



## Setting Up Basic ISDN Service

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This chapter describes tasks that are required to use an ISDN line. It provides an overview of the ISDN technologies currently available, and describes features that you can configure in an ISDN BRI circuit-switched internetworking environment. This information is included in the following main sections:

- ISDN Overview
- ISDN BRI Configuration Task List
- Monitoring and Maintaining ISDN Interfaces
- Troubleshooting ISDN Interfaces
- ISDN BRI Configuration Examples

This chapter describes configuration of the ISDN BRI. See the chapter “Configuring ISDN PRI and Other Signaling on E1 and T1 Lines” for information about configuring the ISDN PRI.

This chapter does not address routing issues, dialer configuration, and dial backup. For information about those topics, see the chapters in the “Dial-on-Demand Routing” part of this publication.

For hardware technical descriptions, and for information about installing the router interfaces, refer to the appropriate hardware installation and maintenance publication for your particular product.

For a complete description of the BRI commands in this chapter, see the *Cisco IOS Dial Services Command Reference* publication. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

## ISDN Overview

Basic ISDN service is described in the section “ISDN Service” in the chapter “Interfaces, Controllers, and Lines Used for Dial Access Overview.” To summarize, Cisco IOS software supports both the ISDN BRI and ISDN PRI.

ISDN BRI provides two bearer (B) channels, each capable of transferring voice or data at 64 kbps, and one 16-kbps data (D) signalling channel, which is used by the telephone network to carry instructions about how to handle each of the B channels. ISDN BRI (also referred to as 2 B + D) provides a maximum of 128 kbps transmission speed, but many users use only half the available bandwidth.

Figure 11 in the chapter “Interfaces, Controllers, and Lines Used for Dial Access Overview” illustrates the channel assignment for each ISDN type.

## Requesting BRI Line and Switch Configuration from a Telco Service Provider

Before configuring the ISDN BRI interface on your Cisco router, you must order a correctly configured ISDN line from your telecommunications service provider. This process varies from provider to provider on a national and international basis. However, some general guidelines follow:

- Ask for two channels to be called by one number.
- Ask for delivery of calling line identification. Providers sometimes call this CLI or automatic number identification (ANI).
- If the router will be the only device attached to the BRI, ask for point-to-point service and a data-only line.
- If the router will be attached to an ISDN bus (to which other ISDN devices might be attached), ask for point-to-multipoint service (subaddressing is required) and a voice-and-data line.

When you order ISDN service, request the BRI switch configuration attributes specified in Table 14.

**Table 14** ISDN BRI Switch Type Configuration Information

Switch Type	Configuration
DMS-100 BRI Custom	2 B channels for voice and data. 2 directory numbers assigned by service provider. 2 service profile identifiers (SPIDs) required; assigned by service provider. Functional signalling. Dynamic terminal endpoint identifier (TEI) assignment. Maximum number of keys = 64. Release key = no, or key number = no. Ringing indicator = no. EKTS = no. PVC = 2. Request delivery of calling line ID on Centrex lines. Set speed for ISDN calls to 56 kbps outside local exchange. Directory number 1 can hunt to directory number 2.

Table 14 ISDN BRI Switch Type Configuration Information (continued)

Switch Type	Configuration
5ESS Custom BRI	<p><b>For Data Only</b></p> <p>2 B channels for data. Point to point. Terminal type = E. 1 directory number (DN) assigned by service provider. MTERM = 1. Request delivery of calling line ID on Centrex lines. Set speed for ISDN calls to 56 kbps outside local exchange.</p> <p><b>For Voice and Data</b></p> <p>(Use these values only if you have an ISDN telephone connected.) 2 B channels for voice or data. Multipoint. Terminal type = D. 2 directory numbers assigned by service provider. 2 SPIDs required; assigned by service provider. MTERM = 2. Number of call appearances = 1. Display = No. Ringing/idle call appearances = idle. Autohold = no. Onetouch = no. Request delivery of calling line ID on Centrex lines. Set speed for ISDN calls to 56 kbps outside local exchange. Directory number 1 can hunt to directory number 2.</p>
5ESS National ISDN (NI) BRI	<p>Terminal type = A. 2 B channels for voice and data. 2 directory numbers assigned by service provider. 2 SPIDs required; assigned by service provider. Set speed for ISDN calls to 56 kbps outside local exchange. Directory number 1 can hunt to directory number 2.</p>
EZ-ISDN 1	<p><b>For Voice and Data</b></p> <p><b>ISDN Ordering Code for Cisco 766/776 Series = Capability S</b> <b>ISDN Ordering Code for Cisco 1604 Series = Capability R</b></p> <p>2 B channels featuring alternate voice and circuit-switched data. Non-EKTS voice features include:</p> <ul style="list-style-type: none"> <li>• Flexible Calling</li> <li>• Call Forwarding Variable</li> <li>• Additional Call Offering</li> <li>• Calling Number Identification (includes Redirecting Number Delivery)</li> </ul>

## Multiple ISDN Switch Types Feature

The Cisco IOS software provides an enhanced Multiple ISDN Switch Types feature that allows you to apply an ISDN switch type to a specific ISDN interface and configure more than one ISDN switch type per router. This feature allows both ISDN BRI and ISDN PRI to run simultaneously on platforms that

support both interface types. See the section “Configuring Multiple ISDN Switch Types” in the chapter “Configuring ISDN PRI and Other Signaling on E1 and T1 Lines” for information about configuring this feature.

## Interface Configuration

The Cisco IOS software also provides custom features for configuring the ISDN BRI interface that provide such capability as call screening, called party number verification, ISDN default cause code override, and for European and Australian customers, Dialed Number Identification Service (DNIS)-plus-ISDN-subaddress binding to allow multiple binds between a dialer profile and an ISDN B channel.

## Dynamic Multiple Encapsulations

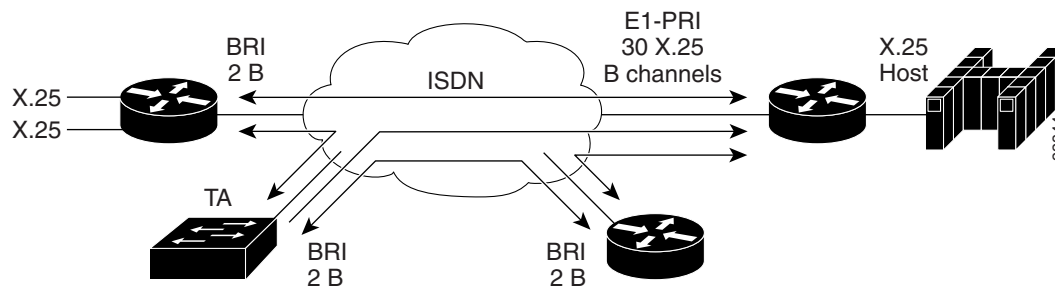
Prior to Cisco IOS Release 12.1, encapsulation techniques such as Frame Relay, High-Level Data Link Control (HDLC), Link Access Procedure, Balanced-Terminal Adapter (LAPB-TA), and X.25 could support only one ISDN B-channel connection over the entire link. HDLC and PPP could support multiple B channels, but the entire ISDN link needed to use the same encapsulation. The Dynamic Multiple Encapsulations feature introduced in Cisco IOS Release 12.1 allows various encapsulation types and per-user configurations on the same ISDN B channel at different times according to the type of incoming call.

With the Dynamic Multiple Encapsulations feature, once calling line identification (CLID) binding is completed, the topmost interface is always used for all configuration and data structures. The ISDN B channel becomes a forwarding device, and the configuration on the D channel is ignored, thereby allowing the different encapsulation types and per-user configurations. Dynamic multiple encapsulations provide support for packet assembler/disassembler (PAD) traffic and X.25 encapsulated and switched packets. For X.25 encapsulations, the configurations reside on the dialer profile.

Dynamic multiple encapsulation is especially important in Europe, where ISDN is relatively expensive and maximum use of all 30 B channels on the same ISDN link is desirable. Further, the feature removes the need to statically dedicate channels to a particular encapsulation and configuration type, and improves channel usage.

Figure 36 shows a typical configuration for an X.25 network in Europe. The Dynamic Multiple Encapsulations feature allows use of all 30 B channels, and supports calls that originate in diverse areas of the network and converge on the same ISDN PRI.

**Figure 36** *European X.25 Network*



## Other Interface Configuration Options

You can also optionally configure *snapshot routing* for ISDN interfaces. Snapshot routing is a method of learning remote routes dynamically and keeping the routes available for a specified period of time, even though routing updates are not exchanged during that period. See the chapter “Configuring Snapshot Routing” in the “Cost-Control Solutions” part of the *Cisco IOS Dial Services Configuration Guide: Network Services* publication for detailed information about snapshot routing.

To place calls on an ISDN interface, you must configure it with dial-on-demand routing (DDR). For configuration information about ISDN using DDR, see the “Dial-on-Demand Routing” part of this publication. For command information, see the *Cisco IOS Dial Services Command Reference* publication.

To configure bandwidth on demand, see the chapters “Configuring Legacy DDR Spokes” or “Configuring Legacy DDR Hubs” later in this publication.

## ISDN BRI Configuration Task List

To configure ISDN lines and interfaces, perform the tasks in the following sections:

- Configuring the ISDN BRI Switch (Required)
- Specifying Interface Characteristics for an ISDN BRI (As Required)

See the sections “Monitoring and Maintaining ISDN Interfaces” and “Troubleshooting ISDN Interfaces” later in this chapter for tips on maintaining your network. See the section “ISDN BRI Configuration Examples” at the end of this chapter for configuration examples.

## Configuring the ISDN BRI Switch

To configure the ISDN switch type, perform the following tasks:

- Configuring the Switch Type (Required)
- Checking and Setting the Buffers (As Required)

## Configuring the Switch Type

To configure the switch type, use the following command in global configuration mode:

Command	Purpose
<code>isdn switch-type switch-type</code>	Selects the service provider switch type; see Table 14 for switch types.

The section “Global ISDN and BRI Interface Switch Type” later in this chapter provides an example of configuring the ISDN BRI switch.



### Note

You can apply an ISDN switch type to a specific BRI interface and configure more than one ISDN switch type per router using the Multiple ISDN Switch Types feature, thus extending the existing global `isdn switch-type` command to the interface level. A global ISDN switch type is required and must be configured on the router before you can configure a switch

type on an interface. See the section “Configuring Multiple ISDN Switch Types” in the chapter “Configuring ISDN PRI and Other Signaling on E1 and T1 Lines” for information about configuring this feature.

Table 15 lists the ISDN BRI service provider switch types.

**Table 15 ISDN Service Provider BRI Switch Types**

Keywords by Area	Switch Type
<b>none</b>	No switch defined
<b>Japan</b>	
<b>ntt</b>	Japanese NTT ISDN switches
<b>Europe and Australia</b>	
<b>basic-1tr6</b>	German 1TR6 ISDN switches
<b>basic-net3</b>	NET3 ISDN, Norway NET3, Australia NET3, and New Zealand NET3 switches (covers the Euro-ISDN E-DSS1 signalling system and is ETSI-compliant)
<b>vn3</b>	French VN3 and VN4 ISDN BRI switches
<b>North America</b>	
<b>basic-5ess</b>	AT&T basic rate switches
<b>basic-dms100</b>	Northern Telecom DMS-100 basic rate switches
<b>basic-ni</b>	National ISDN switches



**Note**

The command parser will still accept the following switch type keywords: **basic-nwnet3**, **vn2**, and **basic-net3**; however, when viewing the NVRAM configuration, the **basic-net3** or **vn3** switch type keywords are displayed respectively.

## Checking and Setting the Buffers

When configuring a BRI, after the system comes up, make sure enough buffers are in the free list of the buffer pool that matches the maximum transmission unit (MTU) of your BRI interface. If not, you must reconfigure buffers in order for the BRI interfaces to function properly.

To check the MTU size and the buffers and, if necessary, to configure the buffers and the MTU size, use any of the following commands beginning in EXEC mode:

Command	Purpose
<code>show interfaces bri <i>number</i></code>	Checks the MTU size.
<code>show buffers</code>	Checks the free buffers.
<code>configure terminal</code> <code>buffers big permanent <i>number</i></code> <code>buffers big max-free <i>number</i></code> <code>buffers big min-free <i>number</i></code> <code>buffers big initial <i>number</i></code>	Configures the buffers.

## Specifying Interface Characteristics for an ISDN BRI

Perform the tasks in the following sections to set interface characteristics for an ISDN BRI, whether it is the only BRI in a router or is one of many. Each of the BRI's can be configured separately.

- Specifying the Interface and Its IP Address (Required)
- Configuring CLI Screening (As Required)
- Configuring Encapsulation on ISDN BRI (Required)
- Configuring Network Addressing (Required)
- Configuring TEI Negotiation Timing (Optional)
- Configuring CLI Screening (Optional)
- Configuring Called Party Number Verification (Optional)
- Configuring ISDN Calling Number Identification (Optional)
- Configuring the Line Speed for Calls Not ISDN End to End (Optional)
- Configuring a Fast Rollover Delay (Optional)
- Overriding ISDN Application Default Cause Codes (Optional)
- Configuring Inclusion of the Sending Complete Information Element (Optional)
- Configuring DNIS-plus-ISDN-Subaddress Binding (Optional)

### Specifying the Interface and Its IP Address

To specify an ISDN BRI and enter interface configuration mode, use the following commands in global configuration mode:

Command	Purpose
<code>interface bri <i>number</i></code> or <code>interface bri <i>slot/port</i></code> (Cisco 7200 series)	Specifies the interface and enter interface configuration mode.
<code>ip address <i>address mask</i></code>	Specifies an IP address for the interface.

### Specifying ISDN SPIDs

Some service providers use SPIDs to define the services subscribed to by the ISDN device that is accessing the ISDN service provider. The service provider assigns the ISDN device one or more SPIDs when you first subscribe to the service. If you are using a service provider that requires SPIDs, your ISDN device cannot place or receive calls until it sends a valid, assigned SPID to the service provider when accessing the switch to initialize the connection.

Currently, only the DMS-100 and NI switch types require SPIDs. The AT&T 5ESS switch type may support a SPID, but we recommend that you set up that ISDN service without SPIDs. In addition, SPIDs have significance at the local access ISDN interface only. Remote routers never receive the SPID.

A SPID is usually a seven-digit telephone number with some optional numbers. However, service providers may use different numbering schemes. For the DMS-100 switch type, two SPIDs are assigned, one for each B channel.

To define the SPIDs and the local directory number (LDN) on the router, use the following commands in interface configuration mode:

Command	Purpose
<code>isdn spid1 spid-number [ldn]</code>	Specifies a SPID and local directory number for the B1 channel.
<code>isdn spid2 spid-number [ldn]</code>	Specifies a SPID and local directory number for the B2 channel.

The LDN is optional but might be necessary if the router is to answer calls made to the second directory number.

## Configuring Encapsulation on ISDN BRI

Each ISDN B channel is treated as a synchronous serial line, and the default serial encapsulation is HDLC. The Dynamic Multiple Encapsulations feature introduced in Cisco IOS Release 12.1 allows incoming calls over ISDN to be assigned an encapsulation type such as Frame Relay, PPP, and X.25 based on CLID or DNIS. PPP encapsulation is configured for most ISDN communication.

To configure encapsulation, use the following command in interface configuration mode:

Command	Purpose
<code>encapsulation [ppp   lapb   frame-relay]</code>	Configures encapsulation type.

## Verifying the Dynamic Multiple Encapsulations Feature

To verify dialer interfaces configured for binding and see statistics on each physical interface bound to the dialer interface, use the **show interfaces EXEC** command.

The following example shows that the output under the B channel keeps all hardware counts that are not displayed under any logical or virtual access interface. The line in the report that states “Interface is bound to Dialer0 (Encapsulation LAPB)” indicates that this B interface is bound to the dialer 0 interface and the encapsulation running over this connection is LAPB, not PPP, which is the encapsulation configured on the D interface and inherited by the B channel.

```
Router# show interfaces bri0:1
```

```
BRI0:1 is up, line protocol is up
Hardware is BRI
MTU 1500 bytes, BW 64 Kbit, DLY 20000 usec, rely 255/255, load 1/255
Encapsulation PPP, loopback not set, keepalive not set
Interface is bound to Dialer0 (Encapsulation LAPB)
LCP Open, multilink Open
Last input 00:00:31, output 00:00:03, output hang never
Last clearing of "show interface" counters never
Queueing strategy: fifo
Output queue 0/40, 0 drops; input queue 0/75, 0 drops
5 minute input rate 0 bits/sec, 1 packets/sec
5 minute output rate 0 bits/sec, 1 packets/sec
  110 packets input, 13994 bytes, 0 no buffer
  Received 91 broadcasts, 0 runts, 0 giants, 0 throttles
  0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
  135 packets output, 14175 bytes, 0 underruns
  0 output errors, 0 collisions, 12 interface resets
  0 output buffer failures, 0 output buffers swapped out
  8 carrier transitions
```

Any protocol configuration and states should be displayed from the dialer 0 interface.

## Encapsulation Configuration Notes

The router might need to communicate with devices that require a different encapsulation protocol or the router might send traffic over a Frame Relay or X.25 network. The Dynamic Multiple Encapsulations feature provides bidirectional support of all serial encapsulations except Frame Relay.

For more information, see the sections “Sending Traffic over Frame Relay, X.25, or LAPB Networks” in the chapters “Configuring Legacy DDR Spokes” and “Configuring Legacy DDR Hubs” later in this publication.

To configure the router for automatic detection of encapsulation type on incoming calls, or to configure encapsulation for Cisco 700 and 800 series (formerly Combinet) router compatibility, see the section “Configuring Automatic Detection of Encapsulation Type” in the chapter “Configuring ISDN Special Signalling” later in this publication.

## Configuring Network Addressing

The steps in this section support the primary goals of network addressing:

- Define which packets are *interesting* and will thus cause the router to make an outgoing call.
- Define the remote host where the calls are going.
- Specify whether broadcast messages will be sent.
- Specify the dialing string to use in the call.

Intermediate steps that use shared argument values tie the host identification and dial string to the interesting packets to be sent to that host.

To configure network addressing, use the following commands beginning in interface configuration mode:

	Command	Purpose
Step 1	<pre>Router(config-if)# dialer map protocol next-hop-address name hostname speed [56   64] dial-string[:isdn-subaddress]</pre> <p>or</p> <pre>Router(config-if)# dialer map protocol next-hop-address name hostname spc [speed 56   64] [broadcast] dial-string[:isdn-subaddress]</pre>	<p>(Most locations) Configures a serial interface or ISDN interface to call one or multiple sites or to receive calls from multiple sites.</p> <p>(Germany) Uses the command keyword that enables ISDN semipermanent connections.</p>
Step 2	<pre>Router(config-if)# dialer-group group-number</pre>	Assigns the interface to a dialer group to control access to the interface.
Step 3	<pre>Router(config-if)# exit</pre>	Exits to global configuration mode.
Step 4	<pre>Router(config)# dialer-list dialer-group protocol protocol-name {permit   deny   list access-list-number   access-group}</pre>	Defines a dial-on-demand routing (DDR) dialer list for dialing by protocol or by a combination of a protocol and an access list.
Step 5	<pre>Router(config)# access-list access-list-number {deny   permit} protocol source address source-mask destination destination-mask</pre>	Defines an access list permitting or denying access to specified protocols, sources, or destinations. Permitted packets cause the router to place a call to the destination protocol address.

German networks allow semipermanent connections between customer routers with BRIs and the 1TR6 basic rate switches in the exchange. Semipermanent connections are less expensive than leased lines.



#### Note

The access list reference in Step 5 of this task list is an example of the **access-list** commands allowed by different protocols. Some protocols might require a different command form or might require multiple commands. Refer to the relevant protocol chapter in the network protocol configuration guide (the *Cisco IOS AppleTalk and Novell IPX Configuration Guide*, for example) for more information about setting up access lists for a protocol.

For more information about defining outgoing call numbers, see the chapters “Configuring Legacy DDR Hubs” and “Configuring Legacy DDR Spokes” later in this publication.

## Configuring TEI Negotiation Timing

You can configure ISDN TEI negotiation on individual ISDN interfaces. TEI negotiation is useful for switches that may deactivate Layers 1 or 2 when there are no active calls. Typically, this setting is used for ISDN service offerings in Europe and connections to DMS-100 switches that are designed to initiate TEI negotiation.

By default, TEI negotiation occurs when the router is powered up. The TEI negotiation value configured on an interface overrides the default or global TEI value. For example, if you configure **isdn tei first-call** globally and **isdn tei powerup** on BRI interface 0, then TEI negotiation **powerup** is the value applied to BRI interface 0. It is not necessary to configure TEI negotiation unless you wish to override the default value (**isdn tei powerup**).

To apply TEI negotiation to a specific BRI interface, use the following command in interface configuration mode:

Command	Purpose
<code>isdn tei [first-call   powerup]</code>	Determines when ISDN TEI negotiation occurs.

## Configuring CLI Screening

CLI screening adds a level of security by allowing you to screen incoming calls. You can verify that the calling line ID is from an expected origin. CLI screening requires a local switch that is capable of delivering the CLI to the router.

To configure CLI screening, use the following command in interface configuration mode:

Command	Purpose
<code>isdn caller number</code>	Configures caller ID screening.



### Note

If caller ID screening is configured and the local switch does not deliver caller IDs, the router rejects all calls.



### Note

In earlier releases of the Cisco IOS software, ISDN accepted all synchronous calls and performed some minimal CLI screening before accepting or rejecting a call. Beginning with Cisco IOS Release 12.1 software, DDR provided a separate process that screens for the profile of the caller. The new screening process also checks that enough resources are available to accept the call and that the call conforms to predetermined rules. When the call is found acceptable, the screening process searches for a matching profile for the caller. The call is accepted only when there is a matching profile.

## Configuring Called Party Number Verification

When multiple devices are attached to an ISDN BRI, you can ensure that only a single device answers an incoming call by verifying the number or subaddress in the incoming call against the configured number or subaddress or both of the device.

You can specify that the router verify a called-party number or subaddress number in the incoming setup message for ISDN BRI calls, if the number is delivered by the switch. You can do so by configuring the number that is allowed. To configure verification, use the following command in interface configuration mode:

Command	Purpose
<code>isdn answer1 [called-party-number] [:subaddress]</code>	Specifies that the router verify a called-party number or subaddress number in the incoming setup message.

Verifying the called-party number ensures that only the desired router responds to an incoming call. If you want to allow an additional number for the router, you can configure it, too.

To configure a second number to be allowed, use the following command in interface configuration mode:

Command	Purpose
<code>isdn answer2 [called-party-number] [:subaddress]</code>	Specifies that the router verify a second called-party number or subaddress number in the incoming setup message.

## Configuring ISDN Calling Number Identification

A router with an ISDN BRI interface might need to supply the ISDN network with a billing number for outgoing calls. Some networks offer better pricing on calls in which the number is presented. When configured, this information is included in the outgoing call Setup message.

To configure the interface to identify the billing number, use the following command in interface configuration mode:

Command	Purpose
<code>isdn calling-number calling-number</code>	Specifies the calling party number.

This command can be used with all switch types except German 1TR6 ISDN BRI switches.

## Configuring the Line Speed for Calls Not ISDN End to End

When calls are made at 56 kbps but delivered by the ISDN network at 64 kbps, the incoming data can be corrupted. However, on ISDN calls, if the receiving side is informed that the call is not an ISDN call from end to end, it can set the line speed for the incoming call.

To set the speed for incoming calls recognized as not ISDN end to end, use the following command in interface configuration mode:

Command	Purpose
<code>isdn not-end-to-end {56   64}</code>	Sets the speed to be used for incoming calls recognized as not ISDN end to end.

## Configuring a Fast Rollover Delay

Sometimes a router attempts to dial a call on an ISDN B channel before a previous call is completely torn down. The fast rollover fails because the second call is made to a different number before the B channel is released from the unsuccessful call. This failure might occur in the following ISDN configurations:

- The two B channels of the BRI are not configured as a hunt group, but have separate numbers defined.
- The B channel is not released by the ISDN switch until after Release Complete signal is processed.

You need to configure this delay if a BRI on a remote peer has two phone numbers configured one for each B channel you are dialing into this BRI, you have a dialer map for each phone number, and the first call succeeds but a second call fails with no channel available.

To configure a fast rollover delay, use the following command in interface configuration mode:

Command	Purpose
<code>isdn fast-rollover-delay seconds</code>	Defines a fast rollover delay.

A delay of 5 seconds should cover most cases. Configure sufficient delay to make sure the ISDN RELEASE\_COMPLETE message has been sent or received before making the fast rollover call. Use the **debug isdn q931** command to display this information. This pattern of failed second calls is a rare occurrence.

## Overriding ISDN Application Default Cause Codes

The ISDN Cause Code Override function is useful for overriding the default cause code of ISDN applications. When this feature is implemented, the configured cause code is sent to the switch; otherwise, default cause codes of the application are sent.

To configure ISDN cause code overrides, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# <code>isdn disconnect-cause {cause-code-number} busy   not-available</code>	Specifies the ISDN cause code to send to the switch.

## ISDN Cause Code Override Configuration Example

The following example sends a BUSY cause code to the switch when an application fails to complete the call:

```
interface serial0:23
 isdn disconnect-cause busy
```

## Verifying ISDN Cause Code Override

To verify that the ISDN Cause Code Override feature is operating correctly, enter the **debug q931** command. The **debug q931** command will display a report of any configuration irregularities.

## Configuring Inclusion of the Sending Complete Information Element

In some geographic locations, such as Hong Kong and Taiwan, ISDN switches require that the Sending Complete information element be included in the outgoing Setup message to indicate that the entire number is included. This information element is generally not required in other locations.

To configure the interface to include the Sending Complete information element in the outgoing call Setup message, use the following command in interface configuration mode:

Command	Purpose
<code>isdn sending-complete</code>	Includes the Sending Complete information element in the outgoing call Setup message.

## Configuring DNIS-plus-ISDN-Subaddress Binding

To configure DNIS-plus-ISDN-subaddress binding, use the following command in global configuration mode:

Command	Purpose
Router(config)# <code>dialer called DNIS:subaddress</code>	Binds a DNIS to an ISDN subaddress.



### Note

This command allows multiple binds between a dialer profile and an ISDN B channel. The configuration requires an ISDN subaddress, which is used in Europe and Australia.

See the section “DNIS-plus-ISDN-Subaddress Binding” later in this chapter for a configuration example.

## Monitoring and Maintaining ISDN Interfaces

To monitor and maintain ISDN interfaces, use any of the following commands:

Command	Purpose
<code>show interfaces bri number</code> <code>show interfaces bri slot/port</code> (Cisco 7200 series)	Displays information about the physical attributes of the ISDN BRI B and D channels.
<code>show controllers bri number</code> <code>show controllers bri slot/port</code> (Cisco 7200 series)	Displays protocol information about the ISDN B and D channels.
<code>show isdn {active   history   memory   status   timers}</code>	Displays information about calls, history, memory, status, and Layer 2 and Layer 3 timers.
<code>show dialer interface bri number</code>	Obtains general diagnostic information about the specified interface.

# Troubleshooting ISDN Interfaces

To test the ISDN configuration of the router, use any of the following commands in EXEC mode:

Command	Purpose
<code>show controllers bri number</code>	Checks Layer 1 (physical layer) of the BRI.
<code>debug q921</code>	Checks Layer 2 (data link layer).
<code>debug isdn events</code> <code>debug q931</code> <code>debug dialer</code> <code>show dialer</code>	Checks Layer 3 (network layer).

See the *Cisco IOS Debug Command Reference* publication for more information about the **debug** commands.

## ISDN BRI Configuration Examples

This section provides the following ISDN BRI configuration examples:

- Global ISDN and BRI Interface Switch Type
- BRI Connected to a PBX
- Multilink PPP on a BRI Interface
- Dialer Rotary Groups
- Compression Examples
- Multilink PPP and Compression
- Voice over ISDN
- DNIS-plus-ISDN-Subaddress Binding

### Global ISDN and BRI Interface Switch Type

The following example shows a global National ISDN switch type (keyword **basic-ni**) and an interface-level NET3 ISDN switch type (keyword **basic-net3**). The **basic-net3** keyword is applied to BRI interface 0 and overrides the global switch setting.

```
isdn switch-type basic-ni
!
interface BRI0
 isdn switch-type basic-net3
```

## BRI Connected to a PBX

The following example provides a simple partial configuration of a BRI interface that is connected to a PBX. This interface is connected to a switch that uses SPID numbers.

```
interface BRI0
  description connected to pbx line 61885
  ip address 7.1.1.3 255.255.255.0
  encapsulation ppp
  isdn spid1 123
  dialer map ip 7.1.1.1 name oldie 61886
  dialer map ip 7.1.1.2 name rudder 61884
  dialer map ip 7.1.1.4 name seinfeld 61888
  dialer-group 1
  no fair-queue
  ppp authentication chap
```

## Multilink PPP on a BRI Interface

The following example enables Multilink PPP on BRI 0:

```
interface BRI0
  description Enables PPP Multilink on BRI 0
  ip address 7.1.1.1 255.255.255.0
  encapsulation ppp
  dialer map ip 7.1.1.2 name starbuck 14195291357
  dialer map ip 7.1.1.3 name roaster speed 56 14098759854
  ppp authentication chap
  ppp multilink
  dialer-group 1
```

## Dialer Rotary Groups

The following example configures BRI interfaces to connect into a rotary group (using the **dialer-group** command) and then configures a dialer interface for that dialer group. This configuration permits IP packets to trigger calls.

```
interface BRI 0
  description connected into a rotary group
  encapsulation ppp
  dialer rotary-group 1

interface BRI 1
  no ip address
  encapsulation ppp
  dialer rotary-group 1

interface BRI 2
  encapsulation ppp
  dialer rotary-group 1

interface BRI 3
  no ip address
  encapsulation ppp
  dialer rotary-group 1
```

```
interface BRI 4
 encapsulation ppp
 dialer rotary-group 1

interface Dialer 0
 description Dialer group controlling the BRIs
 ip address 8.1.1.1 255.255.255.0
 encapsulation ppp
 dialer map ip 8.1.1.2 name angus 14802616900
 dialer-group 1
 ppp authentication chap

dialer-list 1 protocol ip permit
```

## Compression Examples

The following example enables predictor compression on BRI 0:

```
interface BRI0
 description Enables predictor compression on BRI 0
 ip address 7.1.1.1 255.255.255.0
 encapsulation ppp
 dialer map ip 7.1.1.2 name starbuck 14195291357
 compress predictor
 ppp authentication chap
 dialer-group 1
```

The following example enables Stacker compression on BRI 0:

```
interface BRI0
 description Enables stac compression on BRI 0
 ip address 7.1.1.1 255.255.255.0
 encapsulation ppp
 dialer map ip 7.1.1.2 name starbuck 14195291357
 compress stac
 ppp authentication chap
 dialer-group 1
```

## Multilink PPP and Compression

The following example enables Multilink PPP and Stacker compression on BRI 0:

```
interface BRI0
 description Enables PPP Multilink and stac compression on BRI 0
 ip address 7.1.1.1 255.255.255.0
 encapsulation ppp
 dialer map ip 7.1.1.2 name starbuck 14195291357
 ppp authentication chap
 compress stac
 ppp multilink
 dialer-group 1
```

## Voice over ISDN

The following example allows incoming voice calls to be answered on BRI 0:

```
interface bri0
  description Allows incoming voice calls to be answered on BRI 0
  ip address 7.1.1.1 255.255.255.0
  encapsulation ppp
  isdn incoming-voice data
  dialer map ip 7.1.1.2 name starstruck 14038182344
  ppp authentication chap
  dialer-group 1
```

The following example allows outgoing voice calls on BRI 1:

```
interface bri1
  description Places an outgoing call as a voice call on BRI 1
  ip address 9.1.1.1 255.255.255.0
  encapsulation ppp
  dialer map ip 9.1.1.2 name angus class calltype 19091238877
  ppp authentication chap
  dialer-group 1

map-class dialer calltype
  dialer voice-call
```

## DNIS-plus-ISDN-Subaddress Binding

The following example configures a dialer profile for a receiver with DNIS 12345 and ISDN subaddress 6789:

```
dialer called 12345:6789
```

For additional configuration examples, see the sections “Dynamic Multiple Encapsulations over ISDN” and “Verifying the Dynamic Multiple Encapsulations Feature” in the chapter “Configuring Peer-to-Peer DDR with Dialer Profiles” in this publication.