



## Implementing T1 CAS for VoIP

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This chapter describes how to implement the T1 Channel-Associated Signaling (CAS) for VoIP feature. This feature adds support for T1 CAS and E1 R2 signaling with the voice feature card (VFC).

The T1 CAS interface is used for connection to both a private PBX and the PSTN. This feature is required by North American enterprise customers and service providers. For most enterprise customers, T1 CAS is the only type of line they use from the PSTN; E&M may be the only option for connecting to their PBX.

### Feature History for T1 CAS for VoIP

Release	Modification
12.1(5)XM	This feature was introduced on the Cisco AS5800.
12.2(2)XB1	This feature was implemented on the Cisco AS5850.
12.2(11)T	This feature was integrated into this release.

### Finding Support Information for Platforms and Cisco IOS Software Images

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.



#### Note

For more information about related Cisco IOS voice features, see the following:

- “[Overview of ISDN Voice Interfaces](#)” on [page 3](#)
- Entire Cisco IOS Voice Configuration Library—including library preface and glossary, other feature documents, and troubleshooting documentation—at [http://www.cisco.com/en/US/products/ps6441/prod\\_configuration\\_guide09186a0080565f8a.html](http://www.cisco.com/en/US/products/ps6441/prod_configuration_guide09186a0080565f8a.html).

For a list of references cited in this chapter, see the “[Additional References](#)” section on [page 297](#).

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## Prerequisites for Configuring T1 CAS

- Perform the prerequisites that are listed in the [“Prerequisites for Configuring ISDN Voice Interfaces” section on page 3](#).

## Restrictions for Configuring T1 CAS

Restrictions are described in the [Restrictions for Configuring ISDN Voice Interfaces, page 4](#). In addition, the following applies.

Internet service providers can provide switched 56-kbps access to their customers with this feature. The subset of T1 CAS (robbed-bit) supported features is as follows:

- Supervisory: line side
  - fxs-ground-start
  - fxs-loop-start
  - sas-ground-start
  - sas-loop-start
  - Modified R1
- Supervisory: trunk side
  - e&m-fgb
  - e&m-fgd




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**Note** e&m-fgd can receive calling-party number (ANI) and send called-party number (dialed-number identification service or DNIS) but cannot send ANI.

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- e&m immediate start
- fgd-eana




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**Note** fgd-eana can send both ANI and DNIS but cannot receive ANI.

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- Informational: line side
  - DTMF
- Informational: trunk side
  - DTMF
  - MF

# Information About T1 CAS for VoIP

**Note**

General information about ISDN voice interfaces is presented in the [“Information About ISDN Voice Interfaces” section on page 4](#).

To implement this feature, you should understand the following concepts:

- [CAS Basics, page 289](#)
- [E&M and Ground Start/FXS Protocols, page 289](#)

## CAS Basics

CAS is the transmission of signaling information within the voice channel. In addition to receiving and placing calls, CAS also processes the receipt of DNIS and ANI information, which is used to support authentication and other functions.

Various types of CAS are available in the T1 world. The most common forms are loop-start, ground-start, Equal Access North American (EANA), and E&M.

The biggest disadvantage of CAS is its use of user bandwidth to perform signaling functions. CAS is often referred to as robbed-bit-signaling because user bandwidth is “robbed” by the network for other purposes.

Service-provider application for T1 CAS includes connectivity to the public network using T1 CAS from the Cisco router to the end-office switch. In this configuration, the router captures dialed-number or called-party-number information and passes it to the upper-level applications for IVR script selection, modem pooling, and other applications. Service providers also require access to ANI for user identification, billing account number, and, in the future, more complicated call routing.

Service providers who implement VoIP include traditional voice carriers, new voice and data carriers, and existing internet service providers. Some of these service providers might use subscriber-side lines for VoIP connectivity to the PSTN; others use tandem-type service-provider connections.

New CAS functionality for VoIP includes all CAS and E1/R2 signaling already supported for supported Cisco platforms in data applications, with the addition of dialed-number and calling-party-number capture whenever available.

## E&M and Ground Start/FXS Protocols

This feature supports the following T1 CAS systems for VoIP applications:

- E&M—E&M robbed-bit signaling is typically used for trunks. It is generally the only way that a CO switch can provide two-way dialing with direct inward dialing. In all E&M protocols, off-hook is indicated by A=B=1 and on-hook is indicated by A=B=0. For dial-pulse dialing, the A and B bits are pulsed to indicate the addressing digits. There are several further important subclasses of E&M robbed-bit signaling:

- E&M Wink Start—Feature Group B

In the original Wink Start protocol, the terminating side responds to an off-hook from the originating side with a short wink (transition from on-hook to off-hook and back again). This wink indicates that the terminating side is ready to receive addressing digits. After receiving digits, the terminating side goes off-hook for the duration of the call. The originating side maintains off-hook for the duration of the call.

- E&M Wink Start—Feature Group D

In Feature Group D Wink Start with Wink Acknowledge Protocol, the terminating side responds to an off-hook from the originating side with a short wink just as in the original Wink Start. After receiving digits, the terminating side provides another wink (called an acknowledgment wink) to indicate that the terminating side has received the digits. The terminating side goes off-hook to indicate connection when the ultimate called endpoint has answered. The originating side maintains off-hook for the duration of the call.

- E&M Immediate Start

In the Immediate Start Protocol, the originating side does not wait for a wink before sending addressing digits. After receiving digits, the terminating side goes off-hook for the duration of the call. The originating side maintains off-hook for the duration of the call.

- Ground Start/FXS—Ground Start Signaling was developed to help resolve glare when two sides of the connection tried to go off-hook at the same time. This is a problem with loop start because the only way to indicate an incoming call from the network to the customer premises equipment (CPE) using loop start was to ring the phone. The six-second ring cycle left a lot of time for glare to occur. Ground Start Signaling eliminates this problem by providing an immediate-seizure indication from the network to the CPE. This indication tells the CPE that a particular channel has an incoming call on it. Ground Start Signaling differs from E&M because the A and B bits do not track each other (that is, A is not necessarily equal to B). When the CO delivers a call, it seizes a channel (goes off-hook) by setting A to 0. The CO equipment also simulates ringing by toggling the B bit. The terminating equipment goes off-hook when it is ready to answer the call. Digits are usually not delivered for incoming calls.

## How to Configure T1 CAS for VoIP

This section contains the following procedures:

- [Configuring T1 CAS for Use with VoIP, page 290](#) (required)
- [Verifying and Troubleshooting a T1 CAS Configuration, page 293](#) (optional)

## Configuring T1 CAS for Use with VoIP

To configure T1 CAS for use with VoIP, perform the following steps.



Note

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The following shows how to configure the voice ports as *ds0-group* for channelized T1 lines.

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### SUMMARY STEPS

1. **enable**
2. **configure terminal**

3. **controller**
4. **framing**
5. **linecode**
6. **ds0-group timeslots type**
7. Repeat as needed.
8. **dial-peer voice *tag type (destination-pattern, port, prefix)***
9. **dial-peer voice *tag type (incoming called-number, destination-pattern, direct-inward-dial, port, prefix)***
10. Repeat as needed.
11. **exit**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<code>enable</code>  <b>Example:</b> Router> enable	Enters privileged EXEC mode. Enter your password when prompted.
Step 2	<code>configure terminal</code>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	<code>controller {t1   e1} slot/port</code>  <b>Example:</b> Router(config)# controller t1 1/0/0	Enters controller configuration mode for the specified slot/port. The controller ports are labeled RI and E1/PRI cards.
Step 4	<code>framing type</code>  <b>Example:</b> Router(config-control)# framing esf	Enters your telco framing type.
Step 5	<code>linecode type</code>  <b>Example:</b> Router(config-control)# linecode b8zs	Enters your telco line code type.

Command or Action	Purpose
<p><b>Step 6</b></p> <pre>ds0-group group-number timeslots range type type {dtmf   mf} {ani   dnis   ani-dnis}</pre> <p><b>Example:</b></p> <pre>Router(config-control)# ds0-group 1 timeslots 1-24 type e&amp;m-fgb</pre>	<p>Configures all channels for E&amp;M, FXS, and SAS analog signaling. T1 range: 1 to 24. E1 range: 1 to 31.</p> <p>Some of the valid signaling types and keyword combinations are as follows:</p> <ul style="list-style-type: none"> <li>• Type: e&amp;m-fgb <ul style="list-style-type: none"> <li>– dtmf and dnis</li> <li>– mf and dnis</li> </ul> </li> <li>• Type: e&amp;m-fgd <ul style="list-style-type: none"> <li>– dtmf and dnis</li> <li>– mf and ani-dnis or dnis</li> </ul> </li> <li>• Type: fgd-eana <ul style="list-style-type: none"> <li>– mf and ani-dnis</li> </ul> </li> </ul> <p><b>Note</b> Use the same type of signaling that your central office uses. For E1 using the Anadigicom converter, use e&amp;m-fgb. See restrictions applicable to e&amp;m-fgb and e&amp;m-fgd in the <a href="#">“Restrictions for Configuring T1 CAS” section on page 288</a>.</p>
<p><b>Step 7</b></p> <p>Repeat steps 4 to 6 for each additional controller (there are 12). Be sure to increment the controller number and ds0-group number.</p>	<p>—</p>
<p><b>Step 8</b></p> <pre>dial-peer voice tag type destination-pattern port prefix</pre> <p><b>Example:</b></p> <pre>Router(config-control)# dial-peer voice 3070 pots destination-pattern 30... port 1/0/0:D prefix 30</pre>	<p>Enters dial-peer configuration mode and configures a POTS peer destination pattern.</p>
<p><b>Step 9</b></p> <pre>dial-peer voice tag type incoming called-number destination-pattern direct-inward-dial port prefix</pre> <p><b>Example:</b></p> <pre>Router(config-control)# dial-peer voice 21 pots incoming called-number 11... destination-pattern 40... direct-inward-dial port 12/0:2:0 prefix 21</pre>	<p>Specifies, for each POTS peer, the following: incoming called number, destination pattern, and direct inward dial.</p>

	Command or Action	Purpose
Step 10	Repeat steps 8 and 9 for each dial peer.	—
Step 11	<code>exit</code>	Exits the current mode.
	<b>Example:</b> <code>Router(config-control)# exit</code>	<b>Note</b> The message “%SYS-5-CONFIG_I: Configured from console by console” is normal and does not indicate an error.

## Verifying and Troubleshooting a T1 CAS Configuration

To verify and troubleshoot a T1 CAS configuration, perform the following steps (listed alphabetically).

### SUMMARY STEPS

1. `debug cas`
1. `show controllers`
2. `show voice port`
3. `show running-config`

### DETAILED STEPS

#### Step 1 `debug cas`

Use the `debug cas` command to identify and troubleshoot call connection problems on a T1/E1 interface. With this command, you can trace the complete sequence of incoming and outgoing calls.

#### Examples

The following shows an example session to enable debugging CAS and generate troubleshooting output:

```
Router# show debug
Router# debug cas slot 1 port 0
```

```
CAS debugging is on
Router#
```

```
debug-cas is on at slot(1) dsx1(0)
Router# show debug
```

```
CAS debugging is on
```

The following example shows output for the first outgoing call:

```
Router# p 1.1.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.2, timeout is 2 seconds:
*Mar 2 00:17:45: dsx1_alloc_cas_channel: channel 0 dsx1_timeslot
1(0/0): TX SEIZURE (ABCD=0001)(0/0): RX SEIZURE_ACK (ABCD=1101)(0/1):
RX_IDLE (ABCD=1001)(0/2): RX_IDLE (ABCD=1001)(0/3): RX_IDLE
(ABCD=1001)(0/4): RX_IDLE (ABCD=1001)(0/5): RX_IDLE (ABCD=1001)(0/6):
RX_IDLE (ABCD=1001)(0/7): RX_IDLE (ABCD=1001)(0/8): RX_IDLE
(ABCD=1001)(0/9): RX_IDLE (ABCD=1001)(0/10): RX_IDLE (ABCD=1001)(0/11):
RX_IDLE (ABCD=1001)(0/12): RX_IDLE (ABCD=1001)(0/13): RX_IDLE
(ABCD=1001)(0/14): RX_IDLE (ABCD=1001)(0/16): RX_IDLE (ABCD=1001)(0/17):
RX_IDLE (ABCD=1001)(0/18): RX_IDLE (ABCD=1001)(0/19): RX_IDLE
(ABCD=1001)(0/20): RX_IDLE (ABCD=1001)(0/21): RX_IDLE
```

```
(ABCD=1001).(0/22): RX_IDLE (ABCD=1001)(0/23): RX_IDLE
(ABCD=1001)(0/24): RX_IDLE (ABCD=1001)(0/25): RX_IDLE (ABCD=1001)(0/26):
RX_IDLE (ABCD=1001)(0/27): RX_IDLE (ABCD=1001)(0/28): RX_IDLE
(ABCD=1001)(0/29): RX_IDLE (ABCD=1001)(0/30): RX_IDLE
(ABCD=1001)...(0/0): RX ANSWERED (ABCD=0101).
Success rate is 0 percent (0/5)
```

```
Router#
*Mar 2 00:18:13.333: %LINK-3-UPDOWN: Interface Async94, changed state to up
*Mar 2 00:18:13.333: %DIALER-6-BIND: Interface As94 bound to profile Di1
*Mar 2 00:18:14.577: %LINEPROTO-5-UPDOWN: Line protocol on Interface Async94, changed
state to up
```

```
Router# p 1.1.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 160/180/236 ms
The following example shows that the call is cleared on the router:
```

```
Router# clear int dialer 1
Router#
(0/0): TX IDLE (ABCD=1001)(0/0): RX IDLE (ABCD=1001)
*Mar 2 00:18:28.617: %LINK-5-CHANGED: Interface Async94, changed state to reset
*Mar 2 00:18:28.617: %DIALER-6-UNBIND: Interface As94 unbound from profile Di1
*Mar 2 00:18:29.617: %LINEPROTO-5-UPDOWN: Line protocol on Interface Async94, changed
state to down
et2-c3745-1#
*Mar 2 00:18:33.617: %LINK-3-UPDOWN: Interface Async94, changed state to down
```

The following example shows a subsequent outbound CAS call:

```
Router# p 1.1.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.2, timeout is 2 seconds:
*Mar 2 00:18:40: dsx1_alloc_cas_channel: channel 5 dsx1_timeslot
6(0/5): TX SEIZURE (ABCD=0001)(0/5): RX SEIZURE_ACK
(ABCD=1101)...(0/5): RX ANSWERED (ABCD=0101).
Success rate is 0 percent (0/5)
```

```
Router#
*Mar 2 00:19:08.841: %LINK-3-UPDOWN: Interface Async93, changed state to up
*Mar 2 00:19:08.841: %DIALER-6-BIND: Interface As93 bound to profile Di1
*Mar 2 00:19:10.033: %LINEPROTO-5-UPDOWN: Line protocol on Interface Async93, changed
state to up
```

```
Router# p 1.1.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 160/167/176
ms
```

The following example shows the call cleared by the switch:

```
Router#
(0/5): TX IDLE (ABCD=1001)(0/5): RX IDLE (ABCD=1001)
*Mar 2 00:19:26.249: %LINK-5-CHANGED: Interface Async93, changed state to reset
*Mar 2 00:19:26.249: %DIALER-6-UNBIND: Interface As93 unbound from profile Di1
*Mar 2 00:19:27.249: %LINEPROTO-5-UPDOWN: Line protocol on Interface Async93, changed
state to down
Router#
*Mar 2 00:19:31.249: %LINK-3-UPDOWN: Interface Async93, changed state to down
```

The following example shows an incoming CAS call:

```
Router#
(0/0): RX SEIZURE (ABCD=0001)
*Mar 2 00:22:40: dsx1_alloc_cas_channel: channel 0 dsx1_timeslot
1(0/0): TX SEIZURE_ACK (ABCD=1101)(0/0): TX ANSWERED (ABCD=0101)
Router#
*Mar 2 00:23:06.249: %LINK-3-UPDOWN: Interface Async83, changed state to up
*Mar 2 00:23:06.249: %DIALER-6-BIND: Interface As83 bound to profile Di1
*Mar 2 00:23:07.653: %LINEPROTO-5-UPDOWN: Line protocol on Interface Async83, changed
state to up
```

**Step 2** `show controllers {t1 | e1} dial-shelfslotport`

Use this command to display the controller and alarm status for the specified dial shelf/slot/port. Configuration is successful if the controller reports being up and no error are reported.

```
Router# show controllers t1 1/0/0

T1 1/0/0 is up.
  Applique type is Channelized T1
  Cablelength is long gain36 0db
  No alarms detected.
  alarm-trigger is not set
  Framing is ESF, Line Code is B8ZS, Clock Source is Line.
  Data in current interval (180 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
```

**Step 3** `show isdn status`

Use this command to display the status of all ISDN interfaces, including active layers, timer information, and switch-type settings.

**Step 4** `show running-config`

Use this command to display the basic router configuration.

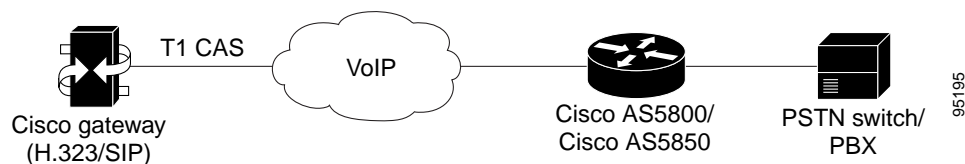
**Step 5** `show voice port`

To display configuration information about a specific voice port, use the **show voice port** command in privileged EXEC mode. Command syntax and options vary according to platform and configuration.

## Configuration Example for T1 CAS for VoIP

The sample configuration is only intended as an example of how to use the commands to configure T1 CAS. It is not an example of a complete configuration for setting up the entire signaling for a telco network.

**Figure 17** T1 CAS for VoIP: Network Topology



```

Router# show running-config

version 12.1
service timestamps debug datetime msec localtime show-timezone
service timestamps log datetime msec localtime show-timezone
service password-encryption
!
hostname travis-nas-01
!
aaa new-model
aaa authentication login default local
aaa authentication login NO_AUTHENT none
aaa authorization exec default local if-authenticated
aaa authorization exec NO_AUTHOR none
aaa authorization commands 15 default local if-authenticated
aaa authorization commands 15 NO_AUTHOR none
aaa accounting exec default start-stop group tacacs+
aaa accounting exec NO_ACCOUNT none
aaa accounting commands 15 default stop-only group tacacs+
aaa accounting commands 15 NO_ACCOUNT none
enable secret 5 $1$LsoW$K/qBH9Ih2WstUxvazDgmy/
!
username admin privilege 15 password 7 06455E365E471D1C17
username gmcilla password 7 071824404D06140044
username krist privilege 15 password 7 0832454D01181118
!
call rsvp-sync
shelf-id 0 router-shelf
shelf-id 1 dial-shelf
!
resource-pool disable
!
modem-pool Default
  pool-range 1/2/0-1/2/143,1/3/0-1/3/143
!
modem-pool accounts
!
modem-pool accounts1
!
modem-pool accounts2
!
clock timezone CST -6
clock summer-time CST recurring
!
ip subnet-zero
ip domain-name cisco.com
ip name-server 172.22.53.210
ip name-server 171.69.2.133
ip name-server 171.69.2.132
ip name-server 171.69.11.48
!
isdn switch-type primary-5ess
!
controller T1 1/0/0
  framing esf
  linecode b8zs
ds0-group 1 timeslots 1-24 type e&m-fgb
!
controller T1 1/0/1
  framing esf
  linecode b8zs
  ds0-group 1 timeslots 1-24 type e&m-fgb
!
controller T1 1/0/2

```

```
framing esf
linecode b8zs
ds0-group 1 timeslots 1-24 type e&m-fgb
!
controller T1 1/0/3
framing esf
linecode b8zs
ds0-group 0 timeslots 1-24 type e&m-fgb dtmf dnis
!
controller T1 1/0/4
```

## Additional References

### General ISDN References

- [“ISDN Features Roadmap” on page 1](#)—Describes how to access Cisco Feature Navigator; also lists and describes, by Cisco IOS release, ISDN features for that release
- [“Overview of ISDN Voice Interfaces” on page 3](#)—Describes relevant underlying technology; lists related documents, standards, MIBs, and RFCs; and describes how to obtain technical assistance
- [“Additional References” section on page 64](#)—Lists additional ISDN references

