

Configuring Analog and Digital Voice Interfaces

Foreign Exchange Station Ports (FXS)

FXS ports connect analog edge devices. This topic identifies the parameters that are configurable on the FXS port.

FXS Voice Port Configuration

- **signal**
- **cptone**
- **description**
- **ring frequency**
- **ring cadence**
- **disconnect-ack**
- **busyout**
- **station id name**
- **station id number**

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In North America, the FXS port connection functions with default settings most of the time. The same cannot be said for other countries and continents. Remember, FXS ports look like switches to the edge devices that are connected to them. Therefore, the configuration of the FXS port should emulate the switch configuration of the local PSTN.

Example

For example, consider the scenario of an international company with offices in the United States and England. The PSTN of each country provides signaling that is standard for that country. In the United States, the PSTN provides a dial tone that is different from the tone in England. When the telephone rings to signal an incoming call, the ring is different in the United States. Another instance when the default configuration might be changed is when the connection is a trunk to a PBX or key system. In that case, the FXS port must be configured to match the settings of that device.

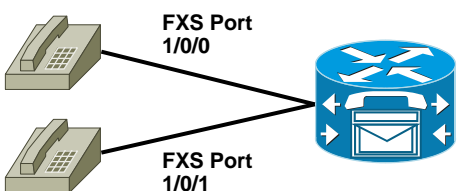
Configuration Parameters

FXS port configuration allows you to set parameters based on the requirements of the connection if default settings need to be altered or the parameters need to be set for fine-tuning. You can set the following configuration parameters:

- **signal:** Sets the signaling type for the FXS port. In most cases, the default signaling of loopstart works well. If the connected device is a PBX or a key system, the preferred signaling is ground start. Modern PBXs and key systems do not normally use FXS ports as connections to the network, but older systems may still have these interfaces. When connecting the FXS port to a PBX or key system, you must check the configuration of the voice system and set the FXS port to match the system setting.
- **cptone:** Configures the appropriate call-progress tone for the local region. The call-progress tone setting determines the dial tone, busy tone, and ringback tone to the originating party.
- **description:** Configures a description for the voice port. You must use the description setting to describe the voice port in **show command** output. It is always useful to provide some information about the usage of a port. The description could specify the type of equipment that is connected to the FXS port.
- **ring frequency:** Configures a specific ring frequency (in Hz) for an FXS voice port. You must select the ring frequency that matches the connected equipment. If set incorrectly, the attached telephone might not ring or might buzz. In addition, the ring frequency is usually country-dependent, and you should take into account the appropriate ring frequency for your area before you configure this command.
- **ring cadence:** Configures the ring cadence for an FXS port. The ring cadence defines how ringing voltage is sent to signal a call. The normal ring cadence in North America is 2 seconds of ringing followed by 4 seconds of silence. In England, normal ring cadence is a short ring followed by a longer ring. When configured, the **cptone** setting automatically sets the ring cadence to match that country. You can manually set the ring cadence if you want to override the default country value. You may have to shut down and reactivate the voice port before the configured value takes effect.
- **disconnect-ack:** Configures an FXS voice port to remove line power if the equipment on an FXS loop-start trunk disconnects first. This removal of line power is not something the user hears. Instead, it is a method for electrical devices to signal that one side has ended the call.
- **busyout:** Configures the ability to busy out an analog port.

- **station id name:** Provides the station name associated with the voice port. This parameter is passed as a calling name to the remote end if the call is originated from this voice port. If no caller ID is received on an FXO voice port, this parameter will be used as the calling name. Maximum string length is limited to 15.
- **station id number:** Provides the station number that is to be used as the calling number associated with the voice port. This parameter is optional and, when it is provided, it will be used as the calling number if the call is originated from this voice port. If not specified, the calling number will be used from a reverse dial-peer search. If no caller ID is received on an FXO voice port, this parameter will be used as the calling number. Maximum string length is 15.

FXS Voice Port Configuration



```

CMERouter(config)#voice-port 1/0/0
CMERouter(config-voiceport)#signal loop-start
CMERouter(config-voiceport)#cptone GB
CMERouter(config-voiceport)#ring cadence pattern01
CMERouter(config)#voice-port 1/0/1
CMERouter(config-voiceport)#signal loop-start
CMERouter(config-voiceport)#cptone GB
CMERouter(config-voiceport)#ring cadence pattern02

```

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Example

The example shows how the British office is configured to enable ground-start signaling on a Cisco 2600 or 3600 series router on FSX voice port 1/0/0. The call-progress tones are set for Great Britain and ring cadence is set for pattern 1.

Foreign Exchange Office Ports (FXO)

FXO ports act like telephones and connect to central office (CO) switches or to a station port on a PBX. This topic identifies the configuration parameters that are specific to FXO ports.

FXO Voice Port Configuration

- **signal**
- **ring number**
- **dial-type**
- **description**
- **supervisory disconnect**

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Configuration Parameters

In most instances, the FXO port connection functions with default settings. FXO port configuration allows you to set parameters based on the requirements of the connection where default settings need to be altered or parameters set for fine-tuning. You can set the following configuration parameters:

- **signal:** Sets the signaling type for the FXO port. If the FXO port is connected to the PSTN, the default settings are adequate. If the FXO port is connected to a PBX, the signal setting must match the PBX.
- **ring number:** Configures the number of rings before an FXO port answers a call. This is useful when you have other equipment available on the line to answer incoming calls. The FXO port answers if the equipment that is online does not answer the incoming call within the configured number of rings.
- **dial-type:** Configures the appropriate dial type for outbound dialing. Older PBXs or key sets may not support dual-tone multifrequency (DTMF) dialing. If you are connecting an FXO port to this type of device, you may need to set the dial type for pulse-dialing.
- **description:** Configures a description for the voice port. Use the description setting to describe the voice port in **show command** output.

- **supervisory disconnect:** Configures supervisory disconnect signaling on the FXO port. Supervisory disconnect signaling is a power denial from the switch that lasts at least 350 ms. When this condition is detected, the system interprets this as a disconnect indication from the switch and clears the call. You should disable supervisory disconnect on the voice port if there is no supervisory disconnect available from the switch. Typically, supervisory disconnect is available when connecting to the PSTN and is enabled by default. When the connection extends out to a PBX, you should verify the documentation to ensure that supervisory disconnect is supported.

FXO Voice Port Configuration



```
CMERouter(config)#voice-port 1/1/0
CMERouter(config-voiceport)#signal ground-start
CMERouter(config-voiceport)#ring number 3
CMERouter(config-voiceport)#dial-type dtmf
CMERouter(config-voiceport)#description Connection_to_PSTN
```

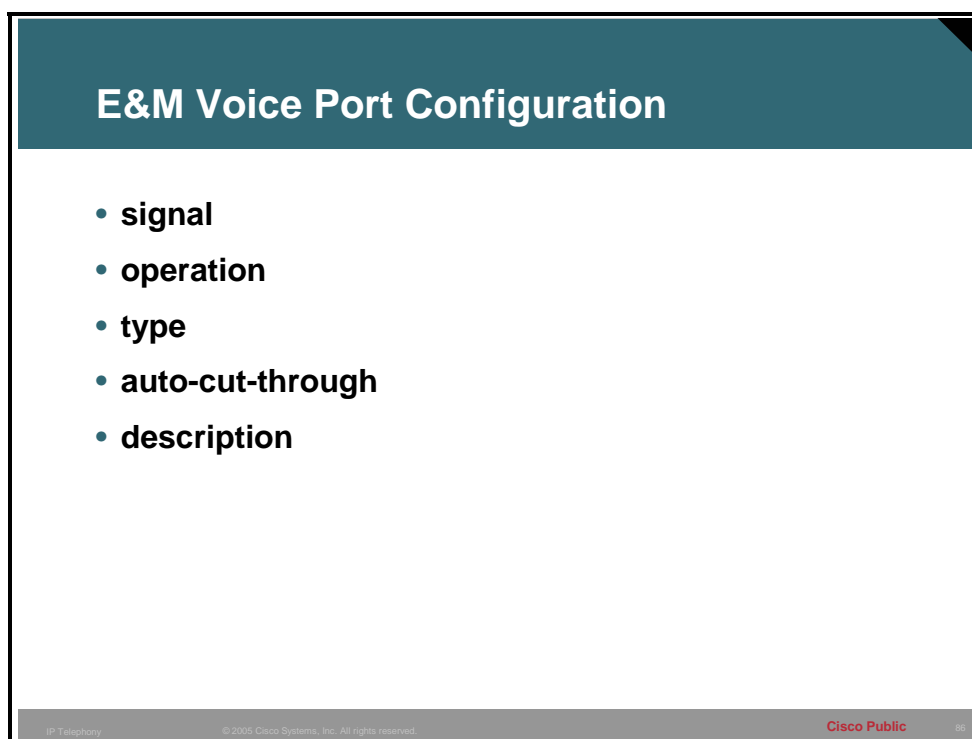
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Example

The configuration in the figure enables loop-start signaling on a Cisco 2600 or 3600 series router on FXO voice port 1/1/0. The ring-number setting of **3** specifies that the FXO port does not answer the call until after the third ring, and the dial type is set to DTMF.

Ear and Mouth Ports (E&M)

E&M ports provide signaling that is used generally for switch-to-switch or switch-to-network trunk connections. This topic identifies the configuration parameters that are specific to the E&M port.



The slide features a dark teal header with the title "E&M Voice Port Configuration" in white. Below the header is a white area containing a bulleted list of configuration parameters. At the bottom of the slide, there is a grey footer with small text on the left and right sides.

E&M Voice Port Configuration

- **signal**
- **operation**
- **type**
- **auto-cut-through**
- **description**

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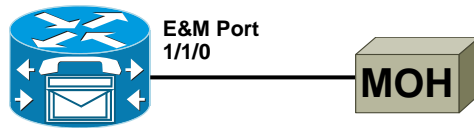
Configuration Parameters

Although E&M ports have default parameters, you must usually configure these parameters to match the device that is connected to the E&M port. You can set the following configuration parameters:

- **signal:** Configures the signal type for E&M ports and defines the signaling that is used when notifying a port to send dialed digits. This setting must match that of the PBX to which the port is connected. You must shut down and reactivate the voice port before the configured value takes effect. With **wink-start** signaling, the router listens on the M lead to determine when the PBX wants to place a call. When the router detects current on the M lead, it waits for availability of digit registers and then provides a short *wink* on the E lead to signal the PBX to start sending digits. With **delay-start**, the router provides current on the E lead immediately upon seeing current on the M lead. When current is stopped for the digit sending duration, the E lead stays high until digit registers are available. With **immediate-start**, the PBX simply waits a short time after raising the M lead and then sends the digits without a signal from the router.

- **operation:** Configures the cabling scheme for E&M ports. The **operation** command affects the voice path only. The signaling path is independent of two-wire versus four-wire settings. If the wrong cable scheme is specified, the user may get voice traffic in one direction only. You must verify with the PBX configuration to ensure that the settings match. You must then shut down and reactivate the voice port for the new value to take effect.
- **type:** Configures the E&M interface type for a specific voice port. The type defines the electrical characteristics for the E and M leads. The E and M leads are monitored for on-hook and off-hook conditions. From a PBX perspective, when the PBX attempts to place a call, it goes high (off hook) on the M lead. The switch monitors the M lead and recognizes the request for service. If the switch attempts to pass a call to the PBX, the switch goes high on the E lead. The PBX monitors the E lead and recognizes the request for service by the switch. To ensure that the settings match, you must verify them with the PBX configuration.
- **auto-cut-through:** Configures the ability to enable call completion when a PBX does not provide an M-lead response. For example, when the router is placing a call to the PBX, even though they may have the same correct signaling configured, not all PBXs provide the wink with the same duration or voltage. The router may not understand the PBX wink. The **auto-cut-through** command allows the router to send digits to the PBX, even when the expected wink is not detected.
- **description:** Configures a description for the voice port. Use the description setting to describe the voice port in **show command** output.

FXS Voice Port Configuration



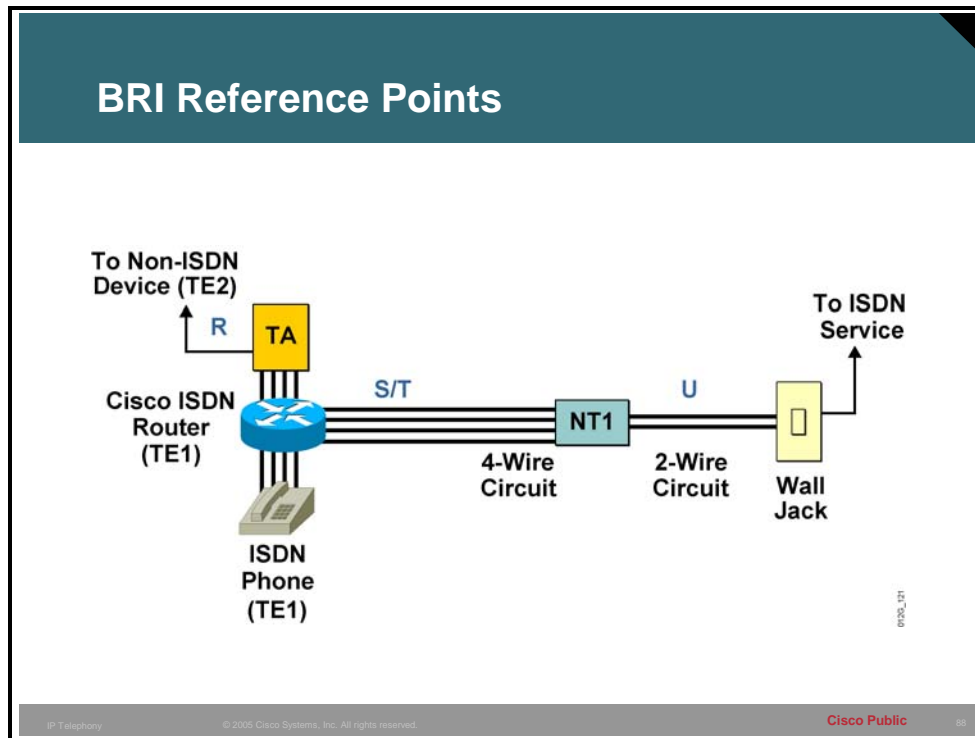
```
CMERouter(config)#voice-port 1/1/0
CMERouter(config-voiceport)#signal immediate
CMERouter(config-voiceport)#auto-cut-through
CMERouter(config-voiceport)#operation 4-wire
CMERouter(config-voiceport)#type 1
CMERouter(config-voiceport)#description MoH_Device
```

Example

The configuration in the figure enables immediate signaling with automatic cut through for an E&M connection to a Music on Hold device. This allows an external device to provide music on hold to the CallManager Express system. The **type** setting matches the E&M port setting on the MOH device as well as the number of wires used by the **operation** command.

Common Channel Signaling (CCS): ISDN BRI

ISDN BRI includes various components and reference points. This topic identifies the most common components and reference points of ISDN BRI.



Given all the ISDN interface abbreviations such as T, S, U, S/T, and so on, what do all of these components and reference points look like in practice?

When creating a network, connect the network termination 1 (NT1) to the wall jack with a standard two-wire connector, then to the ISDN phone, terminal adapter, Cisco ISDN router, and maybe a fax with a four-wire connector. The S/T interface is implemented using an eight-wire connector (two pairs for data transmission and two pairs for providing optional power to the NT and TE).

Caution should be taken when connecting ISDN devices, since RJ-11 and RJ-45 connectors look similar.

The S/T reference point is:

- Four-wire interface (sending [TX] and receiving [RX])
- Point-to-point and multipoint (passive bus), as shown in the figure
- Covered by International Telecommunication Union Telecommunication Standardization Sector (ITU-T) I.430 physical layer specification for BRI interfaces, and American National Standards Institute (ANSI) T1.601 standard for the United States

The S/T interface defines the interface between a TE1 or TA and an NT. A maximum of eight devices can be daisy-chained to the S/T bus.

The U interface defines the two-wire interface between the NT1 and the ISDN cloud. The U interface is used in the United States, while in the rest of the world uses an S/T interface.

The R interface defines the interface between the TA and an attached non-ISDN device (TE2).

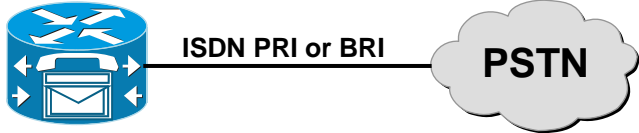
In North America, the NT1 function is commonly integrated into the ISDN device (router, TA), thus permitting a direct connection from the ISDN device to the telco jack.

An NT1 and NT2 combination device is sometimes referred to as an NTU. In most countries, the NT1/NT2 combination is provided by the service provider (telco) and customer access is only available at the S/T interface.

Common Channel Signaling (CCS): ISDN Configuration Tasks

Configuring ISDN BRI requires global and interface configuration tasks. This topic provides a list of configuration tasks required to successfully configure an ISDN BRI connection.

ISDN Configuration Tasks



The diagram illustrates a network configuration. On the left is a blue router icon with a white envelope symbol on its front. A horizontal line connects the router to a grey cloud icon on the right. The line is labeled "ISDN PRI or BRI". The cloud icon is labeled "PSTN".

- **Select the ISDN switch type either globally or on an interface**
- **The interface setting will override the global setting**
- **Configure the interface or controller settings**

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To configure an ISDN BRI interface on a router, global and interface configuration commands must be specified.

- Global configuration tasks include:
 - Select the switch type that matches the ISDN provider switch at the central office (CO).
 - Set destination details. Indicate static routes from the router to other ISDN destinations.
 - Specify the traffic criteria that initiate an ISDN call to the appropriate destination.
- Interface configuration tasks include:
 - Select the ISDN BRI port and configure an IP address and subnet mask.
 - Although the interface automatically inherits the global switch-type setting, some configurations may require a specific switch type to be configured on an interface.
 - Configure optional features, including time-to-wait for the ISDN carrier to respond to the call, and seconds of idle time before the router times out and drops the call.

Common Channel Signaling (CCS): Overview of ISDN BRI Configuration Commands

Configuring ISDN BRI requires global and interface configuration commands. This topic provides an overview of configuration commands required to successfully configure an ISDN BRI connection.

ISDN BRI Configuration Commands

```
CMERouter(config)#  
isdn switch-type switch-type
```

- Sets the ISDN switch type globally

```
CMERouter(config)#  
interface BRI mod/port
```

- Defines a SPID if assigned by the carrier (found in North America)

```
CMERouter(config-if)#  
isdn switch-type switch-type
```

- Sets the ISDN switch type on an interface (overrides the global setting if it exists)

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At the global level, the administrator must specify the ISDN service provider CO switch type. There are several types of switches to choose from and some of these require special parameters. Standards signaling specifics differ by region. Therefore, the switch type varies according to its geographical location. For example, the DMS-100 and National-1 require a service profile identifier (SPID) to be specified. This is optional on some switches (for example, AT&T 5ESS), or not required at all.

Although the interface configuration and selection tasks apply to all routers, this topic focuses on BRI for access routers. PRI details for Cisco routers and access servers with T1/E1 controllers are covered later in the lesson.

The **interface bri** *interface-number* command designates the interface used for ISDN on a router acting as a TE1 device.

A router without a native BRI interface is a TE2 device. It must connect to an external ISDN TA via a serial interface. On a TE2 router, the **interface serial** *interface-number* command must be used.

Use the **isdn switch-type** command to specify the CO switch to which the router connects. For BRI ISDN service, the possible switch types and their corresponding commands are shown in the table here.

isdn switch-type Commands

Command	Description
basic-5ess	AT&T basic rate switches (United States)
basic-dms100	NT DMS-100 (North America)
basic-ni	National ISDN-1 (North America)
basic-qsig	PINX (PBX) switches with QSIG signaling per Q.931
basic-net3	NET3 switch type for United Kingdom, Europe, Asia, and Australia
none	No switch defined

Note Other switch types are available. The list of switch types can differ based on the Cisco IOS[®] version used.

When the **isdn switch-type** command is used in global configuration mode, all ISDN interfaces on the router are configured for that switch type. Beginning with IOS Release 11.3T, the interface configuration mode command was introduced to allow different interfaces to be configured with different switch types. If the command is used in interface configuration mode, only the interface that is configured assumes that switch type. The interface setting always overrides the global setting.

Common Channel Signaling (CCS): ISDN BRI Configuration Commands

Selecting the correct switch type to connect is crucial when configuring ISDN BRI. This topic provides an overview of the **isdn spid** command.

ISDN BRI Configuration Commands

```
CMERouter(config-int)#  
isdn spid1 spid-number [ldn]
```

- **Defines SPID 1 if assigned by the carrier (found in North America)**

```
CMERouter(config-int)#  
isdn spid2 spid-number [ldn]
```

- **Defines SPID 2 if assigned by the carrier (found in North America)**

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Several ISDN service providers use central office switches that require dial-in numbers called service profile identifiers (SPIDs). The SPIDs are used to authenticate call requests that are within contract specifications. These switches include National ISDN and DMS-100 ISDN switches, as well as the AT&T 5ESS multipoint switch. SPIDs are used only in the United States, and are typically not required for ISDN data communications applications. The service provider supplies the local SPID numbers. If uncertain, contact the service provider to determine if the SPIDs need to be configured on your access routers.

Use the **isdn spid1** and **isdn spid2** commands to access the ISDN network when your router makes its call to the local ISDN exchange.

The **isdn spid1** command syntax is shown for the first BRI 64-kbps channel.

isdn spid1 and isdn spid2 Commands

Commands	Description
<i>spid-number</i>	Number identifying the service to which you have subscribed. This value is usually a ten-digit telephone number followed by more digits. The ISDN service provider assigns this value.
<i>ldn</i>	(Optional) Seven-digit local directory number assigned by the ISDN service provider.

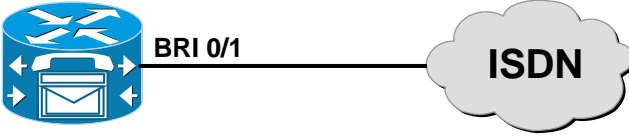
If you want the SPID to be automatically detected, you can specify 0 for the *spid-number* argument.

The *ldn* parameter allows you to associate up to three local directory numbers with each SPID. This number must match the called-party information coming in from the ISDN switch in order to use both B channels on most switches.

Common Channel Signaling (CCS): ISDN BRI Configuration

You may have to configure the Layer 2 B channel encapsulation protocol and authentication when configuring ISDN BRI.

ISDN Configuration Tasks



```
graph LR; Router[Router] --- BRI[BRI 0/1] --- ISDN((ISDN))
```

```
CMERouter(config)#isdn switch-type basic-5ess  
CMERouter(config)#interface bri 0/1  
CMERouter(config-int)#isdn spid1 20655512340001  
CMERouter(config-int)#isdn spid2 20655512340002
```

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Timers and Timing

This topic identifies the timing requirements and adjustments that are applicable to voice interfaces. Under normal use, these timers do not need adjusting. In instances where ports are connected to a device that does not properly respond to dialed digits or hookflash, or where the connected device provides automated dialing, these timers can be configured to allow more or less time for a specific function.

Timers and Timing Configuration

- **timeouts initial**
- **timeouts interdigit**
- **timeouts ringing**
- **timing digit**
- **timing interdigit**
- **timing hookflash-in/hookflash-out**

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Configuration Parameters

You can set a number of timers and timing parameters for fine-tuning the voice port. Following are voice port configuration parameters that you can set:

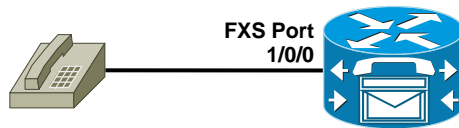
- **timeouts initial:** Configures the initial digit timeout value in seconds. This value controls how long the dial tone is presented before the first digit is expected. This timer typically does not need to be changed.
- **timeouts interdigit:** Configures the number of seconds for which the system will wait (after the caller has input the initial digit) for the caller to input a subsequent digit of the dialed digits. If the digits are coming from an automated device, and the dial plan is a variable length dial plan, you can shorten this timer so that the call proceeds without having to wait the full default of 10 seconds for the interdigit timer to expire.
- **timeouts ringing:** Configures the length of time that a caller can continue ringing a telephone when there is no answer. You can configure this setting to be less than the default of 180 seconds so that you do not tie up the voice port when it is evident that the call is not going to be answered.

- **timing digit:** Configures the DTMF digit-signal duration for a specified voice port. You can use this setting to fine-tune a connection to a device that may have trouble recognizing dialed digits. If a user or device dials too quickly, the digit may not be recognized. By changing the timing on the digit timer you can provide for a shorter or longer DTMF duration.

- **timing interdigit:** Configures the DTMF interdigit duration for a specified voice port. You can change this setting to accommodate faster or slower dialing characteristics.

- **timing hookflash-in and hookflash-out:** Configures the maximum duration (in milliseconds) of a hookflash indication. Hookflash is an indication by a caller that the caller wishes to do something specific with the call, such as transfer the call or place the call on hold. For hookflash-in, the FXS interface processes the indication as on hook if the hookflash lasts longer than the specified limit. If you set the value too low, the hookflash may be interpreted as a hang up; the handset has to be left hung up for a longer period to clear the call if you set the value too high. For hookflash-out, the setting specifies the duration (in milliseconds) of the hookflash indication that the gateway generates outbound. You can configure this to match the requirements of the connected device.

FXS Voice Port Configuration



```
CMERouter(config)#voice-port 1/0/0
CMERouter(config-voiceport)#signal loop-start
CMERouter(config-voiceport)#cptone GB
CMERouter(config-voiceport)#ring cadence pattern01
CMERouter(config-voiceport)#timeouts initial 15
CMERouter(config-voiceport)#timeouts interdigit 15
CMERouter(config-voiceport)#timeouts ringing 120
CMERouter(config-voiceport)#timing hookflash-in 500
```

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Example

The installation in the figure is for a home for the elderly where users may need more time to dial digits than in other residences. Another requirement is to allow the telephone to ring unanswered for only two minutes. The configuration in the figure enables several timing parameters on a Cisco voice-enabled router voice port 1/0/0. The initial timeout is lengthened to 15 seconds, the interdigit timeout is lengthened to 15 seconds, and the hookflash-in timer is set to 500 ms.

Digital Voice Ports

This topic identifies the configuration parameters that are specific to T1 and E1 digital voice ports.

Basic T1/E1 Controller Configuration		
Command	T1	E1
framing	SF, ESF	CRC4, no-CRC4, Australia
linecode	AMI, B8ZS	AMI, HDB3
clock source	Line, Internal	Line, internal

0086_0715

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Configuration Parameters

When you purchase a T1 or E1 connection, make sure that your service provider gives you the appropriate settings. Before you configure a T1 or E1 controller to support digital voice ports, you must enter the following basic configuration parameters to bring up the interface.

- **framing:** Selects the frame type for a T1 or E1 data line. The framing configuration differs between T1 and E1.
 - **Options for T1:** Superframe (SF) or Extended Superframe (ESF)
 - **Options for E1:** cyclic redundancy check (CRC4), no-CRC4, or Australia
 - **Default for T1:** SF
 - **Default for E1:** CRC4

- **linecode:** Configures the line-encoding format for the DS1 link.
 - **Options for T1:** alternate mark inversion (AMI) or binary 8-zero substitution (B8ZS)
 - **Options for E1:** AMI or high density binary 3 (HDB3)
 - **Default for T1:** AMI
 - **Default for E1:** HDB3

- **clock source:** Configures clocking for individual T1 or E1 links.
 - **Options:** line or internal
 - **Default:** line

Channel Associated Signaling (CAS)

This topic describes the commands required to configure a Channel Associated Signaling (CAS) interface.

Basic T1/E1 Controller Configuration


```
CMERouter(config-control)#  
linecode {ami | b8zs}
```

- Configures the linecode for a T1 line


```
CMERouter(config-control)#  
linecode {ami | hdb3}
```

- Configures the linecode for a E1 line

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Use the **linecode** command to identify the physical layer signaling method to satisfy the ones density requirement on the digital facility of the provider. Without a sufficient number of ones in the digital bit stream, the switches and multiplexers in a WAN can lose their synchronization for transmitting signals. The table shows **linecode** command.

linecode Command

Command	Description
ami	Alternate mark inversion. Used for T1 configurations.
b8zs	Binary 8-zero substitution. Use for T1 PRI configurations.
hdb3	High density binary 3. Use for E1 PRI configurations.

Binary 8-zero substitution (B8ZS) accommodates the ones density requirements for T1 carrier facilities using special binary signals encoded over the digital transmission link. It allows 64 kbps (clear channel) for ISDN channels.

Settings for these two Cisco IOS software controller commands on the router must match the framing and line-code types used at the T1/E1 WAN central office (CO) switch of the provider.

T1 configurations typically require **framing esf** and **linecode b8zs**. E1 configurations typically require **linecode hdb3**.

Basic T1/E1 Controller Configuration

```
CMERouter(config-control)#
```

```
framing {sf | esf}
```

- Configures the framing for a T1 line

```
CMERouter(config-control)#
```

```
framing {crc4 | no-crc4 | australia}
```

- Configures the framing for a E1 line

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Use the **framing** controller configuration command to select the frame type used by the PRI service provider. The table shows framing commands you can use.

framing Command

Command	Description
sf	Super Frame. Use for some older T1 configurations.
esf	Extended Super Frame. Use for T1 PRI configurations.
crc4 or no-crc4	Cyclic redundancy check 4. Use for E1 PRI configurations.

Note Esf and crc4 are most common in new T1s or E1s

Basic T1/E1 Controller Configuration

```
CMERouter(config-control)#
```

```
ds0-group ds0-group-no timeslots timeslot-list type  
{e&m-delay-dial | e&m-fgd | e&m-immediate-start |  
e&m-wink-start | ext-sig | fgd-eana | fxo-ground-  
start | fxo-loop-start | fxs-ground-start | fxs-  
loop-start}
```

- Creates the voice ports of the T1 or E1 and the signaling that is used

```
CMERouter(config-control)#
```

```
clock source {line | internal}
```

- Sets the source of the clocking

You must create a digital voice port in the T1 or E1 controller to make the digital voice port available for specific voice port configuration parameters. You must also assign timeslots and signaling to the logical voice port through configuration. The first step is to create the T1 or E1 digital voice port with the **ds0-group** *ds0-group-no* **timeslots** *timeslot-list* **type** *signal-type* command.

The **ds0-group** part of the command automatically creates a logical voice port that is numbered as *ds0-group-no*. The *ds0-group-no* parameter identifies the DS0 group (number from 0 to 23 for T1 and from 0 to 30 for E1). This group number is used as part of the logical voice port numbering scheme.

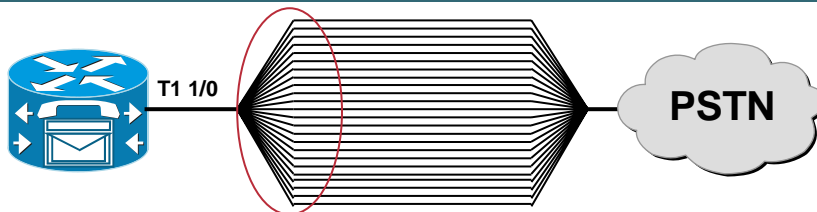
The **timeslots** part of the command allows the user to specify which timeslots are parts of the DS0 group. The *timeslot-list* parameter is a single time-slot number, a single range of numbers, or multiple ranges of numbers separated by commas.

The **type** part of the command defines the emulated analog signaling method that the router uses to connect to the PBX or PSTN. The type depends on whether the interface is T1 or E1.

To delete a DS0 group, you must first shut down the logical voice port. When the port is in shutdown state, you can remove the DS0 group from the T1 or E1 controller with the **no ds0-group** *ds0-group-no* command.

Use the **clock source** {**line** | **internal**} command to configure the T1 and E1 clock source on Cisco routers.

Basic T1/E1 Controller Configuration



```
CMERouter(config)#controller T1 1/0
CMERouter(config-controller)#linecode b8zs
CMERouter(config-controller)#framing esf
CMERouter(config-controller)#ds0-group 1 timeslots 1-24 type fxo-groundstart
CMERouter(config-controller)#clock source line
```

```
CMERouter(config)#controller E1 1/0
CMERouter(config-controller)#linecode hdb3
CMERouter(config-controller)#framing crc4
CMERouter(config-controller)#ds0-group 1 timeslots 1-15 type e&m-wink-start
CMERouter(config-controller)#clock source line
```

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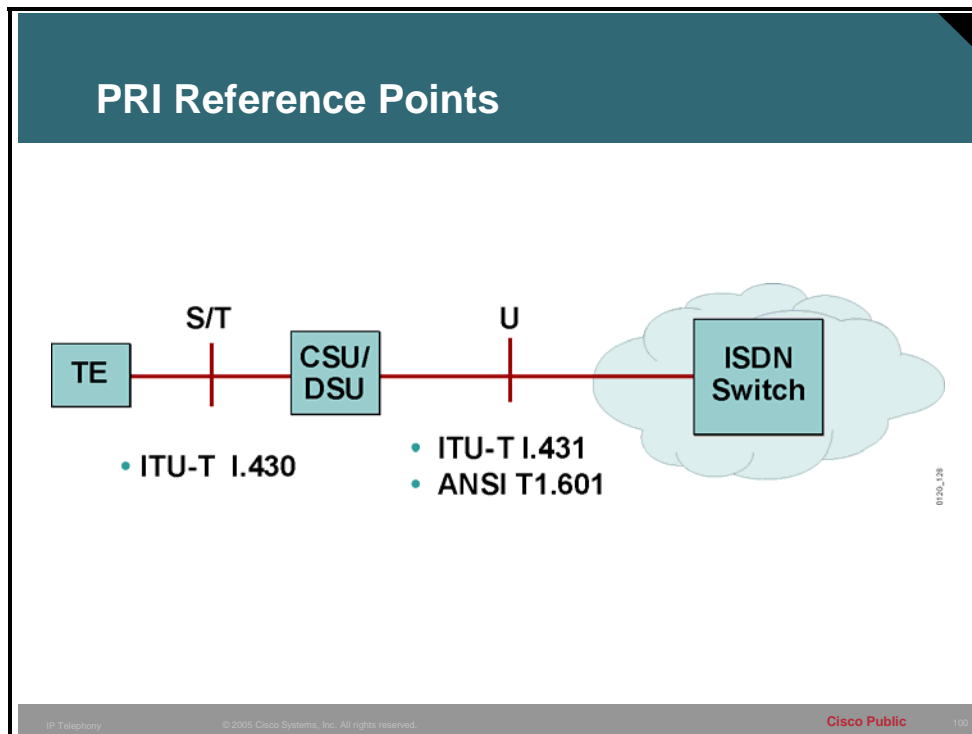
Example

This example configures the T1 controller for ESF, B8ZS linecode, and timeslots 1 through 24 with FXO ground start signaling. The resulting logical voice port is **1/0:1**, where **1/0** is the module and slot number and **:1** is the *ds0-group-no* value that was assigned during configuration.

The E1 configuration uses linecode of HDB3, framing of CRC-4, and timeslots of 1 through 15 with E&M wink start signaling. The resulting logical voice port is **1/0:1**, where the **1/0** is the module and slot number and the **:1** is the *ds0-group-no* value that was assigned during the configuration

Common Channel Signaling (CCS): ISDN Primary Rate Interface (PRI)

ISDN PRI includes various components and reference points. This topic identifies the most common components and reference points of ISDN PRI.



Depending on country implementation, either the ANSI T1.601 or ITU-T I.431 standard governs the physical layer of the PRI interface.

PRI technology is a bit simpler than BRI. The wiring is not multipoint, since there is only the straight connection between the channel service unit/data service unit (CSU/DSU) and the PRI interface. Multipoint refers to the ability to have multiple ISDN devices connected to the network, all of which have access to the ISDN network. Arbitration at Layer 1 and Layer 2 allows multiple devices that need to share the ISDN network to access the network without collisions or interruptions. Because there are no multiple devices, PRI does not require this arbitration.

Common Channel Signaling (CCS): Overview of ISDN PRI Configuration Commands

Configuring ISDN PRI requires global and interface configuration commands.

Selecting the correct switch type to which to connect is crucial when configuring ISDN PRI. This topic provides an overview of the **isdn switch-type** command.

ISDN PRI Configuration Commands

```
CMERouter(config)#  
isdn switch-type switch-type
```

- Sets the ISDN switch type globally

```
CMERouter(config)#  
controller {t1 | e1} {slot/port / unit-number}
```

- Defines a SPID if assigned by the carrier (found in North America)

```
CMERouter(config-controller)#  
isdn switch-type switch-type
```

- Sets the ISDN switch type on an interface (overrides the global setting if it exists)

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Use the **isdn switch-type** command to specify the central office PRI switch to which the router connects. With Cisco IOS® Release 11.3(3)T or later, this command is also available as a controller command to allow different switch types to be supported on different controllers. If configured as a global command, the specified switch type applies to all controllers, unless one is specifically configured on a controller.

An incompatible switch selection configuration can result in failure to make ISDN calls. After changing the switch type, you must reload the router to make the new configuration effective. Telco **isdn switch-type** commands are shown in the table here.

isdn switch-type Command

Command	Description
primary-4ess	AT&T Primary-4ESS switches (United States)
primary-5ess	AT&T Primary -5ESS switches (United States)
primary-dms100	NT DMS-100 switches (North America)
primary-ni	National ISDN switch type
primary-ntt	NTT ISDN PRI switches (Japan)
primary-net5	European and Australian ISDN PRI switches
primary-qsig	QSIG signaling per Q.931
None	No switch defined

Unlike BRI operation, ISDN PRIs do not use service profile identifiers (SPIDs). Therefore, there is no requirement to configure SPIDs, regardless of the ISDN switch type used by the PRI.

Use the **controller {t1 | e1} slot/port** command in global configuration mode to identify the controller to be configured. Use a single *unit-number* to identify the AS5000 Series controller.

controller {t1 | e1} Command

Command	Description
t1	Specifies the controller interface for North America and Japan.
e1	Specifies the controller interface for Europe and most other countries in the world.
<i>slot/port or unit number</i>	Specifies the physical slot/port location or unit number of the controller.

Common Channel Signaling (CCS): ISDN PRI Configuration Commands

Once the T1 or E1 controller is configured, the PRI channels and the corresponding D channel interface must be configured. This topic lists and explains the commands required to configure the ISDN PRI channels and D channel.

ISDN PRI Configuration Commands


```
CMERouter(config-controller)#  
pri-group timeslots range
```

- Sets the PRI group with a range of timeslots


```
CMERouter(config-int)#  
interface serial slot/port:timeslot
```

- Sets the PRI D channel

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The **pri-group** command configures the specified interface for PRI operation and specifies which fixed timeslots (channels) are allocated on the digital facility of the provider.

pri-group Command

Command	Description
timeslots range	The range of timeslots allocated to this PRI. For T1, use values in the range of 1 to 24, and for E1, use values from 1 to 31. The speed of the PRI is the aggregate of the channels assigned.

Example #1: If using all 30 B channels on an E1 PRI (30B+D), specify **pri-group 1-31**.

Example #2: If allocated only the first eight B channels (512 kbps total data bandwidth) for a T1 PRI (23B+D), then specify **pri-group 1-8,24**. Note that the D channel must be specified.

Note When provisioning a PRI line with less than 24 time slots (or 30 for E1), include the D channel for signaling.

Specification of the PRI group automatically creates the corresponding serial interface for the D channel: **interface serial** {*slot/port* | *unit*}:**{23 | 15}**. This interface is used to configure the PRI D channel. The table shows interface serial commands you can use.

interface serial Command

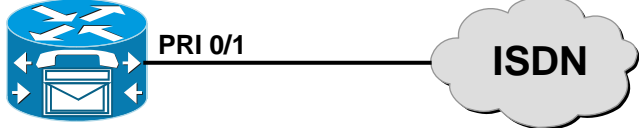
Command	Description
<i>slot/port</i>	The slot/port of the channelized controller.
<i>unit</i>	The unit number of the channelized controller on a Cisco 4000 or AS5000 Series router.
23	A T1 interface that designates channelized DS0s 0 to 22 as the B channels, and DS0 23 as the D channel.
15	An E1 interface that designates 30 B channels and timeslot 16 as the D channel.

Note In an E1 or T1 facility, the channels start numbering at 1 (1 to 31 for E1 and 1 to 24 for T1). Serial interfaces in the Cisco router start numbering at 0. Therefore, channel 16, the E1 signaling channel, is serial port subinterface 15. Channel 24, the T1 signaling channel, is serial subinterface 23.

Common Channel Signaling (CCS): Sample ISDN PRI Configuration

The following topic highlights a sample ISDN PRI configuration.

ISDN Configuration Tasks



```
CMERouter(config)#isdn switch-type primary-ni
CMERouter(config)#controller t1 0/1
CMERouter(config-controller)#pri-group timeslots 1-24
CMERouter(config-controller)#framing esf
CMERouter(config-controller)#linecode b8zs
CMERouter(config-controller)#clock source line
CMERouter(config)#interface serial:23
```

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The table describes the commands found in the figure.

PRI Configuration Commands

Command	Description
isdn switch-type primary-ni	Selects a switch type of National ISDN
controller t1 0/1	Selects the T1 controller 0/0.
pri-group timeslots 1-24	Establishes the interface port to function as PRI with 24 timeslots (including D channel) designated to operate at a speed of 64 kbps.
framing esf	Selects Extended Superframe (ESF) framing, a T1 configuration feature.
linecode b8zs	Selects line code B8ZS for T1.
clock source line	Specifies the T1 line as the clock source for the router.
interface serial 0/0:23	Identifies the D channel on serial interface 0/0.

The **controller t1 0/1** command configures the T1 controller. In the example, the switch type selected using the national ISDN standard. This example is accurate for some operations in the United States.

For an E1 example, the timeslot argument for the **pri-group** command would be **1–31** rather than **1–24** as shown for a T1 example, and the interface command would be **0/1:15** instead of **0/1:23**.