



Configuring Transparent Common Channel Signaling

This chapter describes how to configure support for the PBX signaling format, Transparent Common Channel Signaling (T-CCS). The T-CCS protocol enables the router to interoperate with PBXs that use T-CCS.

This chapter includes the following sections:

- [Configuring T-CCS, page 1](#)
- [T-CCS PBX Configuration Examples, page 19](#)

For a complete description of the commands used in this chapter, refer to the *Cisco IOS Voice Command Reference, Release 12.3*. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at <http://www.cisco.com/go/fn>. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

Configuring T-CCS

This section includes the following information:

- [T-CCS Overview, page 2](#)
- [T-CCS Prerequisite Tasks, page 3](#)
- [T-CCS Configuration Task List, page 4](#)
- [Verifying the T-CCS Configuration, page 15](#)
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- [Monitoring and Maintaining T-CCS and Frame Forwarding, page 18](#)



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T-CCS Overview

T-CCS provides a way to interconnect PBXs and key telephone systems (KTSs) when the private integrated services network exchange (PINX) does not support Q Signaling (QSIG) or when the PINX uses a proprietary solution.

T-CCS allows the connection of two PBXs with digital interfaces that use a proprietary or unsupported common channel signaling (CCS) protocol without the need for interpretation of CCS signaling for call processing. T1/E1 traffic is transported transparently through the data network, and the T-CCS feature preserves proprietary signaling. From the PBX standpoint, this is accomplished through a point-to-point connection. Calls from the PBXs are not routed, but follow a preconfigured route to the destination.

CCS differs from a related technology, channel-associated signaling (CAS), in that it uses a separate transmission channel to relay signaling and address information in embedded packets conforming to standards recommendations. Examples of CCS signaling include Q.931 on ISDN Primary Rate Interface (PRI) and QSIG protocol signaling for PINX devices.

CAS, which is older than CCS, has evolved over many years and is supported on many Cisco routers. CAS signals and the dual tone multifrequency (DTMF), or dial pulse digits that indicate the telephone number of the called party are sent within the actual voice band transmission channel. Digital signal processors (DSPs) in Cisco voice nodes monitor these channels, decode the status and address signaling, and report status and state changes for the telephone calls.

If you are configuring your Cisco platform to route signaling traffic for Voice over Frame Relay (VoFR) or Voice over ATM (VoATM), you can configure T-CCS using T-CCS frame forwarding.

If you are configuring your Cisco platform to route signaling traffic for VoIP, T-CCS is configured by routing traffic over a clear channel codec. The configuration procedures are described in the [““T-CCS Configuration Task List” section on page 4.”](#)

T-CCS Benefits

The T-CCS feature provides the following benefits:

- Efficient and cost-effective services on permanent (virtual) circuits or leased lines.
- PBX feature transparency across a WAN, permitting PBX networks to provide advanced features, such as calling name and number display, camp-on/callback, network call forwarding, centralized attendant, and centralized message waiting.
- Compressed Voice over Frame Relay (VoFR), ATM, and IP support for virtually any CCS-based PBX.
- Dynamic allocation of bandwidth to voice calls using voice activity detection (VAD).

T-CCS Limitations

The T-CCS feature has the following restrictions:

- The digital T1/E1 packet voice trunk network module can have one or two slots for voice/WAN interface cards (VWICs); VWICs supply one or two ports. Only the dual-mode (voice/WAN) multiflex trunk cards are supported in the digital E1 packet voice trunk network module, and not older VICs.
- Drop-and-insert capability is supported only between two ports on the same multiflex card.
- Digital E1 voice is not manageable through Simple Network Management Protocol (SNMP) using existing versions of Cisco Voice Manager.
- On the Cisco MC3810, when T-CCS frame forwarding is configured, the speed (clock rate) of serial interface 1 of the Cisco MC3810 is limited to a maximum of 192 kbps. This restriction assumes that the multiflex trunk module (MFT) is installed in slot 3 on the Cisco MC3810. If the MFT is not installed, then serial interface 1 does not operate, but T-CCS frame forwarding is supported on other interfaces.
- The T-CCS feature supports PVCs, not SVCs.
- Cross-connections imply fractional trunks.
- For Frame Forwarding, preconfigured interfaces can be serial 0, serial 1, or T1/E1 0.

Related Documents for T-CCS

The following documents provide additional information to help implement T-CCS:

- [Cisco Communication Media Module Voice Features for Catalyst 6500 Series and Cisco 7600 Series](#)
- [Cisco IOS Wide-Area Networking Configuration Guide, Release 12.3](#)
- [Cisco IOS Wide-Area Networking Command Reference, Release 12.3](#)
- [Cisco IOS Voice, Video, and Fax Command Reference, Release 12.2](#)
- [Cisco IOS Debug Command Reference, Release 12.3](#)
- [Cisco MC3810 Multiservice Concentrator Hardware Installation Guide](#)
- [Configuring ISDN Interfaces for Voice](#)
- [Configuring Cisco MC3810 Series Concentrators to Use High-Performance Compression Modules](#)
- [PBX Interoperability Portal](#)
- [Voice Port Enhancements in Cisco 2600 and 3600 Series Routers and MC3810 Series Concentrators](#)
- [Voice over Frame Relay Using FRF.11 and FRF.12 Configuration Updates](#)

T-CCS Prerequisite Tasks

The following configuration tasks should be completed before you configure a router for T-CCS:

- Obtain T1 or E1 service from your service provider.
- Establish a working network.
- Complete your company's dial plan.
- Establish a working telephony network based on your company's dial plan. For information about helpful documents, see the section "[Related Documents for T-CCS](#)" section on page 3.

- Install required multiflex trunk modules and voice components:
 - Digital T1/E1 packet voice trunk network modules on Cisco 2600 series and 3600 series routers
 - Two-port T1/E1 digital voice port adapters for Cisco 7200 series and 7500 series routers
 - WS-SVC-CMM-6T1 or WS-SVC-CMM-6E1 port adapter on the Cisco Communication Media Module for the Catalyst 6500 series switch and Cisco 7600 series router
 - DVM on Cisco MC3810 concentrators to support digital cross-connect voice (channel bank functionality)
 - High-performance compression modules (HCM) to support voice compression. See the [“Related Documents for T-CCS” section on page 3.](#)”
- Configure voice card and controller settings.
- Configure serial and LAN interfaces.
- Configure voice ports.
- Configure voice dial peers.

T-CCS Configuration Task List

To configure a router for T-CCS, complete the tasks shown in the following sections:

- [Configuring T-CCS Cross-Connect, page 4](#)
- [Configuring T-CCS Frame Forwarding, page 8](#)
- [Configuring T-CCS for a Clear-Channel Codec, page 10](#)



Note

Although not always explicitly shown in these procedures, T-CCS also requires you to configure voice ports and dial peers.

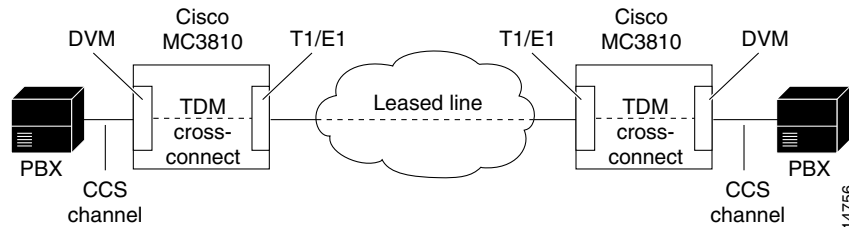
Configuring T-CCS Cross-Connect

This section is divided into the following procedures for T-CCS cross-connect:

- [Configuring T1 and E1 TDM Groups, page 5](#)
- [Configuring T1 and E1 Trunk Bearer Channels, page 6](#)

Figure 1 shows an example of T-CCS cross-connect. In this example, the CCS channel from the PBX is cross-connected on the Cisco MC3810 to a time slot on the T1/E1 controller. The channel is then passed through the WAN as a leased line to the second Cisco MC3810, where it is cross-connected to the DVM signaling time slot (time slot 24 for T1, or time slot 16 for E1). The channel is then passed to the second PBX. The CCS signal byte stream is passed through transparently by the Cisco MC3810.

Figure 1 T-CCS Cross-Connect Configuration



Configuring T1 and E1 TDM Groups

When you configure T-CCS cross-connect for E1 or T1, you set up time slot groups, and then configure cross-connect from the first T1/E1 controller to the second T1/E1 controller. The **mode ccs cross-connect** command allows the cross-connect. This command enables all the channels to perform similarly to normal CAS mode, except that the signaling bit is no longer processed by the router.

To configure T-CCS cross-connect, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# controller {T1 E1} 0	Enters controller configuration mode for controller E1 or T1 0.
Step 2	Router(config-controller)# tdm-group <i>tdm-group-no</i> timeslots <i>timeslot-list</i>	Configures a TDM channel group. The arguments are as follows: <ul style="list-style-type: none"> <i>tdm-group-no</i>—Specifies a TDM channel group number. Valid values are from 0 through 23 for T1; from 0 through 30 for E1. <i>timeslot-list</i>—Specifies a list of time slots. Valid values are from 1 to 24 for T1; from 1 to 15 and from 17 to 31 for E1. You can enter ranges or individual time slot numbers. Note Do not specify the type keyword in this command.
Step 3	Router(config-controller)# exit	Exits controller configuration mode for this controller.
Step 4	Router(config)# controller {T1 E1} 1	Enters controller configuration mode for controller E1 or T1 1.
Step 5	Router(config-controller)# mode ccs cross-connect	Configures the controller to support CCS cross-connect and trigger the signaling channel.

Command	Purpose
Step 6 Router(config-controller)# tdm-group <i>tdm-group-no</i> timeslots <i>timeslot-list</i>	(T1 only) Configures a second TDM channel group. The arguments are as follows: <ul style="list-style-type: none"> • <i>tdm-group-no</i>—Specifies a TDM channel group number. Valid values are from 0 through 23 for T1; from 0 through 30 for E1. • <i>timeslot-list</i>—Specifies a list of time slots. Valid values are from 1 to 24 for T1; from 1 to 15 and from 17 to 31 for E1. You can enter ranges or individual time slot numbers. Note Do not specify the type keyword in this command.
Step 7 Router(config-controller)# ds0-group <i>group-no</i> timeslots <i>timeslot-list</i> type <i>ext-sig</i>	(E1 only) Configures the specified channel group to support CCS mode. The keywords and arguments are as follows: <ul style="list-style-type: none"> • <i>group-no</i>—Specifies a TDM channel group number. Valid values are from 0 through 30. • timeslots <i>timeslot-list</i>—Specifies a list of time slots in the DS0 group. Valid values are from 1 to 31. You can enter ranges or individual time slot numbers. • type—The signaling method. • ext-sig—Specifies FRF.11 support. This keyword is available only when the mode ccs cross-connect command is enabled. Note The ds0-group command replaced the voice-group command that was supported in earlier releases. The ext-sig keyword replaced the ext-sig-master and ext-sig-slave keywords that were supported with the voice-group command.
Step 8 Router(config-controller)# exit	Exits controller configuration mode.
Step 9 Router(config)# cross-connect <i>id-controller-1</i> <i>tdm-group-no-1 controller-2 tdm-group-no-2</i>	Configures cross-connect pass-through between the two controllers. Depending on whether you are using T1 or E1, connect the two TDM controller groups (T1) or connect the TDM group controller to the DS0 group controller (E1).
Step 10 Router(config)# exit	Exits global configuration mode and completes the configuration.

Configuring T1 and E1 Trunk Bearer Channels



Tip

After you configure a T-CCS connection by entering the **connection trunk** command, no change to the configuration takes place until the connection is shut down with a **shutdown** command and then restarted with a **no shutdown** command. For example, the phone number supplied in the **connection trunk**

command can be changed while the connection is in the **no shutdown** state, but the change will not cause the current connection to be closed and a new connection to be opened to the new phone number. This will not take effect until the next **no shutdown** command following a **shutdown** command.

**Note**

T-CCS cross-connect is not supported on analog PVC connections.

To use T-CCS cross-connect for bearer channels of the E1 or T1 trunk, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# controller { T1 E1 } <i>number</i>	Enters controller configuration mode for the controller.
Step 2	Router(config-controller)# mode ccs cross-connect	Configures the controller to support CCS cross-connect. This command automatically creates serial interface 1:15 (E1) or 1:23 (T1).
Step 3	Router(config-controller)# ds0-group <i>group-no</i> timeslots <i>timeslot-list</i> type ext-sig	Configures the specified channel group to support CCS mode. The keywords and arguments are as follows: <ul style="list-style-type: none"> • <i>group-no</i>—Specifies a TDM channel group number. Valid values are from 0 through 23 for T1; from 0 through 30 for E1. • timeslots <i>timeslot-list</i>—Specifies a list of time slots. Valid values are from 1 to 24 for T1; from 1 to 31 for E1. You can enter ranges or individual time slot numbers. • type—The signaling method. • ext-sig—Specifies FRF.11 support. This keyword is available only when the mode ccs cross-connect command is enabled. <p>Note The ds0-group command replaced the voice-group command that was supported in earlier releases. The ext-sig keyword replaced the ext-sig-master and ext-sig-slave keywords that were supported with the voice-group command.</p>
Step 4	Router(config-controller)# exit	Exits controller configuration mode for this controller.

	Command	Purpose
Step 5	Router(config)# voice-port <i>slot/port</i>	Enters voice-port configuration mode. The arguments are as follows: <ul style="list-style-type: none"> <i>slot</i>—Specifies the slot number. For digital voice ports, the <i>slot</i> number is 1 for this configuration. <i>port</i>—Specifies the port number. Valid numbers are from 1 to 24 for T1 and from 1 to 15 or from 17 to 31 for E1. Note The <i>slot:port</i> format is also accepted.
Step 6	Router(config-voiceport)# connection trunk <i>string</i>	Configures the voice-port connection. The <i>string</i> argument is the number of the voice channel that was configured as the ext-sig type for the ds0-group command.
Step 7	Router(config-voiceport)# exit	Exits voice-port configuration mode and completes the configuration.

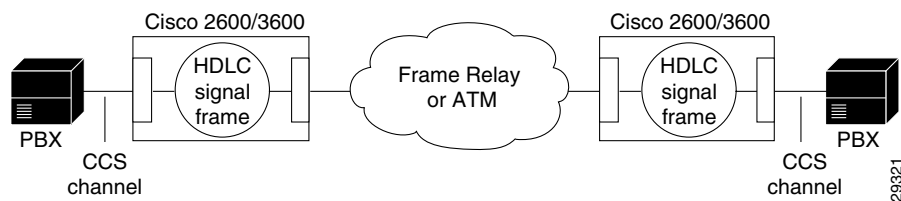
Configuring T-CCS Frame Forwarding

Cisco routers provide support for T-CCS frame forwarding, which allows a router to be connected to a Private Telco Network Exchange (PTNX) without having to interpret CCS signaling information for call processing. T-CCS frame forwarding forwards frames over a preconfigured interface running Frame Relay or ATM encapsulation.

With T-CCS frame forwarding, the connection between PTNXs over the network must be point-to-point and preconfigured. With the T-CCS frame forwarding implementation, calls from the PTNXs are not routed, but follow a preconfigured route to the destination.

Figure 2 shows an example of T-CCS frame forwarding. In the example, the first Cisco router captures the signaling frame from the PBX. The first Cisco router transports the signaling frame as a data frame through the Frame Relay or ATM network to the second Cisco router. The second Cisco router forwards the signaling frame to the PBX signaling channel.

Figure 2 T-CCS Frame Forwarding



To configure T-CCS frame forwarding, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# controller {T1 E1} <i>slot/port</i>	Enters controller configuration mode for the controller at the specified slot/port location. Valid values for slot and port are 0 and 1.
Step 2	Router(config-controller)# mode ccs frame-forwarding	Configures the controller to support CCS transparent signaling.
Step 3	Router(config-controller)# ds0-group <i>ds0-group-no</i> timeslots <i>timeslot-list</i> type ext-sig	<p>Defines the T1/E1 channels for use by compressed voice calls as well as the signaling method that the router uses to connect to the PBX or central office (CO).</p> <p>The keywords and arguments are as follows:</p> <ul style="list-style-type: none"> • <i>ds0-group-no</i>—A value that identifies the DS0 group. Valid values are: 0 to 23 for T1; 0 to 30 for E1. • timeslots <i>timeslot-list</i>—Specifies a list of time slots in the DS0 group. Valid values are from 1 to 24 for T1; from 1 to 30 for E1. <i>The value of timeslot-list</i> can be a single number, a list of numbers separated by commas, or a pair of numbers separated by a hyphen to indicate a range of time slots. To map individual DS0 time slots, define additional groups. The router maps additional voice ports for each defined group. • type—The signaling method. • ext-sig—The signaling method selection for type depends on the connection that you are making: entering the keyword ext-sig specifies the external signaling interface, which signifies that the signaling traffic comes from an outside source. <p>Note The ds0-group command automatically creates a logical voice port that is numbered as follows: <i>slot/port.ds0-group-no</i>. Although only one voice port is created, applicable calls are routed to any channel in the group.</p> <p>Note The ds0-group command replaced the voice-group command that was supported in earlier releases. The ext-sig keyword replaced the ext-sig-master and ext-sig-slave keywords that were supported with the voice-group command.</p>
Step 4	Router(config-controller)# no shutdown	Activates the controller.
Step 5	Router(config-controller)# exit	Exits controller configuration mode.

	Command	Purpose
Step 6	Router(config)# interface serial 1:channelnumber	Enters interface configuration mode. This procedure maps the D channel from the digital T1/E1 packet voice trunk network module to the specified interface. The <i>channelnumber</i> argument specifies the channel number. For T1, enter the channel number as 23 . For E1, enter 15 .
Step 7	Router(config-if)# ccs encap frf11	(Frame Relay only) Configures the CCS encapsulation to use the FRF11 packet format.
Step 8	Router(config-if)# ccs encap atm	(ATM only) Configures the CCS encapsulation to use the ATM packet format.
Step 9	Router(config-if)# ccs connect {serial atm} slot/number [dlci dlci pvc vci pvc vcd pvc vpi/vci pvc string]	(Frame Relay and ATM) Configures the CCS connection. If the CCS connection is over Frame Relay, specify a serial interface and the DLCI. If the CCS connection is over ATM, specify ATM, slot and interface, and the PVC.
Step 10	Router(config-if)# no cdp enable	Disables Cisco Discovery Protocol (CDP) on the interface.
Step 11	Router(config-if)# no keepalive	Disables keepalive packets on the interface.
Step 12	Router(config-if)# exit	Exits interface configuration mode and completes the configuration.

Configuring T-CCS for a Clear-Channel Codec

The T-CCS feature using a clear-channel codec allows tie-line emulation between two PBXs or PSTN switches running HDLC-based common channel signaling such as ISDN, DPNSS, CORNET, QSIG, and others. This configuration supports VoIP, VoFR and VoATM. Signaling frames are transparently forwarded on IP using an emulated 64-kbps channel. These frames travel over a clear-channel codec that is used on the voice port designated as the signaling channel. This codec passes data without changing the signaling frame.

T-CCS is configured when setting up the codec for the voice dial peer. The task table that follows sets up voice dial peers to support the local and remote stations. Not all possible commands are shown in the task table. To learn more, refer to the [Cisco IOS Voice, Video, and Fax Command Reference, Release 12.2](#).

To configure T-CCS for a clear-channel codec, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# controller {T1 E1} slot/port	Enters controller configuration mode for the controller at the specified slot/port location. Valid values for slot and port are 0 and 1.
Step 2	Router(config-controller)# ds0-group ds0-group-no timeslots timeslot-list type ext-sig	<p>Defines the T1/E1 channels for use by compressed voice calls as well as the signaling method the router uses to connect to the PBX or CO.</p> <p>The keywords and arguments are as follows:</p> <ul style="list-style-type: none"> • <i>ds0-group-no</i>—A value that identifies the DS0 group. Valid values are: 0 to 23 for T1; 0 to 30 for E1. • timeslots <i>timeslot-list</i>—Specifies a list of time slots in the DS0 group. Valid values are from 1 to 24 for T1; from 1 to 30 for E1. <i>The value of timeslot-list</i> can be a single number, a list of numbers separated by commas, or a pair of numbers separated by a hyphen to indicate a range of time slots. To map individual DS0 time slots, define additional groups. The router maps additional voice ports for each defined group. • type—The signaling method. • ext-sig—The signaling method selection for type depends on the connection that you are making: entering the keyword ext-sig specifies the external signaling interface, which signifies that the signaling traffic comes from an outside source. <p>Note The ds0-group command automatically creates a logical voice port that is numbered as follows: <i>slot/port:ds0-group-no</i>. Although only one voice port is created, applicable calls are routed to any channel in the group.</p> <p>Note The ds0-group command replaced the voice-group command that was supported in earlier releases. The ext-sig keyword replaced the ext-sig-master and ext-sig-slave keywords that were supported with the voice-group command.</p>
Step 3	Router(config-controller)# no shutdown	Activates the controller.
Step 4	Router(config-controller)# exit	Exits controller configuration mode.

Command	Purpose
Step 5 Router(config)# dial-peer voice <i>number</i> pots	Enters dial-peer configuration mode and defines a local dial peer that will connect to the plain old telephone service (POTS) network. The keywords and arguments are as follows: <ul style="list-style-type: none"> • <i>number</i>—One or more digits identifying the dial peer. Valid entries are from 1 through 2147483647. • pots—Indicates a peer using a basic telephone service.
Step 6 Router(config-dialpeer)# destination-pattern <i>string</i> [T]	Configures the dial peer's destination pattern so that the system can reconcile dialed digits with a telephone number. The keywords and arguments are as follows: <ul style="list-style-type: none"> • <i>string</i>—A series of digits that specify the E.164 or private dialing plan phone number. Valid entries are the digits 0 through 9 and the letters A through D. The plus symbol (+) is not valid. You can enter the following special characters: <ul style="list-style-type: none"> – The star character (*) that appears on standard touch-tone dial pads can be in any dial string. – The period (.) acts as a wildcard character. – Use the comma (,) only in prefixes. The comma inserts a one-second pause. • T—(optional) The timer (T) character. When this character is included at the end of the destination pattern, the system collects dialed digits as they are entered—until the interdigit timer expires (10 seconds, by default) or the user dials the termination of end-of-dialing key (the default is #). <p>Note The timer character must be a capital T.</p>

	Command	Purpose
Step 7	Router(config-dialpeer)# port <i>slot/port:ds0-group-no</i>	<p>Associates the dial peer with a specific logical interface.</p> <p>The arguments are as follows:</p> <ul style="list-style-type: none"> • <i>slot</i>—Specifies the router location where the voice module is installed. Valid entries are from 0 through 3. • <i>port</i>—Specifies the voice interface card location. Valid entries are 0 and 1. • <i>ds0-group-no</i>—Indicates the defined DS0 group number. Each defined DS0 group number is represented on a separate voice port. This allows you to define individual DS0s on the digital T1 card.
Step 8	Router(config-dialpeer)# exit	Exits dial-peer configuration mode to complete the POTS dial-peer configuration.
Step 9	Router(config)# dial-peer voice <i>number voip</i>	<p>Enters dial-peer configuration mode and defines a remote VoIP dial peer.</p> <p>The keywords and arguments are as follows:</p> <ul style="list-style-type: none"> • <i>number</i>—One or more digits identifying the dial peer. Valid entries are from 1 through 2147483647. • voip—Indicates a VoIP peer using voice encapsulation on the IP network.
Step 10	Router(config-dialpeer)# codec clear-channel	<p>Sets codec complexity to clear-channel to use the clear channel codec.</p> <p>Note The voice-card configuration codec complexity command sets the codec options that are available when you execute this command.</p>
Step 11	Router(config-dialpeer)# vad	<p>(Optional) Activates voice activity detection (VAD), which allows the system to reduce unnecessary voice transmissions caused by unfiltered background noise.</p> <p>Note This setting is enabled by default.</p>

Command	Purpose
Step 12 Router(config-dialpeer)# destination-pattern <i>string</i> [T]	<p>Configures the dial peer's destination pattern so that the system can reconcile dialed digits with a telephone number.</p> <p>The keywords and arguments are as follows:</p> <ul style="list-style-type: none"> • <i>string</i>—A series of digits that specify the E.164 or private dialing plan phone number. Valid entries are the digits 0 through 9 and the letters A through D. The plus symbol (+) is not valid. You can enter the following special characters: <ul style="list-style-type: none"> – The star character (*) that appears on standard touch-tone dial pads can be in any dial string. – The period (.) acts as a wildcard character. – Use the comma (,) only in prefixes. The comma inserts a one-second pause. • T—(optional) The timer (T) character. When this character is included at the end of the destination pattern, the system collects dialed digits as they are entered—until the interdigit timer expires (10 seconds, by default) or the user dials the termination of end-of-dialing key (the default is #). <p>Note The timer character must be a capital T.</p>
Step 13 Router(config-dialpeer)# session target { ipv4:destination-address dns:[<i>\$\$\$. \$d\$. \$e\$. \$u\$.</i>] <i>host-name</i> }	<p>Configures the IP session target for the dial peer.</p> <p>The keywords and arguments are as follows:</p> <ul style="list-style-type: none"> • ipv4:destination-address—Indicates the IP address of the dial peer. • dns:host-name—Indicates that the domain name server will resolve the name of the IP address. Valid entries for the argument are characters representing the name of the host device. There are also wildcards available for defining domain names with the keyword by using source, destination, and dialed information in the host name. <p>For complete command syntax information, refer to the Cisco IOS Voice Command Reference, Release 12.3.</p>
Step 14 Router(config-dialpeer)# exit	<p>Exits dial-peer configuration mode and completes the configuration.</p>

Verifying the T-CCS Configuration

To verify the T-CCS configuration, perform the following steps:

- Step 1** Enter the **show controllers e1** command (without specifying a slot and port number) to view the status for all controllers, or enter the **show controllers e1** command with a slot and port number to view the status for a particular controller. Make sure that the status indicates that the controller is up (line 2 in the following example) and no alarms (line 4 in the following example) or errors (lines 9, 10, and 11 in the following example) have been reported.

```
Router# show controllers e1 3/0

E1 3/0 is up.
  Applique type is Channelized E1 - balanced
  No alarms detected.
  alarm-trigger is not set
  Version info Firmware:19990702, FPGA:6
  Framing is CRC4, Line Code is HDB3, Clock Source is Line.
  Data in current interval (2 seconds elapsed):
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail
  Secs

!
controller E1 3/0
  mode ccs frame-forwarding
  channel-group 15 timeslots 16
  ds0-group 0 timeslots 15 type ext-sig
  ds0-group 1 timeslots 1 type ext-sig
  ds0-group 2 timeslots 2 type ext-sig
  ds0-group 3 timeslots 3 type ext-sig
  ds0-group 4 timeslots 4 type ext-sig
  ds0-group 5 timeslots 5 type ext-sig
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  ds0-group 21 timeslots 21 type ext-sig
  ds0-group 22 timeslots 22 type ext-sig
  ds0-group 23 timeslots 23 type ext-sig
  ds0-group 24 timeslots 24 type ext-sig
  ds0-group 25 timeslots 25 type ext-sig
  ds0-group 26 timeslots 26 type ext-sig
  ds0-group 27 timeslots 27 type ext-sig
  ds0-group 28 timeslots 28 type ext-sig
  ds0-group 29 timeslots 29 type ext-sig
  ds0-group 30 timeslots 30 type ext-sig
```

- Step 2** To display information about voice-port configuration, enter the **show voice port summary** command. The following example shows sample output:

```

Router# show voice port summary

```

PORT	CH	SIG-TYPE	ADMIN	OPER	IN STATUS	OUT STATUS	EC
1:1	1	ext	up	up	on-hook	idle	y
1:2	2	ext	up	up	on-hook	idle	y
1:3	3	ext	up	up	on-hook	idle	y
1:4	4	ext	up	up	on-hook	idle	y
1:5	5	ext	up	up	on-hook	idle	y
1:6	6	ext	up	up	on-hook	idle	y
1:7	7	ext	up	up	on-hook	idle	y
1:8	8	ext	up	up	on-hook	idle	y
1:9	9	ext	up	up	on-hook	idle	y
1:10	10	ext	up	up	on-hook	idle	y
1:11	11	ext	up	up	on-hook	idle	y
1:12	12	ext	up	up	on-hook	idle	y
1:13	13	ext	up	up	on-hook	idle	y
1:14	14	ext	up	up	on-hook	idle	y
1:17	17	ext	up	up	on-hook	idle	y
1:18	18	ext	up	up	on-hook	idle	y
1:19	19	ext	up	up	on-hook	idle	y
1:20	20	ext	up	up	on-hook	idle	y
1:21	21	ext	up	up	on-hook	idle	y
1:22	22	ext	up	up	on-hook	idle	y
1:23	23	ext	up	up	on-hook	idle	y
1:24	24	ext	up	up	on-hook	idle	y
1:25	25	ext	up	up	on-hook	idle	y
1:26	26	ext	up	up	on-hook	idle	y

- Step 3** To display information about voice calls, enter the **show voice call summary** privileged EXEC command. The following example shows sample output:

```

Router# show voice call summary

```

PORT	CODEC	VAD	VTSP	STATE	VPM STATE
1:1.1	g729ar8	y	S_CONNECT		S_TRUNKED
1:2.2	g729ar8	y	S_CONNECT		S_TRUNKED
1:3.3	g729ar8	y	S_CONNECT		S_TRUNKED
1:4.4	g729ar8	y	S_CONNECT		S_TRUNKED
1:5.5	g729ar8	y	S_CONNECT		S_TRUNKED
1:6.6	g729ar8	y	S_CONNECT		S_TRUNKED
1:7.7	g729ar8	y	S_CONNECT		S_TRUNKED
1:8.8	g729ar8	y	S_CONNECT		S_TRUNKED
1:9.9	g729ar8	y	S_CONNECT		S_TRUNKED
1:10.10	g729ar8	y	S_CONNECT		S_TRUNKED
1:11.11	g729ar8	y	S_CONNECT		S_TRUNKED
1:12.12	g729ar8	y	S_CONNECT		S_TRUNKED
1:13.13	g729ar8	y	S_CONNECT		S_TRUNKED
1:14.14	g729ar8	y	S_CONNECT		S_TRUNKED
1:17.17	g729ar8	y	S_CONNECT		S_TRUNKED
1:18.18	g729ar8	y	S_CONNECT		S_TRUNKED
1:19.19	g729ar8	y	S_CONNECT		S_TRUNKED
1:20.20	g729ar8	y	S_CONNECT		S_TRUNKED
1:21.21	g729ar8	y	S_CONNECT		S_TRUNKED
1:22.22	g729ar8	y	S_CONNECT		S_TRUNKED
1:23.23	g729ar8	y	S_CONNECT		S_TRUNKED
1:24.24	g729ar8	y	S_CONNECT		S_TRUNKED
1:25.25	g729ar8	y	S_CONNECT		S_TRUNKED
1:26.26	g729ar8	y	S_CONNECT		S_TRUNKED

- Step 4** To display information about configured DS0 and TDM groups, enter the **show running-config** privileged EXEC command. The following example shows sample output:

```
Router# show running-config
.
.
.
controller T1 0
  tdm-group 1 timeslots 24
  framing esf
  linecode b8zs
  channel-group 0 timeslots 1-23 speed 64
!
controller E1 1
  mode ccs cross-connect
  tdm-group 1 timeslots 16
  clock source internal
  ds0-group 0 timeslots 1 type ext-sig
  ds0-group 2 timeslots 2 type ext-sig
  ds0-group 3 timeslots 3 type ext-sig
  ds0-group 4 timeslots 4 type ext-sig
  ds0-group 5 timeslots 5 type ext-sig
  ds0-group 6 timeslots 6 type ext-sig
  .
  .
  ds0-group 23 timeslots 23 type ext-sig
  ds0-group 24 timeslots 24 type ext-sig
  ds0-group 25 timeslots 25 type ext-sig
  ds0-group 26 timeslots 26 type ext-sig
  .
  .
  .
voice-port 1:0
  compand-type a-law
  timeouts wait-release 3
  connection trunk 3001
!
voice-port 1:2
  compand-type a-law
  timeouts wait-release 3
  connection trunk 3002
!
voice-port 1:3
  compand-type a-law
  timeouts wait-release 3
  connection trunk 3003
!
.
.
.
dial-peer voice 12 pots
  destination-pattern 4012
  port 1:12
!
dial-peer voice 13 pots
  destination-pattern 4013
  port 1:13
!
dial-peer voice 14 pots
  destination-pattern 4014
  port 1:14
!
!
cross-connect 1 E1 1 1 T1 0 1
```

**Note**

For full configuration details, see the [“T-CCS Configuration Examples”](#) section on page 19.

Troubleshooting Tips for T-CCS

If the T-CCS connection does not come up, check for the following:

- Loose wires, splices, connectors, shorts, bridge taps, and grounds
- Backwards transmit and receive
- Mismatched framing types (for example, CRC-4 versus no-CRC-4)
- Transmit and receive pair separation (crosstalk)
- Faulty line cards or repeaters
- Noisy lines (for example, power and crosstalk)

If you see errors on the line or the line is going up and down, check for the following:

- Mismatched line codes (HDB3 vs. AMI)
- Improper receive level
- Frame slips due to poor clocking plan

Monitoring and Maintaining T-CCS and Frame Forwarding

To monitor your T-CCS configuration, use these commands as needed:

Command	Purpose
Router# show frame-relay vofr [<i>interface</i> [<i>dlci</i> [<i>cid</i>]]]	Displays information about FRF.11 subchannels and CIDs.
Router# show interface serial0	Displays information the serial interface used with VoFR, the DLCIs used on the interface, and the DLCI used for the Local Management Interface (LMI).
Router# show frame-relay pvc [interface <i>interface</i> [<i>dlci</i>] [<i>cid</i>]]	Displays information about Frame Relay PVCs, on all PVCs, or for a particular CID.
Router# show atm pvc [<i>vpi/vci</i>] [<i>name</i>]	Displays information about all configured ATM PVCs or about a particular PVC by virtual path identifier (VPI) and virtual channel identifier (VCI) numbers or by name.
Router# show interface atm0	Displays information about ATM interface configuration.

T-CCS PBX Configuration Examples

The following sections give sample configurations for the T-CCS PBX signaling format.

T-CCS Configuration Examples

This section contains two examples of T-CCS configuration:

- [T-CCS over Frame Relay Configuration Example, page 19](#)
- [T-CCS over IP Configuration Example, page 20](#)

T-CCS over Frame Relay Configuration Example

The following configuration example shows T-CCS frame forwarding on controller E1. Only relevant sections of the configuration are shown. The example assumes that the IP portion of the network is already in place.

```
hostname routerA
!
voice-card 1
!
controller E1 1/0
mode ccs frame-forwarding
channel-group 15 timeslots 16
ds0-group 0 timeslots 15 type ext-sig
ds0-group 1 timeslots 1 type ext-sig
.
.
.
ds0-group 14 timeslots 14 type ext-sig
ds0-group 17 timeslots 17 type ext-sig
.
.
.
ds0-group 30 timeslots 30 type ext-sig
!
interface Serial10/0
ip address 200.200.200.2 255.255.255.0
no ip directed-broadcast
encapsulation frame-relay
no ip mroute-cache
clockrate 2000000
frame-relay traffic-shaping
frame-relay class fr1
frame-relay map ip 200.200.200.1 231 broadcast
frame-relay interface-dlci 231
vofr data 4 call-control 5
frame-relay intf-type dce
!
```

You must use the **mode ccs frame-forwarding** command to set the E1 interface to enable transparent forwarding of the HDLC signaling protocol through the DSP.

The **ds0-group** command links the specified time slot of the E1 interface to the corresponding voice port, which is automatically created by the router. This allows the voice port to be tied to the correspondent dial-peer using the **connection trunk** command. The **ext-sig** keyword specifies that the signaling traffic is coming from an external source.

The serial interface is set for frame relay traffic.

The example continues with the **voice-port** and **dial-peer** configuration.

```
voice-port 1/0:0
  compand-type a-law
  timeouts wait-release 3
  connection trunk 2000 answer-mode
.
.
.
voice-port 1/0:14
  compand-type a-law
  timeouts wait-release 3
  connection trunk 2014 answer-mode
!
voice-port 1/0:17
  compand-type a-law
  timeouts wait-release 3
  connection trunk 2017 answer-mode
.
.
.
voice-port 1/0:30
  compand-type a-law
  timeouts wait-release 3
  connection trunk 2030 answer-mode
!
dial-peer voice 2000 vofr
  destination-pattern 2000
  session target Serial0/0 231
!
dial-peer voice 1001 pots
  destination-pattern 1001
  port 1/0:1
.
.
.
dial-peer voice 1030 pots
  destination-pattern 1030
  port 1/0:30
!
```

The **dial-peer voice 2000 vofr** command is used to forward the signaling channel over Frame Relay.

The **dial-peer pots** command sends the trunked voice DS0 traffic to the correspondent voice DS0 lines on the E1 port 1/0.

T-CCS over IP Configuration Example

The following configuration example configures T-CCS over IP using the clear-channel codec. The commands used in the configurations are explained inline. Only relevant sections of the configuration are shown. The example assumes that the IP portion of the network is already in place.

```
hostname routerA
!
voice-card 1
!
controller E1 1/0
  ds0-group 0 timeslots 16 type ext-sig
.
.
.
```

```

ds0-group 10 timeslots 10 type ext-sig
!
interface Ethernet0/0
ip address 30.30.30.2 255.255.255.252
no ip directed-broadcast
!
voice-port 1/0:0
  compand-type a-law
  timeouts wait-release 3
  connection trunk 4000 answer-mode
!
voice-port 1/0:1
  compand-type a-law
  timeouts wait-release 3
  connection trunk 5001 answer-mode
.
.
.
voice-port 1/0:10
  compand-type a-law
  timeouts wait-release 3
  connection trunk 5010 answer-mode
!

```

The **ds0-group** command links the specified time slot of the E1 interface to the corresponding voice port, which is automatically created by the router. This allows the voice port to be tied to the corresponding dial peer using the connection trunk command. The **ext-sig** keyword specifies that the signaling traffic is coming from an external source.

The DS0 group assigned for signaling, configured as **ds0-group 0 timeslots 16**, must have the corresponding voice port and dial peer set for the clear-channel codec in order to enable transparent forwarding of the HDLC signaling protocol through the DSP.

The signaling DS0 channel of the E1 port 1/0 is configured to the dial peer whose destination pattern matches the number 4000. The **dial-peer voice 4000 voip** command is used to forward the signaling channel over IP.

The voice DS0 channels of the E1 port 1/0 are configured to the dial peer whose destination pattern matches the number 5... . The **dial-peer voice 5... voip** command is used to trunk the voice channels between routers, as in the following example:

```

dial-peer voice 4000 voip
  destination-pattern 4000
  codec clear-channel
  session target ipv4:10.49.80.204
!
dial-peer voice 3000 pots
  destination-pattern 3000
  port 2/0:0
!
dial-peer voice 5000 voip
  destination-pattern 5...
  session target ipv4:10.49.80.204
!
dial-peer voice 2001 pots
  destination-pattern 2001
  port 2/0:1
.
.
.
dial-peer voice 2010 pots
  destination-pattern 2010
  port 2/0:10

```

The **dial-peer voice 4000 voip** command is used to forward the signaling channel from the router over IP. The clear-channel codec must be applied to this dial peer in order to avoid that compression, and VAD will be applied to the signaling channel, which requires a transparent 644-kbps path through the DSP and the IP cloud.

The **dial-peer voice 3000 pots** command forwards the incoming clear-channel signaling data to the corresponding signaling DS0 channel on the E1 port 1/0 of the router. This is achieved by leveraging the voice-port 1/0:0 that was created by using the **ds0-group 0 timeslots 16 type ext-sig** command.

The **dial-peer voice 5000 voip** command is used to trunk the voice channels between routers. In this case, the codec used is the default G.729.

The **dial-peer voice 2001 pots** through **dial-peer voice 2010 pots** commands associate the VoIP legs of the trunked voice DS0s to the corresponding voice DS0s on the E1 port 1/0 of the router.