC-4 errors are never incremented. If the **crc-4** mode is **checking**, then transmit path CRC-4 errors are never reported.

Examples To display information about the current state of PRI interface 0, use the command:

```
show pri=0 state
```

Related Commands

set pri
show pri configuration
show pri counter

show pri test

Syntax `SHow PRI[=instance] TEST`

where *instance* is the number of the PRI interface

Description This command displays the settings of the test switches. If the interface is not specified, the settings for all PRI interfaces are displayed (Figure 11-51 on page 11-171 and Table 11-65 on page 11-171, Figure 11-52 on page 11-172 and Table 11-66 on page 11-172).

For interfaces based on the Bt 8370 transceiver the transmission and reception of a framed Pseudo Random Bit Sequence is supported. This may be used to test the quality of a link provided a loopback at the remote end may be activated. The state of this test is also shown by this command and the possible states are given in Table 11-67 on page 11-172. When the test is activated the router begins transmitting the PRBS and the receiver tries to lock onto the same PRBS in the received signal. Once the receiver has locked onto the PRBS, bit errors encountered are counted and displayed. The bit error counter is zeroed at boot and whenever the test is activated. If SF/D4 framing is selected for a T1 interface then the number of consecutive zeroes in the PRBS is limited to 7.

Figure 11-51: Example output from the **show pri test** command for an E1 interface with a Bt 8370 transceiver

```
Test switches for PRI instance 0:
Number     Action                                      Status
------------------------------------------------------------
  1     Transceiver local loop .................. no
  2     Transceiver remote loop ................. no
  3     Payload remote loopback ................. no
  4     Transmit/receive framed PRBS ............ no
  5     Force resynchronisation ................. no
  6     Transmit Alarm Indication Signal (AIS) ... no
  7     Transmit Remote Alarm Indication (RAI) ... no

  PRBS State: inactive    PRBS error count          0
```

Table 11-65: ISDN Primary Rate Interface test modes for an E1 interface with a Bt 8370 transceiver

Test	Function
1	A loopback of the entire framed 2048 kbit/s signal back towards the router from the transceiver near the analogue interface.
2	A loopback of the entire framed 2048 kbit/s signal back out the interface by the transceiver.
3	A payload loopback of all slots back out the interface.
4	Transmit a framed 2E15-1 Pseudo Random Bit Sequence and attempt to lock onto the received, looped-back signal (lock state and errors are displayed).
5	A frame resynchronisation is invoked.
6	The Alarm Indication Signal is sent to the network.
7	The Remote Alarm Indication bit is set in the transmitted data stream.

Figure 11-52: Example output from the **show pri test** command for a T1 interface with a Bt 8370 transceiver

```
Number     Action                                        Status
------------------------------------------------------
   1     Transceiver local loop ................... no
   2     Transceiver remote loop .................. no
   3     Payload remote loopback .................. no
   4     Transmit/receive framed PRBS ............. no
   5     Force resynchronisation .................. no
   6     Transmit Alarm Indication Signal (AIS) ... no
   7     Transmit Remote Alarm Indication (RAI) ... no
   8     Transmit the in-band loopback up signal .. no
   9     Transmit the in-band loopback down signal  no

   PRBS State: Inactive    PRBS error count          0
```

Table 11-66: ISDN Primary Rate Interface test modes for an T1 interface with a Bt 8370 transceiver

Test	Function
1	A loopback of the entire framed 1544 kbit/s signal back towards the router from the transceiver near the analogue interface.
2	A loopback of the entire framed 1544 kbit/s signal back out the interface by the transceiver.
3	A payload loopback of all slots back out the interface.
4	Transmit a framed 2E15-1 Pseudo Random Bit Sequence and attempt to lock onto the received, looped-back signal (lock state and errors are displayed).
5	A frame resynchronisation is invoked.
6	The Alarm Indication Signal is sent to the network.
7	The Remote Alarm Indication signal is sent to the network.
8	Transmit the “activate in-band loopback” signal.
9	Transmit the “deactivate in-band loopback” signal.

Table 11-67: States for the PRBS test for interfaces with a Bt 8370 transceiver

State	Meaning
Inactive	The PRBS test is not enabled.
Locking	The receiver is trying to lock onto a PRBS in the received signal.
Locked	The receiver has locked onto a PRBS in the received signal and begun counting bit errors.

The PRBS receiver sometimes locks incorrectly and reports a large number of errors even on a very clean link. If this happens, disable the test and re-enable it to make the receiver lock again.

Examples To display the tests running on PRI interface 0, use the command:

```
show pri=0 test
```

Related Commands

disable pri ctest
enable pri ctest
disable pri test
enable pri test
show pri ctest

show q931

Syntax

`SHow Q931[=`*`interface`*`] [CALL[=`*`q931-call`*`]]`

where:

- *interface* is a slotted interface name or number. Interface names are formed by concatenating an interface type and instance (such as BRI0 or PRI1). Interface numbers are the decimal index of the slotted interface (0, 1, 2...).
- *q931-call* is the number of a Q.931 call.

Description

This command displays Q.931 profile and timer values, or active call information, for the specified ISDN interface.

If the **call** parameter is not specified, information about the Q.931 interface is displayed (Figure 11-53 on page 11-173, Table 11-68 on page 11-174). If the interface is not specified, the information is displayed for all ISDN interfaces.

If the **call** parameter is specified without a value, information about all Q.931 calls is displayed (Figure 11-54 on page 11-175, Table 11-69 on page 11-175). If the **call** parameter is specified with a value, information about the specified Q.931 call is displayed.

Figure 11-53: Example output from the **show q931** command

```
Q.931 interface ... BRI0
Profile ........... NI1-BR
ASD state ......... Operational
Data rate ......... 64k
Number 1 .......... -
Sub-address 1 ..... -
Number 2 .......... -
Sub-address 2 ..... -
DOV number ........ -
No number ......... Accept
No sub-address .... Accept
 DLC1
  State ............. Established
  SPID state ........ OP
  SPID file state ... 3 (Auto SPID successful)
  Current SPID ...... 62155542310101
  USID .............. 0
  Terminal ID ....... 1
DLC2
  State ............. Established
  SPID state ........ OP
  SPID file state ... 3 (Auto SPID successful)
  Current SPID ...... 62155579340101
  USID .............. 0
  Terminal ID ....... 2
Common D channel
  Interface ID .... 00
```

Figure 11-53: Example output from the **show q931** command (cont.)

```
TSPID ............. 20
T301 .............. -
T302 .............. -
T303 .............. 4
T304 .............. 15
T305 .............. 30
T308 .............. 4
T309 .............. 90
T310 .............. -
T313 .............. 4
T314 .............. -
T316 .............. -
T317 .............. -
T318 .............. -
T319 .............. -
T321 .............. -
T322 .............. 4
```

Table 11-68: Parameters in the output of the **show q931** command

Parameter	Meaning
Q.931 interface	The ISDN interface.
Profile	The Q.931 profile in use on the interface; one of: "5ESS-BR" Lucent 5ESS custom (USA & Canada) Basic Rate "AUS-BR" Australian Telecom Basic Rate "AUS-PR" Australian Telecom Primary Rate "China-BR" China Telecom Basic Rate "China-PR" China Telecom Primary Rate "DMS100-BR" NorTel DMS-100 custom (USA & Canada) Basic Rate "ETS-BR" EU/EFTA countries ETSI Basic Rate. "ETS-PR" EU/EFTA countries ETSI Primary Rate.
	"JPN-BR" Japan Basic Rate. "JPN-PR" Japan Primary Rate. "KOREA-BR" Korea Basic Rate "KOREA-PR" Korea Primary Rate "NI1-BR" National ISDN (USA & Canada) Basic Rate "NZL-BR" New Zealand Telecom Basic Rate. "NZL-PR" New Zealand Telecom Primary Rate. "US ASD-BR Auto ISDN switch detection (USA & Canada) Basic Rate
ASD State	The state of the auto ISDN switch detection state machine; one of "ASD-0", "ASD-1", "ASD-2", "ASD-3", "ASD-4", "ASD-5", "ASD-6" or "Operational".
Data rate	The data rate for this interface; one of "56k" or "64k".
Number 1, 2	The ISDN numbers assigned to the interface.
Sub-address 1, 2	The ISDN subaddresses assigned to the interface.
DOV number	The ISDN number assigned for DOV (Data Over Voice) calls. Voice calls received on this number are treated as data calls, not voice calls.
No number	Whether to accept or reject incoming calls with no called number in the SETUP message; one of "Accept" or "Reject".
No sub-address	Whether to accept or reject incoming calls with no called sub-address in the SETUP message; one of "Accept" or "Reject".
DLC*n*	Information about DLC *n*.

Table 11-68: Parameters in the output of the **show q931** command (cont.)

Parameter	Meaning
State	The state of the DLC; one of “Initial”, “Terminal initiated”, “Network initiated” or “OK”.
SPID state	The state of the SPID state machine; one of “NULL“, “IWAIT1“, “IWAIT2”, “IWAIT3”, “AWAIT1”, “AWAIT2”, “AWAIT3”, “5ESSNOTINIT”, “ASPID1”, “ASPID2”, “ASPID3”, “ASPID4”, “OP”, “5ESSPINIT” or “5ESSMINIT”. See Table 11-12 on page 11-35 for a description of these states.
SPID file state	The state of the SPID file state machine; a number from 1 to 13. See Table 11-14 on page 11-36 for a description of these states.
Current SPID	The current SPID with which the router is attempting to initialise the DLC.
USID	The User Service Identifier, which identifies the service profile for the interface. This field is displayed if the *State* field is set to “OK”.
Terminal ID	The Terminal Identifier for the interface. TID values are unique within a given USID. This field is displayed if the *State* field is set to “OK”.
TSPID	The value of the SPID retry timer.
Common D channel	Parameters concerning non-associated signalling, or common D channel.
Interface ID	The non-associated signalling, or common D channel, interface identifier.
T301 to T322	The timeout value for the relevant timer.

Figure 11-54: Example output from the **show q931 call** command

```
Inter  Index  State  CallRef  CallRefInit  Timer  ToGo  TOs
------------------------------------------------------------
   0      0      0     0000      USER          -      -    -
   0      3     10     0003      USER          -      -    -
------------------------------------------------------------
```

Table 11-69: Parameters in the output of the **show q931 call** command

Parameter	Meaning
Inter	The ISDN interface.
Index	The call identification number, internal to the router.
State	The state of the call, as per the Q.931 protocol.
CallRef	The call reference as seen by the Q.931 protocol.
CallRefInit	The initiator of the call.
Timer	The timer currently running for this call.
ToGo	The time remaining on the timer.
TOs	The number of timeouts for this timer.

Related Commands set q931
show q931 spid

show q931 spid

Syntax `SHow Q931[=`*`interface`*`] SPid`

where *interface* is a slotted interface name or number. Interface names are formed by concatenating an interface type and instance (such as BRI0 or PRI1). Interface numbers are the decimal index of the slotted interface (0, 1, 2...).

Description This command displays Q.931 SPID information for the specified ISDN interface. The current state of the SPID files for the interface, as well as the state of the SPID state machine and SPID file state machine are displayed (Figure 11-55 on page 11-176, Table 11-70 on page 11-177).

When the auto-SPID procedure is in progress and the router and network are waiting for user intervention to determine the SPIDs that are to be used, the SPIDs presented by the network are displayed along with the bearer capabilities and numbers for those SPIDs. An instructive message that describes how to enable one or more of the SPIDs is also given (Figure 11-56 on page 11-178, Table 11-71 on page 11-179).

Figure 11-55: Example output from the **show q931 spid** command

```
Q.931 interface ... BRI0
DLC 1 SPID details
  Number ........... -
  SPID file details
    State .......... 3 (Auto SPID successful)
    Manual SPID .... -
    Generic SPID ... -
    Auto SPID ...... 62155542310101
    Auto BC ........ VDX
  SPID details
    State .......... OP
    Current SPID ... 62155542310101
DLC 2 SPID details
  Number ........... -
  SPID file details
    State .......... 3 (Auto SPID successful)
    Manual SPID .... -
    Generic SPID ... -
    Auto SPID ...... 62155579340101
    Auto BC ........ VD
  SPID details
    State .......... OP
    Current SPID ... 62155579340101

No auto SPID information to display for this interface
```

Table 11-70: Parameters in the output of the **show q931 spid** command

Parameter	Meaning
Q.931 interface	The name of the Q.931 interface.
DLC *n* SPID details	Information about DLC (SPID) *n*.
Number	The directory number for this DLC.
SPID file details	Information about the SPID file for this DLC.
State (SPID file)	The state of the SPID file for this DLC; a number from 0 to 13. See Table 11-14 on page 11-36 for a description of these states.
Manual SPID	The manual SPID entered for this DLC.
Generic SPID	The generic SPID obtained from the 10 digit number entered for this DLC.
Auto SPID	The auto SPID selected (either automatically or with manual intervention) for this DLC.
Auto BC	The bearer capabilities associated with the auto SPID for this DLC; one or more of "-" (none), "V" (voice), "D" (data) or "X" (X.25 packet data).
SPID details	Information about the SPID for this DLC.
State (SPID details)	The state of the SPID initialisation for this DLC; one of "NULL", "IWAIT1", "IWAIT2", "IWAIT3", "AWAIT1", "AWAIT2", "AWAIT3", "5ESSNOTINIT", "ASPID1", "ASPID2", "ASPID3", "ASPID4", "OP", "5ESSPINIT" or "5ESSMINIT". See Table 11-12 on page 11-35 for a description of these states.
Current SPID	The current SPID for this DLC.

Figure 11-56: Example output from the **show q931 spid** command during the auto-SPID procedure

```
Q.931 interface ... BRI0
DLC 1 SPID details
  Number ........... -
  SPID file details
    State .......... 0 (No SPIDs entered, auto SPID not run or in progress)
    Manual SPID .... -
    Generic SPID ... -
    Auto SPID ...... -
    Auto BC ........ -
  SPID details
    State .......... ASPID3 (manual intervention required)
    Current SPID ... 01010101010101
DLC 2 SPID details
  Number ........... -
  SPID file details
    State .......... 0 (No SPIDs entered, auto SPID not run or in progress)
    Manual SPID .... -
    Generic SPID ... -
    Auto SPID ...... -
    Auto BC ........ -
  SPID details
    State .......... NULL
    Current SPID ... -

Auto SPID table for BRI0
------------------------------------------------------
Ind    SPID              Bearer    Number        Cause
------------------------------------------------------
 1     62155542310101    VDX       -             -
 2     62155579340101    VD        -             -
------------------------------------------------------

Manual intervention is required for one or more of the SPIDs in the table to
be selected. Enter the command:

  ENABLE Q931=0 ASPID=<index>[,<index>]

where <index> is the index of the desired auto SPID from the above table. Up
to two auto SPIDs may be selected in this fashion.
```

Table 11-71: Parameters in the output of the **show q931 spid** command during the auto-SPID procedure

Parameter	Meaning
Q.931 interface	The name of the Q.931 interface.
DLC *n* SPID details	Information about DLC (SPID) *n*.
Number	The directory number for this DLC.
SPID file details	Information about the SPID file for this DLC.
State (SPID file)	The state of the SPID file for this DLC; a number from 0 to 13. See Table 11-14 on page 11-36 for a description of these states.
Manual SPID	The manual SPID entered for this DLC.
Generic SPID	The generic SPID obtained from the 10 digit number entered for this DLC.
Auto SPID	The auto SPID selected (either automatically or with manual intervention) for this DLC.
Auto BC	The bearer capabilities associated with the auto SPID for this DLC; one or more of "-" (none), "V" (voice), "D" (data) or "X" (X.25 packet data).
SPID details	Information about the SPID for this DLC.
State (SPID details)	The state of the SPID initialisation for this DLC; one of "NULL", "IWAIT1", "IWAIT2", "IWAIT3", "AWAIT1", "AWAIT2", "AWAIT3", "5ESSNOTINIT", "ASPID1", "ASPID2", "ASPID3", "ASPID4", "OP", "5ESSPINIT" or "5ESSMINIT". See Table 11-12 on page 11-35 for a description of these states.
Current SPID	The current SPID for this DLC.
Auto SPID table for *interface*.	The table of SPID values learned by the auto SPID process.
Ind	The index in the auto SPID table used to select this SPID.
SPID	The SPID value for this auto SPID entry.
Bearer	The bearer capabilities associated with this auto SPID entry; one or more of "-" (none), "V" (voice), "D" (data) or "X" (X.25 packet data).
Number	The directory number associated with this auto SPID entry.
Cause	The cause code associated with this auto SPID entry. A cause of 63 means that the auto SPID is already in use for another device.

Examples

To show Q931 SPID information for the bri0 interface, use the command:

```
show q931=bri0 spid
```

Related Commands

set q931
show q931