IP Communications Voice/Fax Network Module

The IP Communications Voice/Fax Network Module feature provides the ability to directly connect the PSTN and legacy telephony equipment to Cisco 2600XM series, Cisco 2691, Cisco 3600 series, and Cisco 3700 series multiservice routers, enabling applications such as IP telephony, toll bypass, and full gateway integration. The voice WAN interface cards (VWICs) supported by the new network modules include 2- and 4-port FXS; 2- and 4-port FXO; 2-port DID, E&M, and BRI (S/T); and 1- and 2-port T1/E1.

Feature History for the IP Communications Voice/Fax Network Module

Release	Modification
12.2(15)ZJ	This feature was introduced.
12.3(4)T	This feature was integrated into Cisco IOS Release 12.3(4)T.
12.3(11)T2	The **groundstart auto-tip** command was added to the command-line interface and the feature was integrated into Cisco IOS Release 12.3(11)T2. This new command is not supported on the Cisco 1700 series platform.

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.

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Prerequisites for the IP Communications Voice/Fax Network Module

The recommended minimum Cisco IOS Release for this feature is Release 12.3(7)T. For optimum results, use Cisco IOS Release 12.3(11)T2.

This feature requires 32 MB of Flash memory, 1.1 MB of I/O memory, and 96 MB of RAM (128 MB of RAM is required for the Cisco 2600XM series and the Cisco 3700 series).

Restrictions for the IP Communications Voice/Fax Network Module

The IP Communications Voice/Fax Network Module feature does not currently offer echo cancellation on the VWICs configured as T1 interfaces, which may result in a degradation of service in some instances.

Information About the IP Communications Voice/Fax Network Module

This section provides information about the following:

IP Communications Voice/Fax Network Module Software Modules

The IP Communications Voice/Fax Network Module feature is composed of software modules that offer the following features on voice network modules:

- Channel group support for up to 32 channels
- Flex option for configuring codec complexity—This new option allows the digital signal processor (DSP) to process up to 16 channels. In addition to continuing support for configuring a fixed number of channels per DSP, the flex option enables the DSP to handle a flexible number of channels. The total number of supported channels varies from 6 to 16, depending on which codec is used for a call. Therefore, the channel density varies from 6 per DSP (high-complexity codec) to 16 per DSP (g.711 codec).
  - Oversubscription—In flex mode, you can connect (or configure in the case of DS0 groups and PRI groups) more voice channels to the module than the DSPs can accommodate. If all voice channels should go active simultaneously, the DSPs will be oversubscribed and calls that are unable to allocate a DSP resource will fail to connect.

- Software-based echo cancellation up to 32-millisecond conversion
- Digital: BRI, PRI, and CAS
- Analog: FXS, FXO, E&M, and DID
- Signaling channel allocation
- Voice channel allocation
- Voice port independent channel allocation
- Hairpinning:
  - Digital to digital (same card)
  - Analog to digital (same card)
- Channel bank support—Analog voice ports are internally connected to a DS0 time slot on a digital T1/E1 interface. All the signaling is transparently sent between the analog voice port and DS0 time slot, and will not be seen by the higher layer voice software.
- DSP crash recovery
- FXO and FXS Caller ID Type 1 and Type 2
- Trunk alarm handling

IP Communications Voice/Fax Network Module Capabilities

Table 1 provides information about the three network modules that support this feature.

Table 1 IP Communications Voice/Fax Network Module Capabilities

Module	DSPs	Number of Channels			T1/E1 Ports	Voice Interface Cards (VICs)
		Medium Complexity	High Complexity	Flex		
NM-HD-1V[1]	1	4	4	4	0	One 2- to 4-port VIC
NM-HD-2V	1	8	6	6 to 8	0	Two 2- to 4-port VICs
NM-HD-2VE	3	24	18	18 to 48	4	Two 2- to 4-port VICs or one VIC and one T1/E1 interface VIC or two T1/E1 interface VICs

1. Number of channels depends on the VIC module installed in the router, not the number of DSPs.

Channel Availability for DSPs Based on Codecs

Table 2 lists the number of channels available on each DSP for the codecs supported by the IP Communications Voice/Fax Network Module feature.

Table 2 Channels on DSP for Codecs Supported by the IP Communications Voice/Fax Network Module

	Channels per DSP		
Codec	**High-Complexity**	**Medium Complexity**	**Flex Complexity**
G.711 (u-law, a-law)	6	8	16[1]
Fax/modem pass-through	6	8	16
Clear-channel codec	6	8	16
G.726 (32K, 24K, 16K)	6	8	8
GSMFR	6	8	8
Fax relay	6	8	8
G.729, G.729B, G.729A, G.729AB	6	8	8
G.728	6	Not supported	6
G.723.1 (5.3K, 6.3K)	6	Not supported	6
G.723.1A (5.3K, 6.3K)	6	Not supported	6
GSMEFR	6	Not supported	6

1. Applicable to the NM-HD-2VE only. The limitation on the number of calls is based on the network module, not the DSP (that is, even though one DSP supports 16 channels, the NM-HD-2V supports only 8 G.711 calls due to the number of analog ports).

How to Configure the IP Communications Voice/Fax Network Module

This section contains the following procedures:

- Configuring the Voice Card for the Flex Option on the IP Communications Voice/Fax Network Module, page 4
- Configuring Digital Interfaces for the IP Communications Voice/Fax Network Module, page 7
- Configuring Channel Bank Support for the IP Communications Voice/Fax Network Module, page 12

Configuring the Voice Card for the Flex Option on the IP Communications Voice/Fax Network Module

To enable the IP Communications Voice/Fax Network Module feature, perform this task to configure the voice card for the flex option in codec complexity.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **voice-card** *slot*
4. **codec complexity** {**flex** | **high** | **medium**}
5. **voice local-bypass**
6. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**voice-card** *slot* **Example:** `Router(config)# voice-card 1`	Enters voice-card configuration mode and specifies the slot location. • For the *slot* argument, specify a value from 0 to 5, depending on your router.

	Command or Action	Purpose
Step 4	**codec complexity** {**flex** | **high** | **medium**} **Example:** `Router(config-voicecard)# codec complexity flex`	Specifies the codec complexity based on the codec standard you are using. • **flex**— Up to 16 calls can be completed per DSP. The number of supported calls varies from 6 to 16, depending on the codec used for a call. • **high**—Up to six voice or fax calls can be completed per DSP, using the following codecs: G.711, G.726, G.729, G.723.1, G.723.1 Annex A, G.728, and GSMEFR. **Note** High-complexity codecs support lower call density than medium-complexity codecs. • **medium**—Up to eight voice or fax calls can be completed per DSP, using the following codecs: G.711, G.726, G.729 Annex A, G.729 Annex B, G.729 Annex B with Annex A, GSMFR, and fax relay. • The keyword that you specify for the **codec complexity** command affects the choice of codecs available using the **codec** dial-peer voice configuration command. **Note** You cannot change codec complexity while DS0 groups are defined. If they are already set up, perform the following steps: 1. Shut down the voice port associated with the controller. 2. Remove the DS0 group or PRI group under the T1 or E1 controller. 3. Enter the **voice-card** *slot* command, and then change the codec complexity. **Note** This procedure applies only to T1 and E1 controllers; it is not valid for analog voice ports.
Step 5	**voice local-bypass** **Example:** `Router(config-voicecard)# voice local-bypass`	Configures local calls to bypass the DSP. • Using this command disables hairpinning.
Step 6	**exit** **Example:** `Router(config-voicecard)# exit`	Exits voice-card configuration mode and returns the router to global configuration mode.

Configuring Digital Interfaces for the IP Communications Voice/Fax Network Module

Perform this task to configure the digital interfaces.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **controller** {**t1** | **e1**} *slot*/*port*
4. **clock source** {**line** [**primary**] | **internal**}
5. **framing** {**sf** | **esf**}
   or
   framing {**crc4** | **no-crc4**}
6. **linecode** {**b8zs** | **ami}**
   or
   linecode {**ami** | **hdb3}**
7. **cablelength long** {**gain26** | **gain36**} {**-15db** | **-22.5db** | **-7.5db** | **0db**}
   or
   cablelength short {**133** | **266** | **399** | **533** | **655**}
8. **ds0-group** *ds0-group-number* **timeslots** *timeslot-list* **type** {**e&m-delay-dial** | **e&m-fgd** | **e&m-immediate-start** | **e&m-wink-start** | **ext-sig** | **fgd-eana** | **fgd-os** | **fxo-ground-start** | **fxo-loop-start** | **fxs-ground-start** | **fxs-loop-start** | **none**}
   or
   pri-group [**timeslots** *range*]
   or
   channel-group *channel-group-number* **timeslots** *range* [**speed** *kbps*]
   or
   tdm-group *tdm-group-number* **timeslots** *timeslot-list* **type** {**e&m** | **fxs** [**loop-start** | **ground-start**] | **fxo** [**loop-start** | **ground-start**]}
9. **exit**
10. **connect** *connection-id* {**t1** | **e1**} *slot*/*port1 tdm-group1* {**t1** | **e1**} *slot*/*port2 tdm-group2*
11. **end**
12. **no shutdown**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**controller** {**t1** | **e1**} *slot*/*port* **Example:** `Router(config)# controller t1 1/1`	Enters controller configuration mode and identifies the controller type (T1 or E1) and a slot and port for configuration commands that specifically apply to the T1 or E1 interface. • Valid values for the *slot* and *port* arguments are 0 and 1.
Step 4	**clock source** {**line** [**primary**] | **internal**} **Example:** `Router(config-controller)# clock source line`	Specifies the clock source. • **line**—Specifies that the clock source is derived from the active line. This is the default. – When both ports are set to line clocking with no primary specification, port 0 is the default primary clock source and port 1 is the default secondary clock source. – When both ports are set to line and one port is set as the primary clock source, the other port is by default the backup or secondary source and is loop-timed. – If one port is set to **clock source line** or **clock source line primary** and the other is set to **clock source internal**, the internal port recovers clock from the clock source line port if the clock source line port is up. If it is down, then the internal port generates its own clock. • If both ports are set to **clock source internal**, there is only one clock source—internal.

Step 5	**framing** {**sf** | **esf**}
	or
	framing {**crc4** | **no-crc4**}
	
	Example:
	`Router(config-controller)# framing esf`
	or
	`Router(config-controller)# framing crc4`
		Sets the framing according to your service provider's instructions.
		• For T1 controllers, select either **sf** or **esf**.
		• For E1 controllers, select either **crc4** or **no-crc4**.

	Command or Action	Purpose

Step 6	**linecode** {**b8zs** | **ami**}
	or
	linecode {**ami** | **hdb3**}
	
	Example:
	`Router(config-controller)# linecode b8zs`
	or
	`Router(config-controller)# linecode hdb3`
		Sets the line encoding according to your service provider's instructions.
		• **b8zs**—Encodes a sequence of eight zeros in a unique binary sequence to detect line-coding violations. Valid for T1 only.
		• **ami**—Represents zeros using a 01 during each bit cell, and represents ones by 11 or 00, alternately, during each bit cell.
		• **hdb3**—Specifies high density binary3 (hdb3) as the line-code type. Valid for the E1 controller only; the default for E1 lines.

Step 7	**cablelength long** {**gain26** | **gain36**} {**-15db** | **-22.5db** | **-7.5db** | **0db**}
	or
	cablelength short {**133** | **266** | **399** | **533** | **655**}
	
	Example:
	`Router(config-controller)# cablelength long gain36 -15db`
	or
	`Router(config-controller)# cablelength short 266`
		Sets a cable length longer than 655 feet for a T1 link.
		• **gain26**—Specifies the decibel pulse gain at 26. This is the default for pulse gain.
		• **gain36**—Specifies the decibel pulse gain at 36.
		• **-15db**—Specifies the decibel pulse rate at –15.
		• **-22.5db**—Specifies the decibel pulse rate at –22.5.
		• **-7.5db**—Specifies the decibel pulse rate at –7.5.
		• **0db**—Specifies the decibel pulse rate at 0 decibels. This is the default for pulse rate.
		or
		Sets a cable length of 655 feet or less for a T1 link.
		• There is no default for **cablelength short**.
		– **133**—Specifies a cable length from 0 to 133 feet.
		– **266**—Specifies a cable length from 134 to 266 feet.
		– **399**—Specifies a cable length from 267 to 399 feet.
		– **533**—Specifies a cable length from 400 to 533 feet.
		– **655**—Specifies a cable length from 534 to 655 feet.
		
		Note If you do not set the cable length, the system defaults to **cablelength long gain26 0db**.

Command or Action	Purpose

Step 8 **ds0-group** *ds0-group-number* **timeslots** *timeslot-list* **type** {**e&m-delay-dial** | **e&m-fgd** | **e&m-immediate-start** | **e&m-wink-start** | **fxo-ground-start** | **fxo-loop-start** | **fxs-ground-start** | **fxs-loop-start**}
or
pri-group [**timeslots** *range*]
or
channel-group *channel-group-number* **timeslots** *range* [**speed** *kbps*]
or
tdm-group *tdm-group-number* **timeslots** *timeslot-list* **type** {**e&m** | **fxs** [**loop-start** | **ground-start**] | **fxo** [**loop-start** | **ground-start**]}
 	
Example:
`Router(config-controller)# ds0-group 10 timeslots 1,2, 7-9 type fxs-loop-start`
or
`Router(config-controller)# pri-group timeslots 1-5`
or
`Router(config-controller)# channel-group 0 timeslots 1-12`
or
`Router(config-controller)# tdm-group 12 timeslots 1, 5-7, 23 type fxo loop-start`
	Defines the T1 or E1 channels for use by compressed voice calls and the signaling method the router uses to connect to the PBX or central office (CO).
	
	Note If you modify the **codec complexity** command parameters, you must first remove any existing DS0 groups, then reinstate them after the change to the codec complexity.
	
	• The **ds0-group** command automatically creates a logical voice port.
	• *ds0-group-number*—Value from 0 to 23 that identifies the DS0 group.
	• *timeslot-list*—Single number, numbers separated by commas, or a pair of numbers separated by a hyphen to indicate a range of time slots. For T1, allowable values are from 1 to 24; for E1, allowable values are from 1 to 31.
	• The signaling method selection for **type** depends on the connection that you are making:
	– E&M connects PBX trunk lines (tie lines) and telephone equipment. The wink and delay settings both specify confirming signals between the sending and receiving ends, or the immediate setting stipulates no special offhook or onhook signal.
	– FXO connects a CO to a standard PBX interface where permitted by local regulations.
	– FXS connects basic telephone equipment and PBXs.
	
	Note Operator ringback is not supported.
	
	or
	
	Specifies that the controller should be set up as a PRI interface.
	• For T1, the last defined channel is the D channel.
	• If a controller is configured as PRI, individual channel groups cannot be configured on that controller.
	• The **controller** command must be entered before this command can be used.

Command or Action	Purpose
	or Specifies a channel group number. • For T1 lines, channel-group numbers can be from 0 to 23. • For E1 lines, channel-group numbers can be from 0 to 30. • **timeslots** *range*—Specifies one or more time slots separated by commas, or ranges of time slots belonging to the channel group separated by a dash. The first time slot is numbered 1. For a T1 controller, the time slots range from 1 to 24. For an E1 controller, the time slots range from 1 to 31. • **speed** *kbps*—(Optional) Specifies the speed of the underlying DS0s in kilobits per second. Valid values are 56 and 64. – The default line speed when configuring a T1 controller is 56 kbps. – The default line speed when configuring an E1 controller is 64 kbps. or (Optional) Specifies TDM channel groups for the drop-and-insert (also called TDM cross-connect) function with a two-port T1 multiflex trunk interface card. • *tdm-group-number*—Value from 0 to 23 that identifies the channel group. • *timeslot-list*—Values are from 1 to 24. • **type**—Depends on the connection. The **fxs** and **fxo** keywords allow you to specify a ground-start or loop-start line. **Note** The group numbers for controller groups must be unique. For example, a TDM group must not have the same ID number as a DS0 group.
Step 9 `exit` **Example:** `Router(config-controller)# exit`	Exits controller configuration mode and returns to global configuration mode.

	Command or Action	Purpose
Step 10	**connect** *connection-id* {**t1** | **e1**} *slot*/*port1* *tdm-group1* {**t1** | **e1**} *slot*/*port2* *tdm-group2* **Example:** `Router(config)# connect connection1 t1 0/0 1 t1 0/1 2`	Defines connections among T1 or E1 controller ports for drop-and-insert (also called TDM cross-connect). • *connection-id*—A name for this connection. • **t1**—Specifies a T1 port. • **e1**—Specifies an E1 port. • *slot*/*port1*—The location of the first T1 or E1 controller to be connected. Valid values for *slot* and *port* are 0 and 1. • *tdm-group1*—The number identifier of the TDM group associated with the first T1 or E1 controller port and created by using the **tdm-group** command. Valid values are from 0 to 23 for T1 and from 0 to 30 for E1. • *slot*/*port2*—The location of the second T1 or E1 controller port to be connected. – Valid values for *slot* are from 0 to 5, depending on the platform. – Valid values for *port* are 0 to 3, depending on the platform and the presence of a network module. • *tdm-group2*—The number identifier of the TDM group associated with the second T1 or E1 controller and created by using the **tdm-group** command. Valid values are from 0 to 23 for T1 and from 0 to 30 for E1.
Step 11	**end** **Example:** `Router(config)# end`	Ends the current configuration session and returns to privileged EXEC mode.
Step 12	**no shutdown** **Example:** `Router(config)# no shutdown`	Activates the controller.

Configuring Channel Bank Support for the IP Communications Voice/Fax Network Module

The channel bank feature provides support for the TDM cross-connect functionality between analog voice ports and digital DS0s on the same NM-HD-2VE using CAS signaling.

To establish a channel bank connection between an analog voice port and a T1 DS0, configure the **connect** (voice-port) command in global configuration mode. To verify the channel bank connection, use the **show connection all** command.

Restrictions

The configuration for cross-connect must be on the same network module.

A maximum of four FXS or FXO ports can be cross-connected to a T1 interface.

A BRI-to-PRI cross-connect cannot be configured.

Analog-to-BRI/PRI cross-connect cannot be configured; the only connection for analog is analog-to-T1/E1 CAS (ds0-group).

The **local-bypass** command has no effect when cross-connect is configured. It is applicable only to calls that are hairpinned via POTS-to-POTS dial peers.

The DS0 group must contain only one time slot. The signaling type of the DS0 group must match that of the analog voice port.

If the channel bank feature is used for the T1 controller, the rest of the unused DS0 group cannot be used for fractional PRI signaling.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **controller** {**t1** | **e1**} *slot*/*port*
4. **ds0-group** *ds0-group-number* **timeslots** *timeslot-list* **type** {**e&m-delay-dial** | **e&m-fgd** | **e&m-immediate-start** | **e&m-wink-start** | **fxo-ground-start** | **fxo-loop-start** | **fxs-ground-start** | **fxs-loop-start**}
5. **exit**
6. **voice-port** *slot*/*port*
7. **shutdown**
8. **operation** {**2-wire** | **4-wire**}
9. **type** {**1** | **2** | **3** | **5**}
10. **signal** {**loop-start** | **ground-start**}
    or
    signal {**wink-start** | **immediate** | **delay-dial**}
11. **no shutdown**
12. **exit**
13. **connect** *connection-name* **voice-port** *voice-port-number* {**t1** | **e1**} *controller-number ds0-group-number*
14. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**controller** {**t1** | **e1**} *slot*/*port* **Example:** `Router(config)# controller t1 1/0`	Enters controller configuration mode and identifies the controller type (T1 or E1) and a slot and port for configuration commands that specifically apply to the T1 or E1 interface. • Valid values for the *slot* and *port* arguments are 0 and 1.
Step 4	**ds0-group** *ds0-group-number* **timeslots** *timeslot-list* **type** {**e&m-delay-dial** | **e&m-fgd** | **e&m-immediate-start** | **e&m-wink-start** | **fxs-ground-start** | **fxs-loop-start** | **fxo-ground-start** | **fxo-loop-start**} **Example:** `Router(config-controller)# ds0-group 1 timeslots 1 type e&m-wink-start`	Defines the T1 or E1 channels for use by compressed voice calls and the signaling method the router uses to connect to the PBX or CO. **Note** If you modify the **codec complexity** command parameters, you must first remove any existing DS0 groups, then reinstate them after the change to the codec complexity. • The **ds0-group** command automatically creates a logical voice port. • *ds0-group-number* Value from 0 to 23 that identifies the DS0 group. • *timeslot-list* Single number, numbers separated by commas, or a pair of numbers separated by a hyphen to indicate a range of timeslots. For T1, allowable values are 1 to 24; For E1, allowable values are 1 to 31. The signaling method selection for **type** depends on the connection that you are making: • E&M connects PBX trunk lines (tie lines) and telephone equipment. The wink and delay settings both specify confirming signals between the sending and receiving ends, or the immediate setting stipulates no special offhook/onhook signal. • FXO connects a CO to a standard PBX interface where permitted by local regulations. • FXS connects basic telephone equipment and PBXs.
Step 5	**exit** **Example:** `Router(config-controller)# exit`	Exits controller configuration mode and returns to global configuration mode.

	Command or Action	Purpose
Step 6	**voice-port** *slot*/*port* **Example:** `Router(config)# voice-port 2/1`	Enters voice-port configuration mode and identifies a slot and port for configuration parameters.
Step 7	**shutdown** **Example:** `Router(config-voiceport)# shutdown`	Administratively shuts down the voice port.
Step 8	**operation** {**2-wire** | **4-wire**} **Example:** `Router(config-voiceport)# operation 4-wire`	Selects a specific cabling scheme for E&M ports: • This command is not applicable to FXS or FXO interfaces because they are, by definition, 2-wire interfaces. • Using this command on a voice port changes the operation of both voice ports on a VPM card. The voice port must be shut down and then opened again for the new value to take effect.
Step 9	**type** {**1** | **2** | **3** | **5**} **Example:** `Router(config-voiceport)# type 2`	Specifies the E&M interface type. • **1**—Specifies: – E—Output, relay to ground – M—Input, referenced to ground • **2**—Specifies: – E—Output, relay to SG – M—Input, referenced to ground – SB—Feed for M, connected to –48V – SG—Return for E, galvanically isolated from ground • **3**—Specifies: – E—Output, relay to ground – M—Input, referenced to ground – SB—Connected to –48V – SG—Connected to ground • **5**—Specifies: – E—Output, relay to ground – M—Input, referenced to –48V

	Command or Action	Purpose

Step 10	**signal** {**loop-start** | **ground-start**}
	or
	signal {**wink-start** | **immediate** | **delay-dial**}
	
	Example:
	`Router(config-voiceport)# signal loop-start`
	or
	`Router(config-voiceport)# signal wink-start`
		Defines the signal type to be used:
		• FXO and FXS voice ports:
		– **loop-start** Only one side of a connection can hang up. This is the default setting for FXO and FXS voice ports.
		– **ground-start** Allows both sides of a connection to place a call and to hang up.
		or
		• E&M voice ports:
		– **wink-start**—Indicates that the calling side seizes the line by going off-hook on its E-lead then waits for a short off-hook "wink" indication on its M-lead from the called side before sending address information as dual tone multifrequency (DTMF) digits. This is the default setting for E&M voice ports.
		– **immediate**—Indicates that the calling side seizes the line by going off-hook on its E-lead and sends address information as DTMF digits.
		– **delay-dial**—Indicates that the calling side seizes the line by going off-hook on its E-lead. After a timing interval, the calling side looks at the supervision from the called side. If the supervision is on-hook, the calling side starts sending information as DTMF digits; otherwise, the calling side waits until the called side goes on-hook and then starts sending address information.

Step 11	**no shutdown** **Example:** `Router(config-voiceport)# no shutdown`	Brings the voice port back to an up state adminstratively.
Step 12	**exit** **Example:** `Router(config-voiceport)# exit`	Exits voice-port configuration mode and returns to global configuration mode.
Step 13	**connect** *connection-name* **voice-port** *voice-port-number* {**t1** | **e1**} *controller-number ds0-group-number* **Example:** `Router(config)# connect connect1 voice-port 1/1/0 t1 1/0 0`	Creates a named connection between two voice ports associated with T1 or E1 interfaces where you have already defined the groups by using the **ds0-group** command.
Step 14	**end** **Example:** `Router(config)# end`	Ends the current configuration session and returns to privileged EXEC mode.

Troubleshooting Tips

In some rare instances, if you have installed the VIC2-2FXO or the VIC2-4FXO and configured the voice port for groundstart signaling, you may have difficulty connecting some outgoing calls. The problem relates to the FXO groundstart voice port failing to detect a tip-ground acknowledgment, resulting in an unsuccessful call setup.

If you encounter this problem, upgrade your Cisco IOS software image to the latest version (for example, if you have Release 12.3(11)T installed, upgrade to Release 12.3(11)T2). This should fix the problem.

If this problem still occurs, you must enable the **groundstart auto-tip** command in the configuration of the FXO voice port. When you are placing outgoing calls, this ensures that the circuit detects a tip-ground acknowledgment from the far end and completes the connection within the time-out parameter. For information about the **groundstart auto-tip** command, refer to the "groundstart auto-tip" section on page 34.

For more information about this problem and more comprehensive troubleshooting steps, use the reference provided in the "Technical Assistance" section on page 19. You can search the website using keywords **groundstart**, **analog**, and **fxo** to obtain information on the topic described here.

Configuration Example for IP Communications Voice/Fax Network Module

This section provides a configuration example for the following:

- Channel Bank Support: Example

Channel Bank Support: Example

This section provides an example of partial output from the **show** command after channel bank support has been configured:

```
Router# show startup-config

!
voice-card 1
!
voice-card 2
!
voice-card 4
!
!
controller T1 1/0
framing esf
linecode b8zs
ds0-group 1 timeslots 1 type e&m-wink-start
!
controller T1 2/0
framing esf
linecode b8zs
ds0-group 1 timeslots 1 type fxs-loop-start
!
controller T1 4/0
framing esf
linecode b8zs
ds0-group 1 timeslots 1 type fxo-loop-start
```

```
connect cbfxs voice-port 4/0/0 T1 4/0 1
!
!
connect cbem voice-port 1/0/0 T1 1/0 1
!
!
connect cbfxo voice-port 2/0/0 T1 2/0 1
!
!
!
voice-port 1/0/0
description E&M port
operation 4-wire
type 2
!
!
voice-port 2/0/0
description FXO port
!
voice-port 4/0/0
description FXS port
!
```

The following is an example of output from the **show connection all** command to list active connections:

```
Router# show connection all

ID  Name Segment 1 Segment 2 State
=============================================================================
1   cbfxs voice-port 4/0/0 T1 4/0 01 UP
2   cbem voice-port 1/0/0 T1 1/0 01 UP
3   cbfxo voice-port 2/0/0 T1 2/0 01 UP
```

Additional References

The following sections provide references related to the IP Communications Voice/Fax Network Module feature.

Related Documents

Related Topic	Document Title
Hardware installation instructions for network modules	*Cisco Network Modules Hardware Installation Guide*
General information about voice configuration and commands	*Cisco IOS Voice Command Reference,* Release 12.3T
Update to information about voice configuration cards	*Voice Network Module and Voice Interface Card Configuration Note*

Standards

Standards	Title
ITU-T for Q.931	*ITU-T, Series Q Recommendations, Q.931 (3/93) - Digital Subscriber Signalling System No 1 (DSS1) - ISDN user - network data link layer 3 - specification for basic call control .*

RFCs

RFCs	Title
No new or modified RFCs are supported by this feature.	—

MIBs

MIBs	MIBs Link
• RFC 1406 MIB • T1 CSU MIB Support • Port Module MIB • T1/E1 Line Status Reporting	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
Technical Assistance Center (TAC) home page, containing 30,000 pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/public/support/tac/home.shtml

Command Reference

This section documents modified commands and commands commonly used with this feature. Due to the complexity of some of these commands, they may be presented here in abbreviated form. The complete platform and syntax information for these commands and all other commands used with this feature are documented in the Cisco IOS Release 12.3 *Voice Configuration Library.*

- **channel-group**
- **codec complexity**
- **connect**
- **connect (drop-and-insert)**
- **ds0-group**
- **groundstart auto-tip**
- **pri-group**
- **tdm-group**

channel-group

To configure serial WAN on a T1 or E1 interface, use the **channel-group** command in controller configuration mode. To clear a channel group, use the **no** form of this command.

Cisco 2600 Series

channel-group *channel-group-number* **timeslots** *range* [**speed** *kbps*] [**aim** *aim-slot-number*]

no channel-group *channel-group-number*

Cisco 2611 (Cisco Signaling Link Terminal [SLT])

channel-group *channel-number*

no channel-group *channel-number*

Cisco 2600XM Series, Cisco 2691, Cisco 3631, Cisco 3660, Cisco 3725, and Cisco 3745

channel-group *channel-group-number* {**timeslots** *range* [**speed** {**56** | **64**}] | **unframed**} [**aim** *aim-slot-number*]

no channel-group [*channel-group-number* **timeslots** *range*]

Cisco AS5350 and Cisco AS5400 Series

channel-group *channel-group-number*

no channel-group *channel-group-number*

Cisco MC3810

channel-group *channel-number* **timeslots** *range* [**speed** *kbps*}]

no channel-group [*channel-number* **timeslots** *range*]

Syntax Description

channel-group-number	Channel-group number on the Cisco 2600 series, Cisco 2600XM, Cisco 2691, Cisco 3631, Cisco 3660, Cisco 3725, and Cisco 3745 routers. When a T1 data line is configured, channel-group numbers can be values from 0 to 23. When an E1 data line is configured, channel-group numbers can be values from 0 to 30. Valid values can be 0 or 1 on the Cisco AS5350 and Cisco AS5400.
timeslots *range*	Specifies one or more time slots separated by commas, or ranges of time slots belonging to the channel group separated by a dash. The first time slot is numbered 1. For a T1 controller, the time slots range from 1 to 24. For an E1 controller, the time slots range from 1 to 31. You can specify a time slot range (for example, 1-29), individual time slots separated by commas (for example 1, 3, 5), or a combination of the two (for example 1-14, 15, 17-31). See the "Examples" section for samples of different timeslot ranges.

speed {**56** | **64**}	(Optional) Specifies the speed of the underlying DS0s in kilobits per second. Valid values are 56 and 64. The default line speed when configuring a T1 controller is 56 kbps on the Cisco 2600 series, Cisco 2600XM series, Cisco 2691, Cisco 3631, Cisco 3660, Cisco 3725, Cisco 3745, and the Cisco MC3810. The default line speed when configuring an E1 controller is 64 kbps on the Cisco 2600 series, Cisco 2600XM series, Cisco 2691, Cisco 3631, Cisco 3660, Cisco 3725, Cisco 3745, and the Cisco MC3810. The line speed controls real-time (VBR-RT) traffic shaping, and the maximum burst size (MBS) is 255 cells.
aim *aim-slot-number*	(Optional) Directs HDLC traffic from the T1/E1 interface to the AIM-ATM-VOICE-30 digital signaling processor (DSP) card on the Cisco 2600 series, Cisco 2600XM series, Cisco 2691, Cisco 3631, Cisco 3660, Cisco 3725, and Cisco 3745.
channel-number	Number of the channel. Valid values can be 0 or 1 on the Cisco SLT (Cisco 2611).
unframed	Specifies the use of all 32 time slots for data. None of the 32 time slots are used for framing signals on the Cisco 2600XM series, Cisco 2691, Cisco 3631, Cisco 3660, Cisco 3725, and Cisco 3745. This is applicable to E1 only.

Defaults

The T1/E1 line is connected to the Motorola MPC-860x processor serial communication controller (SCC) or network module with two voice or WAN interface card (VIC or WIC) slots and 0/1/2 FastEthernet ports DSCC4 by default on Cisco 2600 series, Cisco 2600XM, Cisco 2691, Cisco 3631, Cisco 3660, Cisco 3725, and Cisco 3745 routers.

There is no default behavior or values on the Cisco SLT (Cisco 2611).

The serial interface object encapsulation is set to HDLC on a network access server (NAS) (Cisco AS5350 and Cisco AS5400 series routers).

The default line speed is 56 kbps when a T1 controller is configured on the Cisco 2600 series, Cisco 2600XM series, Cisco 2691, Cisco 3631, Cisco 3660, Cisco 3725, Cisco 3745, and the Cisco MC3810.

The default line speed is 64 kbps when an E1 controller is configured on the Cisco 2600 series, Cisco 2600XM series, Cisco 2691, Cisco 3631, Cisco 3660, Cisco 3725, Cisco 3745, and the Cisco MC3810.

Command Modes

Controller configuration

Command History

Release	Modification
11.3 MA	This command was introduced on the Cisco MC3810.
12.0	This command was integrated into Cisco IOS Release 12.0 on the Cisco MC3810.
12.0(7)XE	This command was implemented on the Catalyst 6000 family switches.
12.1(1)E	This command was integrated into Cisco IOS Release 12.1(1)E.

Release	Modification
12.1(1)T	This command was modified to accommodate two channel groups on a port on 1- and 2-port T1/E1 Multiflex voice or WAN interface cards on the Cisco 2600 and Cisco 3600 series routers.
12.1(3a)E3	The number of valid values for *kbps* was changed on the Cisco MC3810; see the "Usage Guidelines" section for valid values.
12.2(11)T	This command was modified for use on the Cisco AS5350 and Cisco AS5400.
12.2(15)T	The **aim** keyword was added for use on the Cisco 2600 series (including the Cisco 2691), Cisco 2600XM, Cisco 3660, Cisco 3725, and Cisco 3745.
12.3(1)	The **unframed** keyword was added for use on the Cisco 2600XM series, Cisco 2691, Cisco 3631, Cisco 3660, Cisco 3725, and Cisco 3745.

Usage Guidelines

Use this command to direct High-Level Data Link Control (HDLC) traffic from the T1/E1 interface to the AIM-ATM-VOICE-30 DSP card. A channel group is created using Advanced Integration Module (AIM) HDLC resources when a **channel-group** command with the **aim** keyword is parsed during system initialization or when the command is entered during configuration. You must specify the **aim** keyword under a T1/E1 controller port to direct HDLC traffic from the T1/E1 interface to the AIM-ATM-VOICE-30 DSP card on the Cisco 2600 series, Cisco 2600XM series, Cisco 2691, Cisco 3631, Cisco 3660, Cisco 3725, and Cisco 3745.

Note Neither the Cisco AS5400 series NAS nor the Cisco MC3810 is supported with the integrated voice and data WAN on T1/E1 interfaces using the AIM-ATM-VOICE-30 module.

If previous **channel-group** commands are configured with the **aim** keyword, subsequent **channel-group** commands without the **aim** keyword are rejected. Similarly, if a regular **channel-group** command is followed by another **channel-group** command with the **aim** keyword implemented, the second command is rejected on the Cisco 2600 and Cisco 2600XM.

A channel group using AIM HDLC resources is deleted only when a **no channel-group** command is entered.

By default, the **channel-group** command on a NAS sets the serial interface object encapsulation to HDLC. You must override the default by entering the **encapsulation ss7** command for that serial interface object. Once you override the default, encapsulation cannot be changed again for that object. The SS7 encapsulation option is new to the **Integrated Signaling Link Terminal** feature and is available only for interface serial objects created by the **channel-group** command. The Integrated Signaling Link Terminal feature added SLT functionality on Cisco AS5350 and Cisco AS5400 platforms.

A digital SS7 link can be deleted by entering the **no channel-group** *channel-group-number* command on the associated T1/E1 controller. The link must first be stopped using the **no shutdown** command. It is not necessary to remove the channel ID association first.

Use the **channel-group** command in configurations where the router or access server must communicate with a T1 or E1 fractional data line. The channel group number may be arbitrarily assigned and must be unique for the controller. The time slot range must match the time slots assigned to the channel group. The service provider defines the time slots that comprise a channel group.

Note Channel groups, channel-associated signaling (CAS) voice groups, and time-division multiplexing (TDM) groups all use group numbers. All group numbers configured for channel groups, CAS voice groups, and TDM groups must be unique on the local Cisco MC3810 concentrator. For example, you cannot use the same group number for a channel group and for a TDM group. Furthermore, on the Cisco MC3810, only one channel group can be configured on a controller.

The channel group number can be 0 or 1 on the Cisco SLT (Cisco 2611).

The **channel-group** command also applies to Voice over Frame Relay, Voice over ATM, and Voice over HDLC on the Cisco MC3810.

Examples

The following example shows basic configuration directing HDLC traffic from the T1/E1 interface to the AIM-ATM-VOICE-30 DSP card, starting in global configuration mode:

```
Router(config)# controller e1 1/0
Router(config-controller)# clock source internal
Router(config-controller)# channel-group 0 timeslots 1-31 aim 0
```

The following example explicitly sets the encapsulation type to PPP to override the HDLC default:

```
Router# configure terminal
Router(config)# controller t1 6/0
Router(config-controller)# channel-group 2 timeslots 3 aim 0
Router(config-controller)# exit
Router(config)# interface serial 6/0:2
Router(config-if)# encapsulation ppp
Router(config-if)# ip address 12.0.0.1 255.0.0.0
Router(config-if)# no shutdown
Router(config-if)# end
```

The following example shows how to explicitly set the encapsulation type to SS7 to override the HDLC default using the **Integrated Signaling Link Terminal** feature. This example uses an 8PRI DFC card inserted into slot 7, and DS0-timeslot 3 on trunk 5 of that card is used as an SS7 link:

```
Router# configure terminal
Router(config)# controller t1 7/5
Router(config-controller)# channel-group 2 timeslots 3
Router(config-controller)# exit
Router(config)# interface serial 7/5:2
Router(config-if)# encapsulation ss7
Router(config-if)# channel-id 0
Router(config-if)# no shutdown
Router(config-if)# end
```

The following example defines three channel groups. Channel-group 0 consists of a single time slot, channel-group 8 consists of seven time slots and runs at a speed of 64 kbps per time slot, and channel-group 12 consists of two time slots.

```
Router(config-controller)# channel-group 0 timeslots 1
Router(config-controller)# channel-group 8 timeslots 5,7,12-15,20 speed 64
Router(config-controller)# channel-group 12 timeslots 2
```

The following example configures a channel group on controller T1 0 on a Cisco MC3810:

```
Router(config)# controller T1 0
Router(config-controller)# channel-group 10 timeslots 10 64
```

Note SS7 digital F-link support for the 8PRI line card requires use of a third onboard TDM stream to route trunk DS0 messages to the onboard Media Gateway Controllers (MGCs).

Related Commands

Command	Description
framing	Specifies the frame type for the T1 or E1 data line.
invert data	Enables channel inversion.
linecode	Specifies the line code type for the T1 or E1 line.
voice-card	Configures a card with voice processing resources and enters voice card configuration mode.

codec complexity

To specify call density and codec complexity based on the codec standard you are using, use the **codec complexity** command in voice-card configuration mode. To reset the voice card to the default, use the **no** form of this command.

codec complexity {**flex** | **high** | **medium**}

no codec complexity

Syntax Description

flex	Each DSP can support up to 16 voice channels, depending on voice traffic.
high	In high complexity, each DSP supports six voice channels encoded in any of the following formats: • g711alaw—G.711 a-law 64,000 bps. • g711ulaw—G.711 u-law 64,000 bps. • g723ar53—G.723.1 Annex A 5300 bps. • g723ar63—G.723.1 Annex A 6300 bps. • g723r53—G.723.1 5300 bps. • g723r63—G.723.1 6300 bps. • g723r16—G.726 16,000 bps. • g726r24—G726 24,000 bps. • g726r32—G.726 32,000 bps. • g728—G.728 16,000 bps. • g729r8—G.729 8000 bps (default). • g729br8—G.729 Annex B 8000 bps. • fax relay—2400 bps, 4800 bps, 7200 bps, 9600 bps, 12 kbps, and 14.4 kbps.
medium	In medium complexity, each DSP supports eight voice channels encoded in any of the following formats: • g711alaw—G.711 a-law 64,000 bps. • g711ulaw—G.711 u-law 64,000 bps. • g726r16—G.726 16,000 bps. • g726r24—G.726 24,000 bps. • g726r32—G.726 32,000 bps. • g729r8—G.729 Annex A 8000 bps. • G729br8—G.729 Annex B with Annex A 8000 bps. • fax relay—2400 bps, 4800 bps, 7200 bps, 9600 bps, 12 kbps, and 14.4 kbps

Defaults

Medium complexity

Command Modes

Voice-card configuration

Command History

Release	Modification
12.0(5)XK	This command was introduced for the Cisco 2600 and Cisco 3600 series routers.
12.0(7)T	This command was integrated into Cisco IOS Release 12.0(7)T.
12.0(7)XK	Support was added for the Cisco MC3810 multiservice concentrator series for use with the high-performance compression module (HCM).
12.1(2)T	This command was integrated into Cisco IOS Release 12.1(2)T.
12.2(15)ZJ	This command was integrated into Cisco IOS Release 12.2(15)ZJ and the **flex** keyword was added.
12.3(4)T	This command was integrated into Cisco IOS Release 12.3(4)T.

Usage Guidelines

Codec complexity refers to the amount of processing required to perform voice compression. Codec complexity affects the call density—the number of calls that can take place on the DSPs. With higher codec complexity, fewer calls can be handled. Select a higher codec complexity if that is required to support a particular codec or combination of codecs. Select a lower codec complexity to support the greatest number of voice channels, provided that the lower complexity is compatible with the particular codecs in use.

Before codec complexity can be changed, all the DSP voice channels must be in the idle state.

Examples

The following example sets the codec complexity to high on voice card 1 in a Cisco 2600 or Cisco 3600 series router:

```
voice-card 1
codec complexity high
```

Related Commands

Command	Description
ds0-group	Defines T1/E1 channels for compressed voice calls and the CAS method by which the router connects to the PBX or PSTN.
show voice dsp	Displays the current status of all DSP voice channels.

connect

To define connections between T1 or E1 controller ports for the channel bank feature, use the **connect** command in global configuration mode. To restore default values, use the **no** form of this command.

connect *connection-name* **voice-port** *voice-port-number* {**t1** | **e1**} *controller-number ds0-group-number*

no connect *connection-name* **voice-port** *voice-port-number* {**t1** | **e1**} *controller-number ds0-group-number*

Syntax Description

connection-name	A name for this connection.
voice-port	Specifies that a voice port will be used in the connection.
voice-port-number	The voice port slot number and port number.
t1	Specifies a T1 port.
e1	Specifies an E1 port.
controller-number	The location of the first T1 or E1 controller to be connected. Valid values for the slot and port are 0 and 1.
ds0-group-number	The number identifier of the DS0 group associated with the first T1 or E1 controller port. Created by using the **ds0-group** command. Valid values are from 0 to 23 for T1 and from 0 to 30 for E1.

Defaults

There is no drop-and-insert connection between the ports.

Command Modes

Global configuration

Command History

Release	Modification
12.0(5)XK	This command was introduced.
12.0(7)T	This command was integrated into Cisco IOS Release 12.0(7)T.
12.2(15)ZJ	The **voice-port** keyword was added.
12.3(4)T	This command was integrated into Cisco IOS Release 12.3(4)T.

Usage Guidelines

The **connect** command creates a named connect between two DS0 groups associated with voice ports on T1 or E1 interfaces where the groups have been defined by the **ds0-group** command.

Examples

The following example shows how to configure a channel bank connection for FXS loop-start signaling:

```
Router(config)# controller t1 1/0
Router(config-controller)# ds0-group 1 timeslot 0 type fxo-loop-start
Router(config-controller)# exit
Router(config)# voice-port 1/1/0
Router(config-voiceport)# signal-type fxs-loop-start
```

```
Router(config-voiceport)# exit

Router(config)# connect connection1 voice-port 1/1/0 t1 1/0 0
```

Related Commands

ds0-group	Specifies the DS0 time slots that make up a logical voice port on a T1 or E1 controller and the signaling type by which the router communicates with the PBX or PSTN.
show connect	Displays configuration information about drop-and-insert connections that have been configured on a router.

connect (drop-and-insert)

To define connections among T1 or E1 controller ports for drop-and-insert (also called TDM cross-connect), use the **connect** command in global configuration mode. To restore default values, use the **no** form of this command.

connect *id* {**t1** | **e1**} *slot/port1 tdm-group1* {**t1** | **e1**} *slot/port2 tdm-group2*

no connect *id* {**t1** | **e1**} *slot/port1 tdm-group1* {**t1** | **e1**} *slot/port2 tdm-group2*

Syntax Description

id	A name for this connection.
t1	Specifies a T1 port.
e1	Specifies an E1 port.
slot/port1	The location of the first T1 or E1 controller to be connected. Valid values for slot and port are 0 and 1.
tdm-group1	The number identifier of the TDM group associated with the first T1 or E1 controller port and created by using the **tdm-group** command. Valid values are from 0 to 23 for T1 and from 0 to 30 for E1.
slot/port2	The location of the second T1 or E1 controller port to be connected. Valid values for the *slot* argument are from 0 to 5, depending on the platform. Valid values for the *port* argument are 0 to 3, depending on the platform and the presence of a network module.
tdm-group2	The number identifier of the TDM group associated with the second T1 or E1 controller and created by using the **tdm-group** command. Valid values are from 0 to 23 for T1 and from 0 to 30 for E1.

Defaults

There is no drop-and-insert connection between the ports.

Command Modes

Global configuration

Command History

Release	Modification
12.0(5)XK	The command was introduced on the Cisco 2600 and 3600 series.
12.0(7)T	This command was integrated into Cisco IOS Release 12.0(7)T.
12.1(1)T	The command was modified to accommodate two channel groups on a port for 1- and 2-port T1/E1 multiflex voice WAN interface cards (VWICs) on the Cisco 3600 series routers.
12.3(4)T	This command was integrated into Cisco IOS Release 12.3(4)T.

Usage Guidelines

The **connect** command creates a named connect between two TDM groups associated with drop-and-insert ports on T1 or E1 interfaces where you have already defined the groups by using the **tdm-group** command.

Once TDM groups are created on two different physical ports, you can use the **connect** command to start the passage of data between the ports.

The VWIC can make a connection only if the number of time slots at the source and destination are the same. For the connection to be error-free, the two ports must be driven by the same clock source; otherwise, "slips" will occur.

Examples

The following example shows a fractional T1 terminated on port 0 using time slots 1 through 8; a fractional T1 is terminated on port 1 using time slots 2 through 12; and time slots 13 through 20 from port 0 are connected to time slots 14 through 21 on port 1 by using the **connect** command:

```
controller t1 0/0
channel-group 1 timeslots 1-8 tdm-group 1 timeslots 13-20
exit
controller t1 0/1
channel-group 1 timeslots 2-12 tdm-group 2 timeslot 14-21
exit
connect connection1 t1 0/0 1 t1 0/1 2
```

Related Commands

Command	Description
show connect	Displays configuration information about drop-and-insert connections that have been configured on a router.
tdm-group	Configures a list of time slots for creating clear channel groups (pass-through) for TDM cross-connect.

ds0-group

To specify the DS0 time slots that make up a logical voice port on a T1 or E1 controller and to specify the signaling type by which the router communicates with the PBX or public switched telephone network (PSTN), use the **ds0-group** command in controller configuration mode. To remove the group and signaling setting, use the **no** form of this command.

ds0-group *ds0-group-number* **timeslots** *timeslot-list* **type** {**e&m-delay-dial** | **e&m-fgd** | **e&m-immediate-start** | **e&m-wink-start** | **fxo-ground-start** | **fxo-loop-start** | **fxs-ground-start** | **fxs-loop-start**}

no ds0-group *ds0-group-number*

Syntax Description

ds0-group-number	A value from 0 to 23 that identifies the DS0 group.
timeslots *timeslot-list*	A single time-slot number, a single range of numbers, or multiple ranges of numbers separated by commas. For T1, allowable values are from 1 to 24. Examples are as follows: • 2 • 1-15,17-24 • 1-23 • 2,4,6-12
type	The signaling method selection for the type keyword depends on the connection that you are making. The FXS interface allows connection of basic telephone equipment and PBX. The FXO interface is for connecting the CO to a standard PBX interface where permitted by local regulations; it is often used for OPXs.
e&m-delay-dial	The originating endpoint sends an off-hook signal and then waits for an off-hook signal followed by an on-hook signal from the destination.
e&m-fgd	E&M Type II Feature Group D.
e&m-immediate-start	E&M immediate start.
e&m-wink-start	The originating endpoint sends an off-hook signal and waits for a wink start from the destination.
fxo-ground-start	Specifies FXO ground-start signaling.
fxo-loop-start	Specifies FXO loop-start signaling.
fxs-ground-start	FXS ground-start signaling.
fxs-loop-start	FXS loop-start signaling.
none	Null signaling for external call control.

Defaults

No DS0 group is defined.

Command Modes

Controller configuration

Command History

Release	Modification
11.2	This command was introduced for the Cisco AS5300 universal access server as the **cas-group** command.
11.3(1)MA	This command was introduced as the **voice-group** command for the Cisco MC3810 multiservice concentrator.
12.0(1)T	The **cas-group** command was introduced for the Cisco 3600 series routers.
12.0(5)T	The command was renamed **ds0-group** on the Cisco AS5300 and Cisco 2600 and 3600 series routers. Keyword modifications were added.
12.0(5)XE	This command was introduced for the Cisco 7200 series.
12.0(7)XK	Support for this command was extended to the Cisco MC3810 multiservice concentrator. When the **ds0-group** command became available on the Cisco MC3810 multiservice concentrator, the **voice-group** command was removed and no longer supported. The **ext-sig** keyword replaced the **ext-sig-master** and **ext-sig-slave** keywords that were available with the **voice-group** command.
12.0(7)XR	The **mgcp** service type was added.
12.1(1)T	The **ds0-group** command was implemented for the Cisco 7200 series.
12.1(2)XH	The **e&m-fgd** and **fgd-eana** keywords were added for Feature Group D signaling.
12.1(3)T	This command was modified for the Cisco 7500 series routers. The **fgd-os** signaling type and the **voice** service type were added.
12.2(15)ZJ	This command was integrated into Cisco IOS Release 12.2(15)ZJ.
12.3(4)T	This command was integrated into Cisco IOS Release 12.3(4)T.

Usage Guidelines

The **ds0-group** command automatically creates a logical voice port that is numbered as follows:

slot/port:ds0-group-number

Although only one voice port is created for each group, applicable calls are routed to any channel in the group.

Examples

The following example shows ranges of T1 controller time slots configured for FXS ground-start and FXO loop-start signaling on a Cisco 2600 or 3600 series router:

```
T1 1/0
framing esf
 linecode b8zs
 ds0-group 1 timeslots 1-10 type fxs-ground-start
 ds0-group 2 timeslots 11-24 type fxo-loop-start
```

Related Commands

Command	Description
codec	Specifies the voice coder rate of speech for a dial peer.
codec complexity	Specifies call density and codec complexity based on the codec standard you are using.

groundstart auto-tip

To configure a timing delay on an FXO groundstart voice port, use the **groundstart auto-tip** command in voice-port configuration mode. To disable the configured timeout, use the **no** form of this command.

groundstart auto-tip [**delay** *timer*]

no groundstart auto-tip [**delay** *timer*]

Syntax Description

delay	Indicates that a specific delay time will be configured.
timer	Specifies the wait time in milliseconds that the FXO groundstart voice port will wait for a tip ground acknowledgment.

Defaults

This command is disabled by default. If the command is used without the optional keyword, the default time of 200 ms is activated.

Command Modes

Voice-port configuration

Command History

Release	Modification
12.3(11)T2	This command was introduced into Cisco IOS Release 12.3(11)T2.

Usage Guidelines

This command should only be used after you encounter call setup problems involving FXO groundstart analog voice ports. If these problems occur, first load the latest image for your Cisco IOS Release (for example, if you are running Release 12.3(11)T, you should replace this image with Release 12.3(11)T2. Upgrading the software image should eliminate the problem. If not, then use this command as a troubleshooting measure—it should be enabled in a configuration only if you encounter problems in connecting outgoing calls. After the **groundstart auto-tip** command is configured, the problem should not occur again.

Use the **groundstart auto-tip** command only for voice ports configured for FXO groundstart signaling.

The following example sets the delay wait time for tip ground acknowledgment to 250 ms:

```
Router# configure terminal
Router(config)# voice-port 2/0/0
Router(config-voiceport)# shutdown
Router(config-voiceport)# groundstart auto-tip delay 250
Router(config-voiceport)# no shutdown
Router(config-voiceport)# exit
```

Related Commands

Command	Description
voice-port	Specifies that a voice port will be used in the connection.

pri-group

To specify ISDN PRI on a channelized T1 or E1 controller, use the **pri-group** command in controller configuration mode. To remove the ISDN PRI configuration, use the **no** form of this command.

pri-group [**timeslots** *range*]

no pri-group

Syntax Description

timeslots *range*	(Optional) Specifies a single range of values from 1 to 24 for T1. For E1, the allowable range is from 1 to 31. You can specify a time slot range (for example, 1-29), individual time slots separated by commas (for example 1, 3, 5), or a combination of the two (for example 1-14, 15, 17-31).

Defaults

No ISDN PRI group is configured.

Command Modes

Controller configuration

Command History

Release	Modification
11.0	This command was introduced.
12.2(15)ZJ	This command was integrated into Cisco IOS Release 12.2(15)ZJ.
12.3(4)T	This command was integrated into Cisco IOS Release 12.3(4)T.

Usage Guidelines

Before you enter the **pri-group** command, you must specify an ISDN switch type for PRI and a T1 controller.

Note Only one PRI group can be configured on a controller.

Examples

The following example specifies ISDN PRI on T1 slot 1, port 0:

```
isdn switch-type primary-4ess
controllers t1 1/0
framing esf
linecode b8zs
pri-group timeslots 2-6
```

Related Commands

Command	Description
controller	Configures a T1 or E1 controller and enters controller configuration mode.
framing	Specifies a frame type.
isdn switch-type	Specifies the central office switch type on the ISDN PRI interface.

Command	Description
linecode b8zs	Specifies line encoding for a controller.
interface serial	Specifies a serial interface created on a channelized E1 or channelized T1 controller (for ISDN PRI, CAS, or robbed-bit signaling).

tdm-group

To configure a list of time slots for creating clear channel groups (pass-through) for time-division multiplexing (TDM) cross-connect, use the **tdm-group** command in controller configuration mode. To delete a clear channel group, use the **no** form of this command.

tdm-group *tdm-group-number* **timeslot** *timeslot-list* [**type** {**fxs** [**loop-start** | **ground-start**] | **fxo** [**loop-start** | **ground-start**]}]

no tdm-group *tdm-group-number* **timeslot** *timeslot-list* [**type** {**fxs** [**loop-start** | **ground-start**] | **fxo** [**loop-start** | **ground-start**]}]

Syntax Description

tdm-group-number	TDM group number.
timeslot	Time-slot number.
timeslot-list	Time-slot list. The valid range is from 1 to 24 for T1, and from 1 to 15 and 17 to 31 for E1.
type	(Optional) (Valid only when the **mode cas** command is enabled.) Specifies the voice signaling type of the voice port. If configuring a TDM group for data traffic only, do not specify the **type** keyword.
e&m	Connects PBX trunk lines (tie lines) and telephone equipment. The wink and delay settings both specify confirming signals between the sending and receiving ends, or the immediate setting stipulates no special offhook or onhook signal.
fxs	Foreign Exchange Station signaling. Connects a central office (CO) to a standard PBX interface where permitted by local regulations. (Optionally, you can also specify loop-start or ground-start.)
fxo	Foreign Exchange Office signaling. Connects basic telephone equipment and PBXs. (Optionally, you can also specify loop-start or ground-start.)

Defaults

No TDM group is configured.

Command Modes

Controller configuration

Command History

Release	Modification
11.3(1)MA	This command was introduced on Cisco MC3810 multiservice concentrators.
12.1(1)T	This command was modified to include voice WAN interface cards (VWICs) for Cisco 2600 and Cisco 3600 series routers.
12.1(2)T	This command was modified for the OC-3/STM-1 ATM Circuit Emulation Service network module on the Cisco 2600 and 3600 series routers.
12.2(15)ZJ	This command was integrated into Cisco IOS Release 12.2(15)ZJ.
12.3(4)T	This command was integrated into Cisco IOS Release 12.3(4)T.

Usage Guidelines

The **tdm-group** command allows specific time slots to switch from port 0 to port 1 and vice versa. This command is similar to the **channel-group** command, but it does not create a serial interface to terminate the specified channels.

Note Channel groups, CAS voice groups, and TDM groups all use group numbers. All group numbers configured for channel groups, CAS voice groups, and TDM groups must be unique on the local router. For example, you cannot use the same group number for a channel group and for a TDM group.

Examples

The following example shows TDM group 1 being set up to include time slots 13 through 20:

```
tdm-group 1 timeslots 13-20
```

The following example configures TDM group number 20 to support FXS ground-start:

```
tdm-group 20 timeslot 20 type fxs ground-start
```

Related Commands

Command	Description
connect	Starts passage of data between ports for cross-connect TDM.
channel-group	Configures serial WAN on a T1 or E1 interface.

Glossary

ALI—Automatic Location Identification.

ANI—Automatic Number Identification B-channel asymmetric digital subscriber line.

BSP—Buffered Serial Port.

caller ID—A central office function where a call on an analog line sends a burst of modem tones between the first and second rings to the phone; the data burst contains the phone number (and sometimes the name) of the caller.

CDR—Call Detail Record.

CID or **CLID**—Caller Identification (North America uses 1200 baud FSK between first and second ring burst) or calling Line ID.

codec—coder-decoder. Algorithm that compresses or decompresses the data.

D channel—Data channel in an ISDN system that contains call setup, teardown, and X.25 packet data.

DSP—digital signal processor.

DTMF—dual tone multifrequency. Analog in-band signaling (such as touch-tone dialing).

FXS—Foreign Exchange Station used to connect directly to phones, fax machines, and key systems.

FXO—ForeigN Exchange Office. An FXO interface connects to a central office. This is the interface a standard telephone offers.

FXO-M1—FXO voice/fax interface card with battery reversal detection and caller ID support for the United States, Canada, Japan, and others.

FXO-M2—FXO voice/fax interface card with battery reversal detection and caller ID support for Europe.

FXO-M3—FXO voice/fax interface card with battery reversal detection and caller ID support for Australia.

H.323—This ITU-T standard defines a set of call control, channel setup, and codec specifications for sending real-time voice and video over networks that do not offer guaranteed quality of service.

M1—A POTS interface meeting U.S. requirements with battery reversal detection and CID, and termination impedance of 600 ohms resistive.

M2—A POTS interface meeting European requirements with battery reversal detection and CID, and termination impedance of 270 ohms plus 750 ohms in parallel with 150nF.

M3—A POTS interface meeting Australian requirements with battery reversal detection and CID, and termination impedance of 220 ohms plus 820 ohms in parallel with 120nF.

MF—multifrequency.

MGCP—Media Gateway Control Protocol.

NT—Network Termination.

NT1—Network Termination point 1 in ISDN.

NT2—Network Termination point 2 in ISDN.

ONS—On Premises Service for PABXs per EIA/TIA-464.

OPS—Off Premises Service for PABXes per EIA/TIA-464.

PBX/PABX—private (automated) branch exchange.

PSAP—Public Safety Answering Point. A facility equipped and staffed to receive 911 calls.

PSTN—public switched telephone network. Standard analog telephony infrastructure.

S0(S/T)—Subscriber line designation 0 for subscriber terminals using 4-wire full-duplex interfaces containing two B channels + one D channel + monitor overhead.

SLIC—Subscriber Line Interface Circuit. An IC providing central office-like telephone interface functionality.

S/T—Interface 4-wire interface presented by an NT to TEs.

SIP—Session Initiation Protocol.

TE—terminal equipment.

VoIP—Voice over IP. Blanket term that generally notes Cisco's standards based (H.323, and so on) approach to IP voice traffic.

VIC—voice interface card. A version of WIC but with a TDM I/F.

Note Refer to *Internetworking Terms and Acronyms* for terms not included in this glossary.