# Setting Up ISDN Basic Rate Service

This chapter describes tasks that are required to make an ISDN BRI line and interface operational, and it describes features involved in configuring ISDN in a circuit-switched internetworking environment.

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

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

For a complete description of the BRI commands in this chapter, refer to the "ISDN Basic Rate Service Setup Commands" chapter of the *Dial Solutions Command Reference*. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

## ISDN BRI Task List

Perform the tasks in the following sections to configure ISDN lines and interfaces:

- Request BRI Line and Switch Configuration from a Telco Service Provider
- Check and Set the Buffers
- Configure Global Characteristics for ISDN BRI
- Specify Interface Characteristics for an ISDN BRI

You can also perform the following ISDN troubleshooting and maintenance tasks:

- Perform Configuration Self-Tests
- Monitor and Maintain ISDN Interfaces

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 "Configuring Snapshot Routing" chapter in the "Cost-Control Solutions" part of this manual 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 manual. For command information, refer to the "Dial-on-Demand Routing" part of the *Dial Solutions Command Reference*.

To configure bandwidth on demand, see the "Configuring Legacy DDR Spokes" chapter or the "Configuring Legacy DDR Hubs" chapter of this manual.

See the end of this chapter for the "ISDN BRI Configuration Examples" section.

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

Before configuring the ISDN interfaces on your Cisco router, it is necessary to order a correctly configured ISDN line from your telecommunications service provider.

This process varies dramatically from provider to provider on a national and international basis. However, some general guidelines follow:

- On a BRI, 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 is going to be the only device attached to the BRI, ask for point-to-point service and a data-only line.
- If the router is going to 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 11.

**Table 11 ISDN BRI Switch Type Configuration Information**

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

**Table 11 ISDN BRI Switch Type Configuration Information**

| Switch Type | Configuration |
|---|---|
| **5ESS Custom BRI** | **For Data Only**<br>2 B channels for data.<br>Point to point.<br>Terminal type = E.<br>1 directory number (DN) assigned by service provider.<br>MTERM = 1.<br>Request delivery of calling line ID on Centrex lines.<br>Set speed for ISDN calls to 56 kbps outside local exchange.<br><br>**For Voice and Data**<br>(Use these values only if you have an ISDN telephone connected.)<br>2 B channels for voice or data.<br>Multipoint.<br>Terminal type = D.<br>2 directory numbers assigned by service provider.<br>2 service profile identifiers (SPIDs) required, assigned by service provider.<br>MTERM = 2.<br>Number of call appearances = 1.<br>Display = No.<br>Ringing/idle call appearances = idle.<br>Autohold= no.<br>Onetouch = no.<br>Request delivery of calling line ID on Centrex lines.<br>Set speed for ISDN calls to 56 kbps outside local exchange.<br>Directory number 1 can hunt to directory number 2. |
| **5ESS National ISDN (NI-1) BRI** | Terminal type = A.<br>2 B channels for voice and data.<br>2 directory numbers assigned by service provider.<br>2 SPIDs required; assigned by service provider.<br>Set speed for ISDN calls to 56 kbps outside local exchange.<br>Directory number 1 can hunt to directory number 2. |

# Check and Set 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, complete the following tasks beginning in EXEC mode:

| Task | Command |
|---|---|
| Check the MTU size. | **show interfaces bri** *number* |
| Check the free buffers. | **show buffers** |
| Configure the buffers. | **configure terminal**<br><br>**buffers big permanent** *number*<br>**buffers big max-free** *number*<br>**buffers big min-free** *number*<br>**buffers big initial** *number* |

# Configure Global Characteristics for ISDN BRI

To configure the ISDN global characteristics, complete the tasks in the following sections:

- Configure the Switch Type
- Configure TEI Negotiation Timing

## Configure the Switch Type

To configure the switch type, complete the following task in global configuration mode:

| Task | Command |
|---|---|
| Select the service provider switch type.[1] | **isdn switch-type** *switch-type* |

1. Any router with an MBRI must be connected to the same switch type on all its ISDN interfaces.

Table 12 lists the ISDN BRI switch types by geographic areas.

**Table 12 ISDN Service Provider Switch Types**

| Keywords by Area | Switch Type |
|---|---|
| **none** | No switch defined |
| **Australia** | |
| **basic-ts013** | Australian TS013 switches |
| **Europe** | |
| **basic-1tr6** | German 1TR6 ISDN switches |
| **basic-nwnet3** | Norway NET3 switches (phase 1) |
| **basic-net3** | NET3 ISDN switches; covers the Euro-ISDN E-DSS1 signaling system and is ETSI-compliant. |
| **vn2** | French VN2 ISDN BRI switches |
| **vn3** | French VN3 ISDN BRI switches |
| **vn4** | French VN4 ISDN BRI switches |
| **Japan** | |
| **ntt** | Japanese NTT ISDN switches |
| **North America** | |
| **basic-5ess** | AT&T basic rate switches |
| **basic-dms100** | NT DMS-100 basic rate switches |
| **basic-ni1** | National ISDN-1 switches |
| **New Zealand** | |
| **basic-nznet3** | New Zealand Net3 switches |

## Configure TEI Negotiation Timing

You can specify when Layer 2 ISDN terminal endpoint identifier (TEI) negotiation occurs. TEI negotiation is useful in Europe and also useful for switches that might deactivate Layer 2 when no calls are active.

By default TEI negotiation occurs when the router is powered on. To define when TEI negotiation will occur, perform the following task in global configuration mode:

| Task | Command |
|---|---|
| Determine when ISDN TEI negotiation occurs. | **isdn tei** [**first-call** \| **powerup**] |

# Specify 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 BRIs can be configured separately. You must perform the tasks in the following sections:

- Specify the Interface and Its IP Address
- Configure Encapsulation
- Configure Network Addressing

In addition, you can configure the following optional interface characteristics on the BRI:

- Specify ISDN Service Profile Identifiers (SPIDs)
- Configure Calling Line Identification Screening
- Configure Called Party Number Verification
- Configure ISDN Calling Number Identification
- Configure the Line Speed for Calls Not ISDN End-To-End
- Configure a Fast Rollover Delay
- Configure Inclusion of the Sending Complete Information Element

## Specify the Interface and Its IP Address

To specify an ISDN Basic Rate Interface (BRI) and enter interface configuration mode, perform the following task in global configuration mode:

| Task | Command |
|---|---|
| Specify the interface and enter interface configuration mode. | **interface bri** *number*<br>**interface bri** *slot/port* (Cisco 7200 series) |
| Specify an IP protocol address for the interface. | **ip address** *ip-address mask* |

## Configure Encapsulation

PPP encapsulation is configured for most ISDN communication.

Each ISDN B channel is treated as a synchronous serial line and supports HDLC and PPP encapsulation. The default serial encapsulation is HDLC.To configure PPP encapsulation, perform the following task in interface configuration mode:

| Task | Command |
|---|---|
| Configure PPP Encapsulation | **encapsulation ppp** |

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. For more information, see the "Configuring Frame Relay on ISDN D and B Channels" and "Configuring X.25 on ISDN D and B Channels" chapters of this manual.

To configure the router for automatic detection of encapsulation type on incoming calls, or to configure encapsulation for Combinet compatibility, see the "Configuring Special ISDN Signaling" chapter of this manual.

## Configure 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 transmitted to that host.

To configure network addressing, complete the following tasks beginning in interface configuration mode:

| Task | | Command |
|---|---|---|
| **Step 1** | (Most locations) Define the remote recipient's protocol address, host name, and dialing string; optionally, provide the ISDN subaddress; set the dialer speed to 56 or 64 kbps, as needed.<br>or | **dialer map** *protocol next-hop-address* **name** *hostname* **speed 56\|64** *dial-string*[**:***isdn-subaddress*] |
| | (Germany) Use the command keyword that enables ISDN semipermanent connections. | **dialer map** *protocol next-hop-address* **name** *hostname* **spc** [**speed 56 \| 64**] [**broadcast**] *dial-string*[**:***isdn-subaddress*] |
| **Step 2** | Assign the interface to a dialer group to control access to the interface. | **dialer-group** *group-number* |
| **Step 3** | Associate the dialer group number with an access list number. | **dialer-list** *dialer-group* **list** *access-list-number* |
| **Step 4** | Define 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. | **access-list** *access-list-number* {**deny \| permit**} *protocol source address source-mask destination destination-mask* |

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

**Note** The access list reference in Step 4 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 Protocols Configuration Guide, Part 1* or the *Network Protocols Configuration Guide, Part 2* for more information about setting up access lists for a protocol.

For more information about defining outgoing call numbers, see the "Configuring DDR" chapter.

## Specify ISDN Service Profile Identifiers (SPIDs)

Some service providers use service profile identifiers (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-1 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 are never sent 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, perform the following tasks in interface configuration mode:

| Task | Command |
|---|---|
| Specify a SPID and local directory number for the B1 channel. | **isdn spid1** *spid-number* [*ldn*] |
| Specify a SPID and local directory number for the B2 channel. | **isdn spid2** *spid-number* [*ldn*] |

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

## Configure Calling Line Identification Screening

This task applies only to Cisco 2500 series, Cisco 3000 series, and Cisco 4000 series routers that have a BRI.

Calling line identification (CLI, also called *caller ID*) 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 caller ID screening, perform the following task in interface configuration mode:

| Task | Command |
|---|---|
| Configure caller ID screening. | **isdn caller** *number* |

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

## Configure 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 device's configured number or subaddress or both.

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, perform the following task in interface configuration mode:

| Task | Command |
|---|---|
| Specify that the router verify a called-party number or subaddress number in the incoming setup message. | **isdn answer1** [*called-party-number*][**:***subaddress*] |

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, perform the following task in interface configuration mode:

| Task | Command |
|---|---|
| Specify that the router verify a second called-party number or subaddress number in the incoming setup message. | **isdn answer2** [*called-party-number*][**:***subaddress*] |

## Configure 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, perform the following task in interface configuration mode:

| Task | Command |
|---|---|
| Specify the calling party number. | **isdn calling-number** *calling-number* |

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

## Configure 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, complete the following task in interface configuration mode:

| Task | Command |
|---|---|
| Set the speed to be used for incoming calls recognized as not ISDN end-to-end. | **isdn not-end-to-end** {**56** \| **64**} |

## Configure a Fast Rollover Delay

Sometimes a router attempts to dial a call on an ISDN B channel before a previous, failed 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 might occur in ISDN configurations where:

- The two B-channels of the BRI are not configured as a hunt group, but have separate numbers defined, and
- 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, complete the following task in interface configuration mode:

| Task | Command |
|---|---|
| Define a fast rollover delay. | **isdn fast-rollover-delay** *seconds* |

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.

## Configure 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 not required in other locations.

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

| Task | Command |
|---|---|
| Include the Sending Complete information element in the outgoing call Setup message. | **isdn sending-complete** |

# Perform Configuration Self-Tests

To test the router's ISDN configuration, we suggest that you perform the following tasks:

| Task | Command |
|---|---|
| Check Layer 1 (physical layer) of the BRI. | **show controllers bri** *number* |
| Check Layer 2 (data link layer). | **debug q921** |
| Check Layer 3 (network layer). | **debug isdn events** |
| | **debug q931** |
| | **debug dialer** |
| | **show dialer** |

See the *Debug Command Reference* for information about the **debug** commands.

# Monitor and Maintain ISDN Interfaces

Use the following commands to monitor and maintain ISDN interfaces:

| Task | Command |
|---|---|
| Display information about the physical attributes of the ISDN BRI B and D channels. | **show interfaces bri** *number*<br>**show interfaces bri** *slot*/*port* (Cisco 7200 series) |
| Display protocol information about the ISDN B and D channels. | **show controllers bri** *number*<br>**how controllers bri** *slot*/*port* (Cisco 7200 series) |
| Display information about calls, history, memory, status, and Layer 2 and Layer 3 timers. | **show isdn** {**active** \| **history** \| **memory** \| **status** \| **timers**} |
| Obtain general diagnostic information about the specified interface. | **show dialer interface bri** *number* |

# ISDN BRI Configuration Examples

This section provides the following ISDN BRI configuration examples:

- BRI Connected to a PBX Example
- Multilink PPP on a BRI Interface Example
- Dialer Rotary Groups Example
- Compression Examples
- Voice over ISDN Examples

## BRI Connected to a PBX Example

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 Example

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 Example

The following example configures BRI interfaces to connect into a rotary group (dialer-group) 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 Example

The following example enables PPP Multilink 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 Examples

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 places an outgoing call as a voice call 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
```