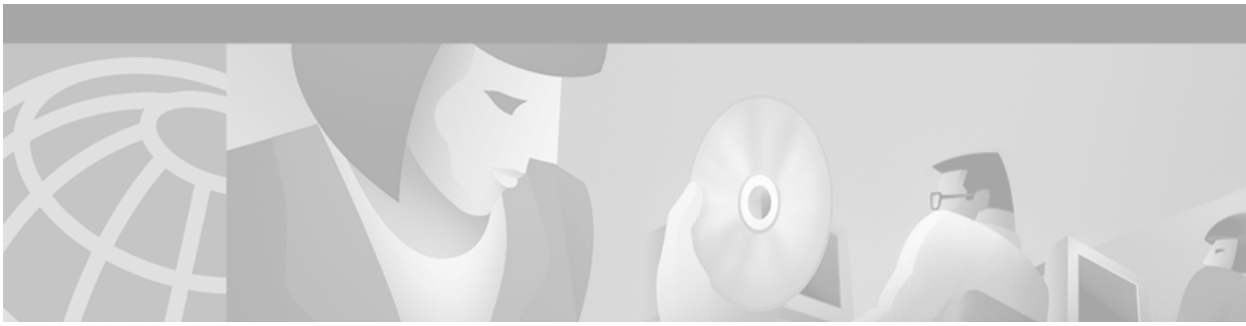


E1 R2 and Channel-Associated Signaling Configuration

The following sections are provided:

Feature Summary

This document describes the following types of signaling for Cisco platforms:

- E1 Channel-Associated Signaling
- R2 Signaling

Other E1 configurations are described in the Cisco IOS Release 12.1 *Multiservice Applications Configuration Guide* and *Multiservice Applications Command Reference*.

E1 Channel-Associated Signaling

Channel-associated signaling for channelized E1 lines, which are commonly deployed in networks in Latin America, Asia, and Europe, are supported on Cisco routers. Channel-associated signaling is configured to support channel banks in the network that convert various battery and ground operations on analog lines into signaling bits, which are forwarded over digital lines.

Channel associated signaling (CAS) is the transmission of signaling information within the voice channel. CAS is configured on an E1 controller and enables the access server to send or receive analog calls. The signaling uses the16th channel (time slot); thus, channel-associated signaling fits in the out-of-band signaling category.

R2 Signaling

R2 signaling is an international signaling standard that is common to channelized E1 networks. However, there is no single signaling standard for R2. The ITU-T Q.400-Q.490 recommendation defines R2, but a number of countries and geographic regions implement R2 in entirely different ways. Cisco Systems addresses this challenge by supporting many localized implementations of R2 signaling in its Cisco IOS software.

Cisco System's E1 R2 signaling default is ITU, which supports the following countries: Denmark, Finland, Germany, Russia (ITU variant), Hong Kong (ITU variant), and South Africa (ITU variant). The expression "ITU variant" means there are multiple R2 signaling types in the specified country, but Cisco supports the ITU variant.

Cisco Systems also supports specific local variants of E1 R2 signaling in the following regions, countries, and corporations:

- Argentina
- Australia
- Brazil
- China
- Columbia
- Costa Rica
- East Europe (includes Croatia, Russia, and Slovak Republic)
- Ecuador ITU
- Ecuador LME
- Greece
- Guatemala
- Hong Kong (uses the China variant)
- Indonesia
- Israel
- Korea
- Malaysia
- New Zealand
- Parguay
- Peru
- Philippines
- Saudi Arabia
- Singapore
- South Africa (Panaftel variant)
- Telmex corporation (Mexico)
- Telnor corporation (Mexico)
- Thailand
- Uruguay

- Venezuela
- Vietnam

About In-Band and Out-of-Band Signaling

The terms *in-band* and *out-of-band* indicate whether various signals—used to set up, control, and terminate calls—travel in the same channel (or band) with users' voice calls or data, or whether those signals travel a separate channel (or band).

ISDN, which uses the D channel for signaling and the B channels for user data, fits into the out-of-band signaling category.

Robbed-bit signaling, which uses bits from specified frames in the user data channel for signaling, fits into the in-band signaling category.

Channel-associated signaling, which uses E1 time slot 16 (the D channel) for signaling, fits into the out-of-band signaling category.

Benefits

- R2 custom localization—R2 signaling is supported for a wide range of countries and geographical regions. Cisco is continually supporting new countries.
- E1 voice traffic using R2 signaling can be routed to IP, ATM, or Frame Relay networks.

Related Documents

- Cisco IOS Release 12.1 *Multiservice Applications Configuration Guide*
- Cisco IOS Release 12.1 *Multiservice Applications Command Reference*

Supported Platforms

This feature is supported on the following platforms:

- Cisco 2600 series routers
- Cisco 3600 series routers
- Cisco 7200 series routers

Supported MIBs and RFCs

None.

Configuration Tasks

See the following sections for configuration tasks for CAS and E1 R2 signaling. Each task in the list indicates if the task is optional or required.

- Configuring Channel-Associated Signaling
- Configuring E1 R2 Signaling

Configuring Channel-Associated Signaling

To configure CAS on the E1 controllers, use the following commands, beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# configure t`	Enters global configuration to configure E1 R2 for your Cisco router.
Step 2	`Router(config-controller)# controller e1` *slot/port*	Specifies the E1 controller that you want to configure with R2 signaling.
Step 3	`Router(config-controller)# ds0-group` *ds0-group-no* `timeslots` *timeslot-list* `type {e&m-immediate | e&m-delay | e&m-wink | fxs-ground-start | fxs-loop-start |fxo-ground-start | fxo-loop-start}`	Configures channel-associated signaling and the signaling protocol on a specified number of time slots.
Step 4	`Router(config-controller)# framing crc4`	Defines the framing characteristics as cyclic redundancy check 4 (CRC4).
Step 5	`Router(config-controller)# linecode hdb3`	Defines the line code as high-density bipolar 3 (HDB3).
Step 6	`Router(config-controller)# clock source line primary`[1]	Specifies one E1 line to serve as the primary or most stable clock source line.

1. Specify the other E1 line as the secondary clock source with the **clock source line secondary** command.

If you do not specify the time slots, channel-associated signaling is configured on all 30 B channels and one D channel on the specified controller.

Configuring E1 R2 Signaling

R2 signaling is channelized E1 signaling used in Europe, Asia, and South America. It is equivalent to channelized T1 signaling in North America. There are two aspects of R2 signaling: line signaling and interregister signaling. R2 line signaling includes R2 digital, R2 analog, and R2 pulse. R2 interregister signaling includes R2 compelled, R2 noncompelled, and R2 semicompelled. These signaling types are configured using the **ds0-group (controller e1)** command.

Many countries and regions have their own E1 R2 variant specifications, which supplement the ITU-T Q.400-Q.490 recommendation for R2 signaling. Unique E1 R2 signaling parameters for specific countries and regions are set by issuing the **cas-custom** *channel* command followed by the **country** *name* command.

Cisco's implementation of R2 signaling has DNIS support turned on by default. If you enable the **ani** option, the collection of DNIS information is still performed. Specifying the **ani** option does not disable DNIS collection. DNIS is the number being called. ANI is the caller's number. For example, if you are configuring router A to call router B, then the DNIS number is assigned to router B, the ANI number is assigned to router A. ANI is similar to Caller ID.

To configure E1 R2 signaling, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`router(config)# controller E1 slot/port`	Specifies the E1 controller that you want to configure with R2 signaling.
Step 2	`router(config-controller)# ds0-group channel timeslots range type signal` Replace the signal variable with any of the following choices under R2 analog, R2 digital, or R2 pulse: **r2-analog** [**dtmf** | **r2-compelled** [**ani**] | **r2-non-compelled** [**ani**] | **r2-semi-compelled** [**ani**]] or **r2-digital** [**dtmf** | **r2-compelled** [**ani**] | **r2-non-compelled** [**ani**] | **r2-semi-compelled** [**ani**]] or **r2-pulse** [**dtmf** | **r2-compelled** [**ani**] | **r2-non-compelled** [**ani**] | **r2-semi-compelled** [**ani**]]	Configures R2 channel-associated signaling on the E1 controller. For a complete description of the available R2 options, see the **ds0-group (controller e1)** command reference page.
Step 3	`router(config-controller)# cas-custom channel`	Enters cas-custom mode. In this mode, you can localize E1 R2 signaling parameters, such as specific R2 country settings for Hong Kong. For the customization to take effect, the *channel* number used in the **cas-custom** command must match the *channel* number specified by the **ds0-group** command.

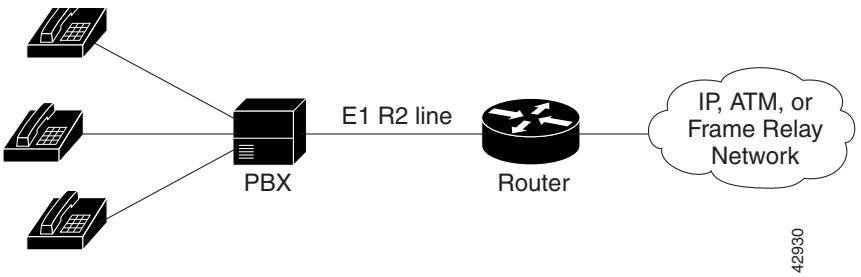
	Command	Purpose
Step 4	`router(config-ctrl-cas)# country` *name* `use-defaults`	Specifies the local country, region, or corporation specification to use with R2 signaling. Replaces the *name* variable with one of the supported country names. Cisco strongly recommends that you include the **use-defaults** option, which engages the default settings for a specific country. The default setting for all countries is ITU. See the **cas-custom** command reference page for the list of supported countries, regions, and corporation specifications.
Step 5	• `router(config-ctrl-cas)# ani-digits` • `router(config-ctrl-cas)# answer-signal` • `router(config-ctrl-cas)# caller-digits` • `router(config-ctrl-cas)# category` • `router(config-ctrl-cas)# default` • `router(config-ctrl-cas)# dnis-digits` • `router(config-ctrl-cas)# invert-abcd` • `router(config-ctrl-cas)# ka` • `router(config-ctrl-cas)# kd` • `router(config-ctrl-cas)# metering` • `router(config-ctrl-cas)# nc-congestion` • `router(config-ctrl-cas)# unused-abcd` • `router(config-ctrl-cas)# request-category`	(Optional) Further customizes the R2 signaling parameters. Some switch types require you to fine tune your R2 settings. Do not tamper with these commands unless you fully understand your switch's requirements. For nearly all network scenarios, the **country** *name* **use-defaults** command fully configures your country's local settings. You should not need to perform Step 5. See the **cas-custom** command reference page for more information about each signaling command.

For another E1 R2 configuration example, see the section "Configuration Example" on page 7.

Sample Network Topology for E1 R2

Figure 1 shows a sample network topology for using E1 R2 signaling with a Cisco 2600, 3600, or 7200 series router. All the controllers on the router are configured with R2 digital signaling. Additionally, localized R2 country settings are enabled on the router. For a sample configuration, see the "Configuration Example" section on page 7.

Figure 1 E1 R2 Connections for the Cisco 2600/3600/7200 Series Routers



Verifying E1 R2 Signaling

To verify the E1 R2 signaling configuration, enter the **show controller e1** command to view the status for all controllers, or enter the **show controller e1** *slot/port* command 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 that no alarms (line 6 in the following example) or errors (lines 9, 10, and 11 in the following example) have been reported.

```
Router# show controller E1 1/0

E1 1/0 is up.
  Applique type is Channelized E1
  Cablelength is short 133
  Description: E1 WIC card Alpha
  No alarms detected.
  Framing is CRC4, Line Code is HDB3, Clock Source is Line Primary.
  Data in current interval (1 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
```

Troubleshooting Tips

If the connection does not come up, check 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 the following:

- Mismatched line codes (HDB3 versus AMI)
- Receive level
- Frame slips due to poor clocking plan

Configuration Example

The following example configures R2 signaling and customizes R2 parameters on controller E1 2/0 of a Cisco 2600 or 3600 series router with a digital T1/E1 packet voice trunk network module. In most cases, the same R2 signaling type is configured on each E1 controller.

Step 1 Enter global configuration mode using the **configure terminal** command:

```
3600# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
```

Step 2 Specify the E1 controller that you want to configure with R2 signaling using the **controller e1** *number* global configuration command. A controller informs the access server how to distribute or provision individual timeslots for a connected channelized E1 line. You must configure one E1 controller for each E1 line.

```
3600(config)# controller e1 2/0
```

Step 3 Configure channel associated signaling with the **ds0-group** *channel* **timeslots** *range* **type** *signal* command. The signaling type forwarded by the connecting telco switch must match the signaling configured on the Cisco 2600 or 3600 series router. The Cisco IOS configuration options are **r2-analog**, **r2-digital**, or **r2-pulse**.

```
3600(config-controller)# ds0-group 1 timeslots 1-31 type ?
  r2-analog            R2 ITU Q411
  r2-digital           R2 ITU Q421
  r2-pulse             R2 ITU Supplement 7
```

The following example specifies R2 ITU Q421 digital line signaling (**r2-digital**). This example also specifies R2 compelled register signalling and provisions the ANI ADDR option.

```
3600(config-controller)# ds0-group 1 timeslots 1-31 type r2-digital r2-compelled ani
3600(config-controller)#
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 1 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 2 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 3 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 4 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 5 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 6 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 7 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 8 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 9 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 10 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 11 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 12 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 13 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 14 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 15 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 17 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 18 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 19 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 20 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 21 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 22 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 23 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 24 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 25 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 26 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 27 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 28 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 29 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 30 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 31 is up
```

Note For a description of the supported R2 signaling options, see the **ds0-group (controller e1)** command reference page. The actual R2 channel-associated signaling is configured on the sixteenth time slot, which is the reason why the time slot does not come up in the sample output.

Step 4 Customize some of the E1 R2 signaling parameters with the **cas-custom** *channel* controller configuration command. This example specifies the default R2 settings for Argentina. See the **cas-custom** command reference page for a detailed description of these options.

```
3600(config-controller)# cas-custom 1
3600(config-ctrl-cas)# ?
CAS custom commands:
  ani-digits        Expected number of ANI digits
  answer-signal     Answer signal to be used
  caller-digits     Digits to be collected before requesting CallerID
  category          Category signal
  country           Country Name
  default           Set a command to its defaults
  dnis-digits       Expected number of DNIS digits
  exit              Exit from cas custom mode
  invert-abcd       invert the ABCD bits before tx and after rx
  ka                KA Signal
  kd                KD Signal
  metering          R2 network is sending metering signal
  nc-congestion     Non Compelled Congestion signal
  no                Negate a command or set its defaults
  request-category  DNIS digits to be collected before requesting category
  unused-abcd       Unused ABCD bit values

3600(config-ctrl-cas)# country ?
  argentina             Argentina
  australia             Australia
  brazil                Brazil
  china                 China
  columbia              Columbia
  .
  .
  .
3600(config-ctrl-cas)# country argentina ?
  use-defaults   Use Country defaults
  <cr>

3600(config-ctrl-cas)# country argentina use-defaults
```

Note Cisco highly recommends that you specify your country's default settings. To display a list of supported countries, issue the **country** command. The default setting for all countries is ITU.

Command Reference

This section documents new and modified commands. All other commands used with this feature are documented in the Cisco IOS Release 12.1 command references.

- **cas-custom**
- **ds0-group (controller e1)**

cas-custom

To customize E1 R2 signaling parameters for a particular E1 channel group on a channelized E1 line, use the **cas-custom** controller configuration command. Use the **no** form of this command to disable the signaling customization.

cas-custom *channel*
no cas-custom *channel*

Syntax Description

channel	Specifies a single channel group number, which can be from 0 through 30. This channel group number must match the channel number specified in the **ds0-group** command.

Defaults

No customized signaling parameters are set. If you do not specify a country name using the **country** *name* command, which is described in the Cisco IOS *Dial Services Command Reference*, ITU is the selected default signal.

Command Modes

Controller configuration

Command History

Release	Modification
11.2 P	The command was introduced on the Cisco AS5200 and AS5300 access servers.
12.1(2)XH	The command was modified for the digital T1/E1 packet voice trunk network module on Cisco 2600 and 3600 series routers

Usage Guidelines

The customization parameters set by the **cas-custom** *channel* command are applied to the same channel group number used in the **cas-group** *channel* **timeslots** *range* **type** *signal* command. These channel group numbers must match. Otherwise, the customized features specified by the **cas-custom** command will not be applied to the **cas-group** command's configuration. The signaling customization will not take effect. See Example 1.

However, you will not need to configure or set more than one channel group number per E1 line in most cases. Though rarely used, it is possible to split a single E1 (time slots 1 through 31) into two groups (for example, time slots 1 through 15 on group 1 and time slots 17 through 31 in group 2).

Cisco strongly recommends that you use the **use-defaults** option when specifying a particular country type. See the **country** *name* command in the Cisco IOS *Dial Services Command Reference*. This additional keyword ensures that all the local country settings are correctly enabled. For example, issue the **country greece use-defaults** command. If the **use-defaults** option is not specified, generic ITU will be the default setting for all countries. See Example 2.

You can configure the system to deviate from a country's default settings as defined by Cisco. To do this, choose from the following list of commands described in the Cisco IOS *Dial Services Command Reference*: **ani-digits min** *number* **max** *number*, **answer-signal** {**group-a** | **group-b**} *number*, **caller-digits** *number*, **category** *number*, **dnis-digits min** *number* **max** *number*, **invert-abcd**, **ka** *number*, kd *number*, **metering**, **nc-congestion**, and **unused-abcd** *value*. To return a country back to its country specific default settings, issue the **country** *name* **use-defaults** command. To return a country back to the ITU standard, issue the **default country** *name* **use-defaults** command. See Example 3 and Example 4.

The cas-custom mode has many associated commands that are used to customize R2 signaling settings. Some switches require you to fine-tune your R2 settings. Do not tamper with these commands unless you understand exactly how your router will be effected. See the Cisco IOS *Dial Services Command Reference* for supported **cas-custom** commands.

Example 1

The following example displays the available signaling parameters after you enter cas-custom mode. Notice that the same channel group 1 is specified in the **cas-group** command and the **cas-custom** command.

```
router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z
router(config)# controller e1 1/0
router(config-controller) cas-group 1 timeslots 1-31 type r2-digital r2-compelled
router(config-controller) cas-custom 1
router(config-ctrl-cas)# ?
CAS custom commands:
  ani-digits        Expected number of ANI digits
  answer-signal     Answer signal to be used
  caller-digits     Digits to be collected before requesting CallerID
  category          Category signal
  country           Country Name
  default           Set a command to its defaults
  dnis-digits       Expected number of DNIS digits
  exit              Exit from cas custom mode
  invert-abcd       invert the ABCD bits before tx and after rx
  ka                KA Signal
  kd                KD Signal
  metering          R2 network is sending metering signal
  nc-congestion     Non Compelled Congestion signal
  no                Negate a command or set its defaults
  request-category  DNIS digits to be collected before requesting category
  unused-abcd       Unused ABCD bit values
```

Example 2

You can localize your R2 configuration for a specific country. Don't forget to include the **use-defaults** option as described in the Cisco IOS *Dial Services Command Reference*. For example, use the **country argentina use-defaults** command for a R2 scenario in Argentina.

```
router(config-ctrl-cas)# country ?
  argentina             Argentina
  australia             Australia
  brazil                Brazil
  china                 China
  columbia              Columbia
  costarica             Costa Rica
  easteurope            East Europe
  ecuador-itu           Ecuador ITU
  ecuador-lme           Ecuador LME
  greece                Greece
  guatemala             Guatemala
  hongkong-china        Hong Kong (China variant)
  indonesia             Indonesia
  israel                Israel
  itu                   ITU
  korea                 Korea
  malaysia              Malaysia
  newzealand            New Zealand
  paraguay              Paraguay
  peru                  Peru
  philippines           Philippines
  saudiarabia           Saudi Arabia
  singapore             Singapore
  southafrica-panaftel  South Africa Panaftel
  telmex                Telmex
  telnor                Telnor
  thailand              Thailand
  uruguay               Uruguay
  venezuela             Venezuela
  vietnam               Vietnam

router(config-ctrl-cas)# country argentina ?
  use-defaults   Use Country defaults
  <cr>

router(config-ctrl-cas)# country argentina use-defaults
```

Example 3

The following example customizes the signaling for channel group 1. The configuration collects three digits before it requests ANI information for analog calls received on a Cisco 2600 or 3600 series router in Argentina.

```
router(config-controller)# cas-custom 1
router(config-ctrl-cas)# country argentina use-defaults
router(config-ctrl-cas)# caller-digits 3
router(config-controller)# ^z
router(config)#
```

Example 4

Because cas-custom mode gives you the flexibility to customize R2 parameters, the margin for user error increases. Therefore, the Cisco IOS software enables you to return a country to its default R2 settings using the **use-defaults** option. The following example begins by bringing up Argentina's default settings, changing a few customization parameters, then returning the Argentina R2 setting back to its original state.

```
router(config-ctrl-cas)# country argentina use-defaults
router(config-ctrl-cas)# caller-digits 3
router(config-ctrl-cas)# unused-abcd 1
router(config-ctrl-cas)# metering
router(config-ctrl-cas)# country argentina use-defaults
```

Related Commands

ds0-group (controller E1)

ds0-group (controller e1)

To define E1 channels for compressed voice calls and the channel-associated signaling (CAS) method by which the router connects to the PBX or PSTN, enter the **ds0-group** controller configuration command. The **no** form of the command removes the group and signaling setting.

ds0-group *channel* **timeslots** *range* **type** *signal*
no ds0-group *channel* **timeslots** *range* **type** *signal*

Syntax Description

channel — Specifies a single channel group number. Replace the *channel* variable with a number from 0 through 30.

timeslots *range* — Specifies a time-slot range, which can be from 1 through 31. You can specify a time-slot range (for example, 1-31), individual timeslots separated by commas (for example 1, 3, 5), or a combination of the two (for example 1-14, 15, 17-31). The sixteenth time slot is reserved for out-of-band signaling.

type *signal* — Specifies the type of channel associated signaling. Configure the signal type that your central office uses. Replace the *signal* variable with one of the following signal types:

- **r2-analog** [**r2-compelled** [**ani**] | **r2-non-compelled** [**ani**] | **r2-semi-compelled** [**ani**]]
- **r2-digital** [**r2-compelled** [**ani**] | **r2-non-compelled** [**ani**] | **r2-semi-compelled** [**ani**]]
- **r2-pulse** [**r2-compelled** [**ani**] | **r2-non-compelled** [**ani**] | **r2-semi-compelled** [**ani**]]

The following descriptions are provided for the previous three R2 syntax bullets:

r2-analog—Specifies R2 ITU Q411 analog line signaling, which reflects the on/off switching of a tone in frequency-division multiplexing circuits (before TDM circuits were created). The tone is used for line signaling.

r2-digital—Specifies R2 ITU Q421 digital line signaling, which is the most common signaling configuration. The A and B bits are used for line signaling.

r2-pulse—Specifies R2 ITU supplement 7 pulse line signaling, which is a transmitted pulse that indicates a change in the line state.

r2-compelled [**ani**]—Specifies R2 compelled register signaling. You can also specify provisioning the ANI addr option.

r2-non-compelled [**ani**]—Specifies R2 noncompelled register signaling.

r2-semi-compelled [**ani**]—Specifies R2 semicompelled register signaling.

Defaults

No channel-associated signaling is configured on the controller. All R2 signaling types have DNIS turned on by default.

Command Modes

Controller configuration

Command History

Release	Modification
11.3 MA	The command was introduced as the **voice-group** command for the Cisco MC3810 multiservice access concentrator.
12.0(5)XK and 12.0(7)T	The command was introduced for the Cisco 2600 and 3600 series router with a different name and some keyword modifications.
12.1(2)XH	The command was modified for E1 R2 signaling.

Usage Guidelines

Use this command to configure support for incoming and outgoing call signals (such as on-hook and off-hook) on each E1 controller.

If you specify the time-slot range 1-31, the system software automatically uses the sixteenth time slot to transmit the channel-associated signaling.

The signaling you configure on the access server must match the signaling used by the central office. For example if the central office switch is forwarding R2 analog signaling to a Cisco 2600 or 3600 series router, then the router's E1 controller must also be configured for R2 analog signaling (**r2-analog**).

All R2 signaling options have DNIS support turned on by default. If you enable the **ani** option, the collection of DNIS information is still performed. Specifying the **ani** option does not disable DNIS. DNIS is the number being called. ANI is the caller's number. For example, if you are configuring router A to call router B, then the DNIS number is router B, the ANI number is router A. ANI is very similar to Caller ID.

To customize the R2 signaling parameters, refer to the **cas-custom** controller configuration command. When you enable the **ds0-group** command, the **cas-custom** command is automatically set up to be polled for configuration information. However, unless you enable or turn on specific features with the **ds0-custom** command, the cas-custom feature has an empty set of signaling parameters.

DNIS is automatically collected for modem pools and R2 tone signaling. You do not need to specify the collection of DNIS information with the **ds0-group** command. However, if you are using non-R2 tone signaling, the system must be manually configured to collect DNIS information. For non-R2 CAS signaling, DNIS collection is done only for E&M-fgb.

Examples

In most cases, you will configure the same channel-associated signaling on each E1 controller. The following examples configure signaling and customized parameters on controller E1 2 using the **ds0-group** and **cas-custom** controller configuration commands.

The actual channel-associated signaling is configured on the sixteenth time slot, which is the reason why this time slot does not come up in the following output.

```
router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
router(config)# controller e1 2
router(config-controller)# ds0-group 1 timeslots 1-31 type r2-digital r2-compelled ani
router(config-controller)#
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 1 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 2 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 3 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 4 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 5 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 6 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 7 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 8 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 9 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 10 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 11 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 12 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 13 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 14 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 15 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 17 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 18 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 19 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 20 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 21 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 22 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 23 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 24 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 25 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 26 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 27 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 28 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 29 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 30 is up
%DSX0-5-RBSLINEUP: RBS of controller 0 timeslot 31 is up
```

The following example shows all the supported E1 signaling types on a Cisco 2600 or 3600 series router.

```
router(config-controller)# ds0-group 1 timeslots 1-31 type ?
  e&m-fgb              E & M Type II FGB
  e&m-fgd              E & M Type II FGD
  e&m-immediate-start  E & M Immediate Start
  fxs-ground-start     FXS Ground Start
  fxs-loop-start       FXS Loop Start
  p7                   P7 Switch
  r2-analog            R2 ITU Q411
  r2-digital           R2 ITU Q421
  r2-pulse             R2 ITU Supplement 7
  sas-ground-start     SAS Ground Start
  sas-loop-start       SAS Loop Start

router(config-controller)# cas-group 1 timeslots 1-31 type r2-analog ?
  r2-compelled       R2 Compelled Register Signalling
  r2-non-compelled   R2 Non Compelled Register Signalling
  r2-semi-compelled  R2 Semi Compelled Register Signalling
  <cr>
```

R2 signaling parameters can be customized with the **cas-custom** controller configuration command:

```
router(config-controller)# cas-custom 1
router(config-ctrl-cas)# ?
CAS custom commands:
  caller-digits  Digits to be collected before requesting CallerID
  category       Category signal
  country        Country Name
  default        Set a command to its defaults
  exit           Exit from cas custom mode
  invert-abcd    invert the ABCD bits before tx and after rx
  metering       R2 network is sending metering signal
  nc-congestion  Non Compelled Congestion signal
  no             Negate a command or set its defaults
```

Debug Commands

This section illustrates some of the EXEC mode debug commands that are useful when analyzing and troubleshooting your system. Note that important information appears in bold, and bold text preceded by the "<<" characters explains the process.

The **debug vpm all** command displays information that allows you to troubleshoot E1 signaling:

```
cisco-router# debug vpm all
Apr 19 19:18:54 PDT: htsp_process_event: [1/0/16, 1.4 , 34]
em_onhook_offhookem_offhookem_onhookhtsp_setup_ind  << port goes offhook
Apr 19 19:18:54 PDT: htsp_process_event: [1/0/16, 1.5 , 8]
Apr 19 19:19:01 PDT: htsp_process_event: [1/0/16, 1.5 , 10] htsp_alert_notify
Apr 19 19:19:01 PDT: htsp_process_event: [1/0/16, 1.5 , 11]
Apr 19 19:19:02 PDT: htsp_process_event: [1/0/16, 1.5 , 11]
Apr 19 19:19:15 PDT: htsp_process_event: [1/0/16, 1.5 , 22]
em_offhook_onhookem_stop_timers em_onhook            << port goes onhook
Apr 19 19:19:15 PDT: htsp_process_event: [1/0/16, 1.4 , 7] em_onhook_releaseem_onhook
```

The **debug vtsp all** command displays information that allows you to troubleshoot digits received and sent on a call:

```
cisco-router# debug vtsp all
Apr 19 19:21:55 PDT: dsp_cp_tone_on: [1/0:1 (9502)] packet_len=30 channel_id=1
packet_id=72 tone_id=3 n_freq=2 freq_of_first=350 freq_of_second=440 amp_of_first=4000
amp_of_second=4000 direction=1 on_time_first=65535 off_time_first=0 on_time_second=65535
off_time_second=0  << providing dialtone

Apr 19 19:21:59 PDT: vtsp_process_dsp_message: MSG_TX_DTMF_DIGIT_BEGIN:
digit=2,rtp_timestamp=0xF2D37240
act_report_digit_begin
Apr 19 19:22:00 PDT: vtsp_process_dsp_message: MSG_TX_DTMF_DIGIT_OFF: digit=2,
duration=102act_report_digit_end
Apr 19 19:22:00 PDT: dsp_cp_tone_off: [1/0:1 (9502)] packet_len=8 channel_id=1
packet_id=71
Apr 19 19:22:00 PDT: vtsp_timer: 34838705
Apr 19 19:22:00 PDT: vtsp_process_dsp_message: MSG_TX_DTMF_DIGIT_BEGIN:
digit=3,rtp_timestamp=0xF2D37240
act_report_digit_begin
Apr 19 19:22:00 PDT: vtsp_process_dsp_message: MSG_TX_DTMF_DIGIT_OFF: digit=3,
duration=92act_report_digit_end
Apr 19 19:22:00 PDT: dsp_cp_tone_off: [1/0:1 (9502)] packet_len=8 channel_id=1
packet_id=71
Apr 19 19:22:00 PDT: vtsp_timer: 34838724
Apr 19 19:22:00 PDT: vtsp_process_dsp_message: MSG_TX_DTMF_DIGIT_BEGIN:
digit=1,rtp_timestamp=0xF2D37240 act_report_digit_begin
Apr 19 19:22:00 PDT: vtsp_process_dsp_message: MSG_TX_DTMF_DIGIT_OFF: digit=1,
duration=92act_report_digit_end
Apr 19 19:22:00 PDT: dsp_cp_tone_off: [1/0:1 (9502)] packet_len=8 channel_id=1
packet_id=71
Apr 19 19:22:00 PDT: vtsp_timer: 34838744
Apr 19 19:22:00 PDT: vtsp_process_dsp_message: MSG_TX_DTMF_DIGIT_BEGIN:
digit=9,rtp_timestamp=0xF2D37240
act_report_digit_begin
Apr 19 19:22:00 PDT: vtsp_process_dsp_message: MSG_TX_DTMF_DIGIT_OFF: digit=9,
duration=102act_report_digit_end
Apr 19 19:22:00 PDT: dsp_cp_tone_off: [1/0:1 (9502)] packet_len=8 channel_id=1
packet_id=71
Apr 19 19:22:00 PDT: vtsp_timer: 34838768
Apr 19 19:22:00 PDT: vtsp_process_dsp_message: MSG_TX_DTMF_DIGIT_BEGIN:
digit=8,rtp_timestamp=0xF2D37218
act_report_digit_begin
Apr 19 19:22:00 PDT: vtsp_process_dsp_message: MSG_TX_DTMF_DIGIT_OFF: digit=8,
duration=107act_report_digit_end

*** The Caller dialed the digits 23198 ***
```

The **debug voip ccapi inout** EXEC command traces the execution path through the call control API, which serves as the interface between the call-session application and the underlying network-specific software.

During the capabilities exchange shown in the command output, both sides agree on what compression to use, and the **debug voip ccapi inout** output helps you determine what each side is negotiating.

You can use the output from this command to understand how calls are being handled by the router. This command shows how a call flows through the system. By using this debug level, you can see the call setup and teardown operations performed on both the telephony and network call legs:

```
cisco-router# debug voip ccapi inout
 Apr 19 19:23:11 PDT: sess_appl: ev(19=CC_EV_CALL_SETUP_IND), cid(9504), disp(0)  << a
new call is originating
Apr 19 19:23:11 PDT: ccCallSetContext (callID=0x2520, context=0x61C0806C)
Apr 19 19:23:11 PDT: ccCallSetupAck (callID=0x2520)
Apr 19 19:23:11 PDT: ccGenerateTone (callID=0x2520 tone=8)  << dialtone
Apr 19 19:23:18 PDT: cc_api_call_digit_begin (vdbPtr=0x61A1B1B4, callID=0x2520, digit=2,
flags=0x1, timestamp=0xCE2796D1, expiration=0x0)  << digit 2 received
Apr 19 19:23:18 PDT: sess_appl: ev(10=CC_EV_CALL_DIGIT_BEGIN), cid(9504), disp(0)
Apr 19 19:23:18 PDT: ssa: cid(9504)st(0)oldst(0)cfid(-1)csize(0)in(1)fDest(0)
Apr 19 19:23:18 PDT: ssaIgnore cid(9504), st(0),oldst(0), ev(10)
Apr 19 19:23:18 PDT: cc_api_call_digit (vdbPtr=0x61A1B1B4, callID=0x2520, digit=2,
duration=102)
Apr 19 19:23:18 PDT: sess_appl: ev(9=CC_EV_CALL_DIGIT), cid(9504), disp(0)
Apr 19 19:23:18 PDT: ssa: cid(9504)st(0)oldst(0)cfid(-1)csize(0)in(1)fDest(0)
Apr 19 19:23:18 PDT: cc_api_call_digit_begin (vdbPtr=0x61A1B1B4, callID=0x2520, digit=3,
flags=0x1, timestamp=0xCE2796D1, expiration=0x0)
Apr 19 19:23:18 PDT: sess_appl: ev(10=CC_EV_CALL_DIGIT_BEGIN), cid(9504), disp(0)
Apr 19 19:23:18 PDT: ssa: cid(9504)st(0)oldst(0)cfid(-1)csize(0)in(1)fDest(0)
Apr 19 19:23:18 PDT: ssaIgnore cid(9504), st(0),oldst(0), ev(10)
Apr 19 19:23:18 PDT: cc_api_call_digit (vdbPtr=0x61A1B1B4, callID=0x2520, digit=3,
duration=102)  << digit 3 received
Apr 19 19:23:18 PDT: sess_appl: ev(9=CC_EV_CALL_DIGIT), cid(9504), disp(0)
Apr 19 19:23:18 PDT: ssa: cid(9504)st(0)oldst(0)cfid(-1)csize(0)in(1)fDest(0)
Apr 19 19:23:18 PDT: cc_api_call_digit_begin (vdbPtr=0x61A1B1B4, callID=0x2520, digit=1,
flags=0x1, timestamp=0xCE2796D1, expiration=0x0)
Apr 19 19:23:18 PDT: sess_appl: ev(10=CC_EV_CALL_DIGIT_BEGIN), cid(9504), disp(0)
Apr 19 19:23:18 PDT: ssa: cid(9504)st(0)oldst(0)cfid(-1)csize(0)in(1)fDest(0)
Apr 19 19:23:18 PDT: ssaIgnore cid(9504), st(0),oldst(0), ev(10)
Apr 19 19:23:18 PDT: cc_api_call_digit (vdbPtr=0x61A1B1B4, callID=0x2520, digit=1,
duration=92)    << digit 1 received
Apr 19 19:23:18 PDT: sess_appl: ev(9=CC_EV_CALL_DIGIT), cid(9504), disp(0)
Apr 19 19:23:18 PDT: ssa: cid(9504)st(0)oldst(0)cfid(-1)csize(0)in(1)fDest(0)
Apr 19 19:23:18 PDT: cc_api_call_digit_begin (vdbPtr=0x61A1B1B4, callID=0x2520, digit=9,
flags=0x1, timestamp=0xCE2796B9, expiration=0x0)
Apr 19 19:23:18 PDT: sess_appl: ev(10=CC_EV_CALL_DIGIT_BEGIN), cid(9504), disp(0)
Apr 19 19:23:18 PDT: ssa: cid(9504)st(0)oldst(0)cfid(-1)csize(0)in(1)fDest(0)
Apr 19 19:23:18 PDT: ssaIgnore cid(9504), st(0),oldst(0), ev(10)
Apr 19 19:23:18 PDT: cc_api_call_digit (vdbPtr=0x61A1B1B4, callID=0x2520, digit=9,
duration=105)    << digit 9 received
Apr 19 19:23:18 PDT: sess_appl: ev(9=CC_EV_CALL_DIGIT), cid(9504), disp(0)
Apr 19 19:23:18 PDT: ssa: cid(9504)st(0)oldst(0)cfid(-1)csize(0)in(1)fDest(0)
Apr 19 19:23:18 PDT: cc_api_call_digit_begin (vdbPtr=0x61A1B1B4, callID=0x2520, digit=8,
flags=0x1, timestamp=0xCE279691, expiration=0x0)
Apr 19 19:23:18 PDT: sess_appl: ev(10=CC_EV_CALL_DIGIT_BEGIN), cid(9504), disp(0)
Apr 19 19:23:18 PDT: ssa: cid(9504)st(0)oldst(0)cfid(-1)csize(0)in(1)fDest(0)
Apr 19 19:23:18 PDT: ssaIgnore cid(9504), st(0),oldst(0), ev(10)
Apr 19 19:23:18 PDT: cc_api_call_digit (vdbPtr=0x61A1B1B4, callID=0x2520, digit=8,
duration=100)    << digit 8 received
Apr 19 19:23:18 PDT: sess_appl: ev(9=CC_EV_CALL_DIGIT), cid(9504), disp(0)
Apr 19 19:23:18 PDT: ssa: cid(9504)st(0)oldst(0)cfid(-1)csize(0)in(1)fDest(0)
Apr 19 19:23:18 PDT: ssaSetupPeer cid(9504) peer list:  tag(20000)
Apr 19 19:23:18 PDT: ssaSetupPeer cid(9504), destPat(23198), matched(1), prefix(),
peer(61C04464)   << matched dial-peer 20000 voip

Apr 19 19:23:18 PDT: peer_tag=20000    << matched dial-peer voip 20000
Apr 19 19:23:18 PDT: ccIFCallSetupRequest: (vdbPtr=0x61A25524, dest=, callParams      <<
voip call setup
={called=23198, calling=+9.......T, fdest=0, voice_peer_tag=20000}, mode=0x0)
Apr 19 19:23:18 PDT: ccCallSetContext (callID=0x2521, context=0x61C12E18)
```

```
Apr 19 19:23:18 PDT: ccCallProceeding (callID=0x2520, prog_ind=0x0)
Apr 19 19:23:19 PDT: cc_api_call_alert(vdbPtr=0x61A25524, callID=0x2521, prog_ind=0x88,
sig_ind=0x1)
Apr 19 19:23:19 PDT: sess_appl: ev(7=CC_EV_CALL_ALERT), cid(9505), disp(0)
Apr 19 19:23:19 PDT: ssa:
cid(9505)st(1)oldst(0)cfid(-1)csize(0)in(0)fDest(0)-cid2(9504)st2(1)oldst2(0)
Apr 19 19:23:19 PDT: ccCallAlert (callID=0x2520, prog_ind=0x88, sig_ind=0x1)
Apr 19 19:23:19 PDT: ccConferenceCreate (confID=0x61A21670, callID1=0x2520,
callID2=0x2521, tag=0x0)
Apr 19 19:23:19 PDT: cc_api_bridge_done (confID=0x33, srcIF=0x61A25524, srcCallID=0x2521,
dstCallID=0x2520, disposition=0, tag=0x0)
Apr 19 19:23:19 PDT: cc_api_bridge_done (confID=0x33, srcIF=0x61A1B1B4, srcCallID=0x2520,
dstCallID=0x2521, disposition=0, tag=0x0)
Apr 19 19:23:19 PDT: cc_api_caps_ind (dstVdbPtr=0x61A25524, dstCallId=0x2521, sr
<< negotiating capabilities with the remote VoIP gateway

Apr 19 19:23:36 PDT: sess_appl: ev(8=CC_EV_CALL_CONNECTED), cid(9505), disp(0)
Apr 19 19:23:36 PDT: ssa:
cid(9505)st(4)oldst(1)cfid(51)csize(0)in(0)fDest(0)-cid2(9504)st2(4)oldst2(4)
<< the VoIP call is connected

 Apr 19 19:23:54 PDT: sess_appl: ev(12=CC_EV_CALL_DISCONNECTED), cid(9505),disp(0)
<< the VoIP call is disconnected
 Apr 19 19:23:54 PDT: ccCallDisconnect (callID=0x2520, cause=0x10 tag=0x0)
<< the VoIP call is disconnected by cause_code 0x10
```

Debug Reference Information

The information in this section helps you interpret the output from **debug** and **show** commands.

Table 1 shows R2 call disconnection causes. In the examples that follow, the disconnects are caused by normal call clearing.

Table 1 Q.931 Call Disconnection Causes

Call Disconnection Cause Value	Meaning and Number
CC_CAUSE_UANUM = 0x1	/* unassigned number. (1) */
CC_CAUSE_NO_ROUTE = 0x3	/* no route to destination. (3) */
CC_CAUSE_NORM = 0x10	/* normal call clearing. (16) */
CC_CAUSE_BUSY = 0x11	/* user busy. (17) */
CC_CAUSE_NORS = 0x12	/* no user response. (18) */
CC_CAUSE_NOAN = 0x13	/* no user answer. (19) */
CC_CAUSE_REJECT = 0x15	/* call rejected. (21) */
CC_CAUSE_INVALID_NUMBER = 0x1C	/* invalid number. (28) */
CC_CAUSE_UNSP = 0x1F	/* normal, unspecified. (31) */
CC_CAUSE_NO_CIRCUIT = 0x22	/* no circuit. (34) */
CC_CAUSE_NO_REQ_CIRCUIT = 0x2C	/* no requested circuit. (44) */
CC_CAUSE_NO_RESOURCE = 0x2F	/* no resource. (47) */
CC_CAUSE_NOSV = 0x3F	/* service or option not available,
	Unspecified. (63) */

Table 2 Tone Types and Their Meanings

Tone Type	Meaning
CC_TONE_RINGBACK	0x1 - Ring Tone
CC_TONE_FAX	0x2 - Fax Tone
CC_TONE_BUSY	0x4 - Busy Tone
CC_TONE_DIALTONE	0x8 - Dial Tone
CC_TONE_OOS	0x10 - Out of Service Tone
CC_TONE_ADDR_ACK	0x20 - Address Acknowledgement Tone
CC_TONE_DISCONNECT	0x40 - Disconnect Tone
CC_TONE_OFF_HOOK_NOTICE	0x80 - Tone indicating the phone was left off hook
CC_TONE_OFF_HOOK_ALERT	0x100 /* A more urgent version of CC_TONE_OFF_HOOK_NOTICE*/
CC_TONE_CUSTOM	0x200 - Custom Tone - used when specifying a custom tone
CC_TONE_NULL	0x0 - Null Tone

These are codec capabilities bits that can appear in command output:

- CC_CAP_CODEC_G711U 0x1
- CC_CAP_CODEC_G711A 0x2
- CC_CAP_CODEC_G723ar63 0x2000
- CC_CAP_CODEC_G723ar53 0x4000
- CC_CAP_CODEC_G723r63 0x100
- CC_CAP_CODEC_G723r53 0x200
- CC_CAP_CODEC_G726r16 0x10
- CC_CAP_CODEC_G729 0x4
- CC_CAP_CODEC_G729 0x8000
- CC_CAP_CODEC_G729a 0x8
- CC_CAP_CODEC_G729b 0x800
- CC_CAP_CODEC_G729ab 0x1000

These are fax capabilities bits that can appear in command output. The numbers following “FAX_” refer to the fax speed (for example, “144” means 14,400 bps):

- CC_CAP_FAX_NONE 0x1
- CC_CAP_FAX_VOICE 0x2
- CC_CAP_FAX_144 0x4
- CC_CAP_FAX_96 0x8
- CC_CAP_FAX_72 0x10
- CC_CAP_FAX_48 0x20
- CC_CAP_FAX_24 0x40
- CC_CAP_FAX_120 0x80

These are the VAD on and off capability bits:

- CC_CAP_VAD_OFF 0x1
- CC_CAP_VAD_ON 0x2