



Configuring ISDN Special Signalling

This chapter describes features that either depend on special signalling services offered by an ISDN network service provider or overcome an inability to deliver certain signals. It describes these features in the following main sections:

- ISDN Special Signalling Configuration Task List
- Troubleshooting ISDN Special Signalling
- ISDN Special Signalling Configuration Examples

For an overview of ISDN PRI, see the section “ISDN Service” in the “Interfaces, Controllers, and Lines Used for Dial Access Overview” chapter, and the section “ISDN Overview” in the “Setting Up Basic ISDN Service” chapter.

For a complete description of the ISDN signalling 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 Special Signalling Configuration Task List

Perform the tasks in the following sections to configure special signalling features of ISDN; all tasks are optional:

- Configuring ISDN AOC (Optional)
- Configuring NFAS (Optional)
- Configuring ISDN Semipermanent Connections (Optional)
- Configuring ISDN BRI for Leased-Line Service (Optional)
- Configuring Automatic Detection of Encapsulation Type (Optional)
- Configuring Encapsulation for Combinet Compatibility (Optional)

See the section “ISDN Special Signalling Configuration Examples” at the end of this chapter for examples of these signalling features. See the “Troubleshooting ISDN Special Signalling” section later in this chapter for help in troubleshooting ISDN signalling features.

Configuring ISDN AOC

ISDN Advice of Charge (AOC) allows users to obtain charging information for all calls during the call (AOC-D) or at the end of the call (AOC-E) or both.

Users must have subscribed through their local ISDN network to receive the AOC information from the switch. No router configuration changes are required to retrieve this call charging information.

The ISDN AOC feature also supports, for the AOC-D service, an optional configurable short-hold mode that provides a dynamic idle timeout by measuring the call charging period, based on the frequency of the AOC-D or the AOC-E message from the network. The short-hold mode allows users to track call costs and to control and possibly reduce tariff charges. The short-hold mode idle time will do the following:

- Disconnect a call just prior to the beginning of a new charging period if the call has been idle for at least the configured minimum idle time.
- Maintain the call to the end of the current charging period past the configured idle timeout if the time left in the charging period is longer.

Incoming calls are disconnected using the static dialer idle timeout value.

The AOC-D and AOC-E messages are part of the Facility Information Element (IE) message. Its contents can be verified with the **debug q931** command. Call accounting information from AOC-D and AOC-E messages is stored in Simple Network Management Protocol (SNMP) MIB objects.

ISDN AOC is provided for ISDN PRI NET5 and ISDN BRI NET3 switch types only. AOC information at call setup is not supported.

Configuring Short-Hold Mode

No configuration is required to enable ISDN AOC. However, you can configure the optional short-hold minimum idle timeout period for outgoing calls; the default minimum idle timeout is 120 seconds. If the short-hold option is not configured, the router default is to use the static dialer idle timeout. If the short-hold idle timeout has been configured but no charging information is available from the network, the static dialer idle timeout applies.

To configure an ISDN interface and provide the AOC short-hold mode option on an ISDN interface, perform the following steps:

-
- Step 1** Configure the ISDN BRI or PRI interface, as described in the chapter “Setting Up Basic ISDN Service” or the section “ISDN PRI Configuration Task List” in the chapter “Configuring ISDN PRI and Other Signaling on E1 and T1 Lines” later in this publication, using the relevant keyword in the **isdn switch-type** command:
- BRI interface—**basic-net3**
 - PRI interface—**primary-net5**
- Step 2** Configure dialer profiles or legacy dial-on-demand routing (DDR) for outgoing calls, as described in the chapters in the “Dial-on-Demand Routing” part of this publication, making sure to do the following:
- Configure the static line-idle timeout to be used for incoming calls.
 - For each destination, use the **dialer map** command with the **class** keyword (legacy DDR) or a **dialer string class** command (dialer profiles) to identify the dialer map class to be used for outgoing calls to the destination.

- Step 3** Configure each specified dialer map class, providing a dialer idle timeout, or ISDN short-hold timeout, or both for outgoing calls, as described in this chapter.

To configure a dialer map class with timers, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	<code>map-class dialer <i>classname</i></code>	Specifies the dialer map class.
Step 2	<code>dialer idle-timeout <i>seconds</i></code>	(Optional) Specifies a static idle timeout for the map class to override the static line-idle timeout configured on the BRI interface.
Step 3	<code>dialer isdn short-hold <i>seconds</i></code>	Specifies a dialer ISDN short-hold timeout for the map class.

Monitoring ISDN AOC Call Information

To monitor ISDN AOC call information, use the following command in EXEC mode:

Command	Purpose
<code>show isdn {active [<i>dsl</i> <i>serial number</i>] history [<i>dsl</i> <i>serial number</i>] memory nfas group <i>number</i> service [<i>dsl</i> <i>serial number</i>] status [<i>dsl</i> <i>serial number</i>] timers [<i>dsl</i> <i>serial number</i>] }</code>	Displays information about active calls, call history, memory, nfes group, service or status of PRI channels, or Layer 2 or Layer 3 timers. The history keyword displays AOC charging time units used during the call and indicates whether the AOC information is provided during calls or at the end of calls. (The service keyword is available for PRI only.)

Configuring NFAS

ISDN Non-Facility Associated Signalling (NFAS) allows a single D channel to control multiple PRI interfaces. Use of a single D channel to control multiple PRI interfaces frees one B channel on each interface to carry other traffic. A backup D channel can also be configured for use when the primary NFAS D channel fails. When a backup D channel is configured, any hard system failure causes a switch over to the backup D channel and currently connected calls remain connected.

ISDN NFAS Prerequisites

NFAS is only supported with a channelized T1 controller and, as a result, must be ISDN PRI capable. Once the channelized T1 controllers are configured for ISDN PRI, only the NFAS primary D channel must be configured; its configuration is distributed to all the members of the associated NFAS group. Any configuration changes made to the primary D channel will be propagated to all NFAS group members. The primary D channel interface is the only interface shown after the configuration is written to memory.

The channelized T1 controllers on the router must also be configured for ISDN, as described in the section “ISDN PRI Configuration Task List” in the chapter “Configuring ISDN PRI and Other Signaling on E1 and T1 Lines” in this document.

The router must connect to either an AT&T 4ESS, Northern Telecom DMS-100 or DMS-250, or National ISDN switch type. Table 20 shows the applicable ISDN switch types and supported NFAS types.

Table 20 ISDN Switch Types and Supported NFAS Types

Switch Type	NFAS Type
Lucent 4ESS	Custom NFAS
Northern Telecom DMS-250	Custom NFAS
Northern Telecom DMS-100	Custom NFAS
Lucent 5ESS	Custom (Does not support NFAS)
Lucent 5ESS	NI NFAS
AGCS GTD5	NI NFAS
Other Switch Types	NI NFAS



Note

On the Northern Telecom DMS-100 switch, when a single D channel is shared, multiple PRI interfaces may be configured in a single trunk group. The additional use of alternate route indexing, which is a feature of the DMS-100 switch, provides a rotary from one trunk group to another. This feature enables the capability of building large trunk groups in a public switched network.

The ISDN switch must be provisioned for NFAS. The primary and backup D channels should be configured on separate T1 controllers. The primary, backup, and B-channel members on the respective controllers should be the same as that configured on the router and ISDN switch. The interface ID assigned to the controllers must match that of the ISDN switch.

ISDN NFAS Configuration Task List

To configure NFAS on channelized T1 controllers configured for ISDN, perform the tasks in the following section: Configuring NFAS on PRI Groups (required).

You can also disable a channel or interface, if necessary, and monitor NFAS groups and ISDN service. To do so, perform the tasks in the following sections:

- Disabling a Channel or Interface (Optional)
- Monitoring NFAS Groups (Optional)
- Monitoring ISDN Service (Optional)

See the section “NFAS Primary and Backup D Channels” later in this chapter for ISDN, NFAS, and DDR configuration examples.

Configuring NFAS on PRI Groups

This section documents tasks used to configure NFAS with D channel backup. When configuring NFAS, you use an extended version of the ISDN **pri-group** command to specify the following values for the associated channelized T1 controllers configured for ISDN:

- The range of PRI time slots to be under the control of the D channel (time slot 24).
- The function to be performed by time slot 24 (primary D channel, backup, or none); the latter specifies its use as a B channel.
- The group identifier number for the interface under control of the D channel.

To configure ISDN NFAS, use the following commands in controller configuration mode:

	Command	Purpose
Step 1	<code>pri-group timeslots 1-24 nfas_d primary nfas_interface number nfas_group number</code>	On one channelized T1 controller, configures the NFAS primary D channel.
Step 2	<code>pri-group timeslots 1-24 nfas_d backup nfas_interface number nfas_group number</code>	On a different channelized T1 controller, configures the NFAS backup D channel to be used if the primary D channel fails.
Step 3	<code>pri-group timeslots 1-24 nfas_d none nfas_interface number nfas_group number</code>	(Optional) On other channelized T1 controllers, configures a 24-B-channel interface, if desired.

For an example of configuring three T1 controllers for the NFAS primary D channel, the backup D channel, and 24 B channels, along with the DDR configuration for the PRI interface, see the section “NFAS Primary and Backup D Channels” at the end of this chapter.

When a backup NFAS D channel is configured and the primary NFAS D channel fails, rollover to the backup D channel is automatic and all connected calls stay connected.

If the primary NFAS D channel recovers, the backup NFAS D channel remains active and does not switch over again unless the backup NFAS D channel fails.

Disabling a Channel or Interface

You can disable a specified channel or an entire PRI interface, thus taking it out of service or placing it into one of the other states that is passed in to the switch. To disable a specific channel or PRI interface, use one of the following commands in interface configuration mode:

Command	Purpose
<code>isdn service dsl number b_channel number state state-value</code>	Takes the individual B channel specified by the <i>number</i> argument out of service or sets it to a different state.
<code>isdn service dsl number b_channel 0 state state-value</code>	Sets the entire PRI to the specified state. The supported <i>state-values</i> are as follows: <ul style="list-style-type: none"> • 0—In service • 1—Maintenance • 2—Out of service

When the T1 Controller Is Shut Down

In the event that a controller belonging to an NFAS group is shut down, all active B-channel calls on the controller that is shut down will be cleared (regardless of whether the controller is set to be primary, backup, or none), and one of the following events will occur:

- If the controller that is shut down is configured as the primary and no backup is configured, all active calls on the group are cleared.
- If the controller that is shut down is configured as the primary, and the active (In service) D channel is the primary and a backup is configured, then the active D channel changes to the backup controller.
- If the controller that is shut down is configured as the primary, and the active D channel is the backup, then the active D channel remains as backup controller.
- If the controller that is shut down is configured as the backup, and the active D channel is the backup, then the active D channel changes to the primary controller.



Note

The active D channel changeover between primary and backup controllers happens only when one of the link fails and not when the link comes up. The T309 timer is triggered when the changeover takes place.

Monitoring NFAS Groups

To monitor NFAS groups, use the following command in EXEC mode:

Command	Purpose
<code>show isdn nfas group <i>number</i></code>	Displays information about members of an NFAS group.

Monitoring ISDN Service

To display information about ISDN channel service states, use the following command in EXEC mode:

Command	Purpose
<code>show isdn service</code>	Displays information about ISDN channels and the service states.

Configuring ISDN Semipermanent Connections

German networks allow semipermanent connections between customer routers with BRI interfaces and the 1TR6 basic rate switches in the exchange. Australian networks allow semipermanent connections between ISDN PRI interfaces and the TS-014 primary rate switches in the exchange. Semipermanent connections are offered at better pricing than leased lines.

Configuring BRI interfaces for semipermanent connection requires only that you use a keyword that indicates semipermanent connections when you are setting up network addressing as described in the previous section of this chapter.

To configure a BRI for semipermanent connections, follow this procedure:

- Step 1** Set up the ISDN lines and ports as described in the chapter “Configuring ISDN Special Signalling” or in the section “ISDN PRI Configuration Task List” in the chapter “Configuring ISDN PRI and Other Signaling on E1 and T1 Lines” later in this document.
- Step 2** Configure DDR on a selected interface, as described in the “Dial-on-Demand Routing” part of this publication.

To begin DDR network addressing, use the following command in interface configuration mode:

Command	Purpose
<code>dialer map protocol next-hop-address name hostname spc [speed 56 64] [broadcast] dial-string[:isdn-subaddress]</code>	Defines the remote recipient’s protocol address, host name, and dialing string; indicate semipermanent connections; optionally, provide the ISDN subaddress; set the dialer speed to 56 or 64 kbps, as needed.

Configuring ISDN BRI for Leased-Line Service

To configure ISDN BRI for leased line service, perform the tasks in one of the following sections as needed and available locally:

- Configuring Leased-Line Service at Normal Speeds (Available in Japan and Germany)
- Configuring Leased-Line Service at 128 Kbps (Available only in Japan)



Note

Once an ISDN BRI interface is configured for access over leased lines, it is no longer a dialer interface, and signalling over the D channel no longer applies. Although the interface is called **interface bri n**, it is configured as a synchronous serial interface having the default High-Level Data Link (HDLC) encapsulation. However, the Cisco IOS commands that set the physical characteristics of a serial interface (such as the pulse time) do not apply to this interface.

Configuring Leased-Line Service at Normal Speeds

This service is offered in Japan and Germany and no call setup or teardown is involved. Data is placed on the ISDN interface similar to the way data is placed on a leased line connected to a serial port.

To configure the BRI to use the ISDN connection as a leased-line service, use the following commands in global configuration mode:

	Command	Purpose
Step 1	<code>isdn switch-type switch-type</code>	Configures the BRI switch type, as specified by the local service provider.
Step 2	<code>isdn leased-line bri number 128</code>	Specifies the BRI interface number.

To disable leased-line service if you no longer want to support it on a specified ISDN BRI, use the following command in global configuration mode:

Command	Purpose
<code>no isdn leased-line bri number</code>	Removes leased line configuration from a specified ISDN BRI interface.

Configuring Leased-Line Service at 128 Kbps

The Cisco IOS software supports leased-line service at 128 kbps via ISDN BR. This service combines two B channels into a single pipe. This feature requires one or more ISDN BRI hardware interfaces that support channel aggregation and service provider support for ISDN channel aggregation at 128 kbps. When this software first became available, service providers offered support for ISDN channel aggregation at 128 kbps only in Japan.



Note This feature is not supported on the Cisco 2500 series router because its BRI hardware does not support channel aggregation.

To enable leased-line service at 128 kbps on a specified ISDN BRI, use the following commands in global configuration mode:

	Command	Purpose
Step 1	<code>isdn switch-type switch-type</code>	Selects the service provider switch type.
Step 2	<code>isdn leased-line bri number 128</code>	Configures a specified BRI for access over leased lines.

To complete the configuration of the interface, see the chapter “Configure a Synchronous Serial Ports” in this publication.

To remove the leased-line service configuration from a specified ISDN BRI, use the following command in global configuration mode:

Command	Purpose
<code>no isdn leased-line bri number</code>	Removes leased-line configuration from a specified ISDN BRI interface.

Configuring Automatic Detection of Encapsulation Type

You can enable a serial or ISDN interface to accept calls and dynamically change the encapsulation in effect on the interface when the remote device does not signal the call type. For example, if an ISDN call does not identify the call type in the lower-layer compatibility fields and is using an encapsulation that is different from the one configured on the interface, the interface can change its encapsulation type dynamically.

This feature enables interoperability with ISDN terminal adapters that use V.120 encapsulation but do not signal V.120 in the call setup message. An ISDN interface that by default answers a call as synchronous serial with PPP encapsulation can change its encapsulation and answer such calls.

Automatic detection is attempted for the first 10 seconds after the link is established or the first 5 packets exchanged over the link, whichever is first.

To enable automatic detection of encapsulation type, use the following command in interface configuration mode:

Command	Purpose
<code>autodetect encapsulation encapsulation-type</code>	Enables automatic detection of encapsulation type on the specified interface.

You can specify one or more encapsulations to detect. Cisco IOS software currently supports automatic detection of PPP and V.120 encapsulations.

Configuring Encapsulation for Combinet Compatibility

Historically, Combinet devices supported only the Combinet Proprietary Protocol (CPP) for negotiating connections over ISDN B channels. To enable Cisco routers to communicate with those Combinet bridges, the Cisco IOS supports a the CPP encapsulation type.

To enable routers to communicate over ISDN interfaces with Combinet bridges that support only CPP, use the following commands in interface configuration mode:

	Command	Purpose
Step 1	<code>encapsulation cpp</code>	Specifies CPP encapsulation.
Step 2	<code>cpp callback accept</code>	Enables CPP callback acceptance.
Step 3	<code>cpp authentication</code>	Enables CPP authentication.

Most Combinet devices support PPP. Cisco routers can communicate over ISDN with these devices by using PPP encapsulation, which supports both routing and fast switching.

Cisco 700 and 800 series routers and bridges (formerly Combinet devices) support only IP, Internet Protocol Exchange (IPX), and bridging. For AppleTalk, Cisco routers automatically perform half-bridging with Combinet devices. For more information about half-bridging, see the section “Configuring PPP Half-Bridging” in the chapter “Configuring Media-Independent PPP and Multilink PPP” later in this publication.

Cisco routers can also half-bridge IP and IPX with Combinet devices that support only CPP. To configure this feature, you only need to set up the addressing with the ISDN interface as part of the remote subnet; no additional commands are required.

Troubleshooting ISDN Special Signalling

To troubleshoot ISDN, use any of the following commands in EXEC mode:

Command	Purpose
<code>debug dialer</code>	Displays the values of timers.
<code>debug isdn q921 [interface bri number]</code> or <code>debug isdn q921 interface serial slot/controller-number:23</code>	Displays link layer information for all interfaces or, optionally, for a single BRI interface. Displays link layer information for a single PRI interface.
<code>debug isdn q931 [interface bri number]</code> or <code>debug isdn q931 interface serial slot/controller-number:23</code>	Displays the content of call control messages and information elements, in particular the Facility IE message for all interfaces or, optionally, for a single BRI interface. Displays the content of call control messages and information elements, in particular the Facility IE message for a single PRI interface.

ISDN Special Signalling Configuration Examples

This section provides the following configuration examples:

- ISDN AOC Configuration
- ISDN NFAS Configuration Examples
- ISDN BRI Leased-Line Configuration

ISDN AOC Configuration

This section provides the following ISDN AOC configuration examples:

- Using Legacy DDR for ISDN PRI AOC Configuration
- Using Dialer Profiles for ISDN BRI AOC Configuration

Using Legacy DDR for ISDN PRI AOC Configuration

This example shows ISDN PRI configured on an E1 controller. Legacy DDR is configured on the ISDN D channel (serial interface 0:15) and propagates to all ISDN B channels. A static dialer idle-timeout is configured for all incoming calls on the B channels, but the map classes are configured independently of it. Map classes Kappa and Beta use AOC charging unit duration to calculate the timeout for the call. A short-hold idle timer is set so that if the line is idle for 10 or more seconds, the call is disconnected when the current charging period ends. Map class Iota uses a static idle timeout.

```
version 11.2
service timestamps debug datetime msec
service timestamps log datetime msec
!
hostname A
```

```

!
username c2503isdn password 7 1511021F0725
username B password 7 110A1016141D29
username C password 7 1511021F072508
isdn switch-type primary-net5
!
controller E1 0
  pri-group timeslots 1-31
!
interface Serial 0:15
  ip address 10.0.0.35 255.0.0.0
  encapsulation ppp
  dialer idle-timeout 150
  dialer map ip 10.0.0.33 name c2503isdn class Iota 06966600050
  dialer map ip 10.0.0.40 name B class Beta 778578
  dialer map ip 10.0.0.45 name C class Kappa 778579
  dialer-group 1
  ppp authentication chap
!
map-class dialer Kappa
  dialer idle-timeout 300
  dialer isdn short-hold 120
!
map-class dialer Iota
  dialer idle-timeout 300
!
map-class dialer Beta
  dialer idle-timeout 300
  dialer isdn short-hold 90
!
dialer-list 1 protocol ip permit

```

Using Dialer Profiles for ISDN BRI AOC Configuration

This example shows ISDN BRI configured as a member of two dialer pools for dialer profiles.

```

version 11.2
service timestamps debug datetime msec
service timestamps log datetime msec
!
hostname delorean
!
username spanky password 7 0705344245
username delorean password 7 1511021F0725
isdn switch-type basic-net3
!
interface BRI0
  description Connected to NTT 81012345678901
  no ip address
  dialer pool-member 1 max-link 1
  dialer pool-member 2 max-link
  encapsulation ppp
  no fair-queue
!
interface Dialer1
  ip address 7.1.1.8 255.255.255.0
  encapsulation ppp
  dialer remote-name spanky
  dialer string 81012345678902 class Omega
  dialer pool 1
  dialer-group 1
  ppp authentication chap
!

```

```

interface Dialer2
 ip address 8.1.1.8 255.255.255.0
 encapsulation ppp
 dialer remote-name dmsisdn
 dialer string 81012345678902 class Omega
 dialer string 14153909503 class Gamma
 dialer pool 2
 dialer-group 1
 ppp authentication chap
 !
 map-class dialer Omega
 dialer idle-timeout 60
 dialer isdn short-hold 150
 !
 map-class dialer Gamma
 dialer isdn short-hold 60
 !
 dialer-list 1 protocol ip permit

```

ISDN NFAS Configuration Examples

This section provides the following configuration examples:

- NFAS Primary and Backup D Channels
- PRI Interface Service State

NFAS Primary and Backup D Channels

The following example configures ISDN PRI and NFAS on three T1 controllers of a Cisco 7500 series router. The NFAS primary D channel is configured on the 1/0 controller, and the NFAS backup D channel is configured on the 1/1 controller. No NFAS D channel is configured on the 2/0 controller; it is configured for 24 B channels. Once the NFAS primary D channel is configured, it is the only interface you see and need to configure; DDR configuration for the primary D channel—which is distributed to all B channels—is also included in this example.

```

isdn switch-type primary-4ess
 !
 ! NFAS primary D channel on the channelized T1 controller in 1/0.
 controller t1 1/0
 framing esf
 linecode b8zs
 pri-group timeslots 1-24 nfas_d primary nfas_interface 0 nfas_group 1 .
 !
 ! NFAS backup D channel on the channelized T1 controller in 1/1.
 controller t1 1/1
 framing esf
 linecode b8zs
 pri-group timeslots 1-24 nfas_d backup nfas_interface 1 nfas_group 1 .
 !
 ! NFAS 24 B channels on the channelized T1 controller in 2/0
 controller t1 2/0
 framing esf
 linecode b8zs
 pri-group timeslots 1-24 nfas_d none nfas_interface 2 nfas_group 1
 !
 ! NFAS primary D channel interface configuration for PPP and DDR. This
 ! configuration is distributed to all the B channels in NFAS group 1 on the
 ! three channelized T1 controllers.
 !

```

```
interface Serial 1/0:23
 ip address 1.1.1.2 255.255.255.0
 no ip mroute-cache
 encapsulation ppp
 dialer map ip 1.1.1.1 name flyboy 567898
 dialer map ip 1.1.1.3 name flyboy 101112345678
 dialer map ip 1.1.1.4 name flyboy 01112345678
 dialer-group 1
 no fair-queue
 no cdp enable
 ppp authentication chap
```

PRI Interface Service State

The following example puts the entire PRI interface back in service after it previously had been taken out of service:

```
isdn service dsl 0 b-channel 0 state 0
```

ISDN BRI Leased-Line Configuration

The following example configures the BRI 0 interface for leased-line access at 128 kbps. Because of the leased-line-not dialed-environment, configuration of ISDN called and calling numbers are not needed and not used. The BRI 0 interface is henceforth treated as a synchronous serial interface, with the default HDLC encapsulation.

```
isdn leased-line bri 0 128
```

The following example configures the BRI 0 interface for PPP encapsulation:

```
interface bri 0
 ip address 1.1.1.2 255.255.255.0
 encapsulation ppp
 bandwidth 128
```

