



IP Communications High-Density Digital Voice/Fax Network Module

The IP Communications High-Density Digital Voice/Fax Network Module feature supports high-density digital voice and low-density analog voice connectivity along with data and integrated access connectivity. The network modules offer built-in T1/E1 ports, and include a single voice interface card (VIC)/voice WAN interface card (VWIC) slot for Foreign Exchange Station (FXS), Foreign Exchange Office (FXO), E&M, software-configured Centralized Automatic Message Accounting (CAMA), direct inward dialing (DID), BRI, or E1 and T1 cards, up to a maximum of four T1/E1 ports. The network modules also support up to 32 HDLC channels with an aggregate capacity of 2.048 Mbps.



Note

The CAMA card (VIC-2CAMA) is not supported. However, any port on the VIC2-2FXO and the VIC2-4FXO can be software configured to support analog CAMA for dedicated E-911 services (North America only).

Feature History for the IP Communications High-Density Digital Voice/Fax Network Module

Release	Modification
12.3(7)T	This feature was introduced.
12.3(14)T	This feature was integrated into Cisco IOS Release 12.3(14)T and support was added for the DID feature in the VIC-4FXS/DID.

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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Restrictions for IP Communications High-Density Digital Voice/Fax Network Module

Before you can run the IP Communications High-Density Digital Voice/Fax Network Module feature on T1/E1 interfaces, you must install an IP Plus image (minimum) of Cisco IOS Release 12.3(14)T or a later release. When the IP Communications High-Density Digital Voice/Fax Network Module feature is used in a Cisco CallManager network, the CCM 4.0(1) SR1 or CCM 3.3(4) release must be installed.

Software echo cancellation is the default configuration—G.168-compliant echo cancellation is enabled by default with a coverage of 64 milliseconds.

Only Packet Fax/Voice DSP modules (PVDM2s) are supported on the IP Communications High-Density Digital Voice/Fax Network Module.

Only voice interface cards that start with VIC2 are supported in the IP Communications High-Density Digital Voice/Fax Network Module feature except for VIC-1J1, VIC-2DID, and VIC-4FXS/DID.

The DID feature in VIC-4FXS/DID is not supported in the original release of this feature. However, the DID feature in VIC-4FXS/DID is supported starting with Cisco IOS Release 12.3(14)T.

The CAMA card (VIC-2CAMA) is not supported. Any port on the VIC2-2FXO and the VIC2-4FXO can be software configured to support analog CAMA for dedicated E-911 services (North America only).

DSP sharing is available for T1/E1 digital ports, but not for analog or BRI ports.

Information About IP Communications High-Density Digital Voice/Fax Network Module

This section provides information about the following:

- [IP Communications High-Density Digital Voice/Fax Network Module Key Features, page 3](#)
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IP Communications High-Density Digital Voice/Fax Network Module Key Features

The IP Communications High-Density Digital Voice/Fax Network Module features the following:

- High-density digital voice connectivity up to 4 T1/E1 ports or 120 medium-complexity channels
- High-density data WAN connectivity up to 4 T1/E1 ports
- Analog voice connectivity up to 4 ports
- Built-in T1/E1 ports configurable for either T1 or E1 operation via command-line interface (CLI)
- Up to 32 HDLC channel groups with a total bandwidth of 2.048 Mbps
- PVDM2 technology that supports higher call densities and more flexibility in channel allocation per DSP
- G.168-compliant echo cancellation for tail circuits up to 64 milliseconds

IP Communications High-Density Digital Voice/Fax Network Module Hardware Configuration Options

The IP Communications High-Density Digital Voice/Fax Network Module is available on three network modules, with the option of zero, one, or two built-in T1/E1 ports. Each built-in port can be software-configured to support either T1 or E1 operation. Each network module also supports a single VIC/VWIC slot that can be fitted with a Cisco VWIC or Cisco VIC. The Cisco VICs are daughter cards that install into the network modules and provide the interface to the PSTN and to telephony equipment (PBX, key systems, fax machines, and phones). The Cisco VWICs are daughter cards that provide the interface to the PBX, PSTN, and WAN.

The IP Communications High-Density Digital Voice/Fax Network Module must be used with the new PVDM2s, providing scalability of 4 to 120 channels using the latest digital signal processing technology. Up to a maximum of four PVDM2s can be installed on each NM-HDV2 network module. You can select the minimum number and density-type PVDM2s depending on the voice channels currently needed, and then scale the number of PVDMs as requirements expand. These new PVDM2 SIMMs can be configured for high complexity, medium complexity, or flex. Flex complexity is the default configuration. In this mode, the network module will dynamically select the appropriate codec

(medium or high) depending on the PVDM2s available. In addition, the DSPs on the PVDM2s can be shared across multiple IP Communications High-Density Digital Voice/Fax Network Modules installed on a voice gateway router. [Table 1](#) summarizes the configuration options. [Table 2](#) summarizes the numbers of channels (based on complexity) for the PVDM2. On the Cisco 2800 series and Cisco 3800 series Integrated Services Routers, the IP Communications High-Density Digital Voice/Fax Network Module can be used with PVDM2s on the motherboard of the platform.

Table 1 Configuration Options for the IP Communications High-Density Digital Voice/Fax Network Module

Hardware Type	SKU Number	Description
Network modules	NM-HDV2	1-slot IP communications voice/fax network module
	NM-HDV2-1T1/E1	2-slot IP communications voice/fax network module with one slot for T1/E1 interface
	NM-HDV2-2T1/E1	2-slot IP communications voice/fax network module with two slots for T1/E1 interface
Packet voice data modules	PVDM2-8	8-channel packet fax/voice DSP module
	PVDM2-16	16-channel packet fax/voice DSP module
	PVDM2-32	32-channel packet fax/voice DSP module
	PVDM2-48	48-channel packet fax/voice DSP module
	PVDM2-64	64-channel packet fax/voice DSP module
VIC and VWIC options	VIC2-2FXO	2-port voice interface card—FXO (universal)—also supports CAMA
	VIC2-4FXO	4-port VIC—FXO (universal)—also supports CAMA
	VIC2-2FXS	2-port VIC—FXS
	VIC-4FXS/DID	4-port FXS or DID VIC
	VIC2-2E/M	2-port voice interface card—E&M
	VIC2-2BRI-NT/TE	2-port voice interface card—BRI
	VIC-2DID	2-port DID voice/fax interface card
	VIC-1J1	1-port J1 voice interface card
	VWIC-1MFT-T1	1-port RJ-48 multiflex trunk—T1
	VWIC-2MFT-T1	2-port RJ-48 multiflex trunk—T1
	VWIC-2MFT-T1-D1	2-port RJ-48 multiflex trunk—T1 with drop and insert
	VWIC-1MFT-E1	1-port RJ-48 multiflex trunk—E1
	VWIC-2MFT-E1	2-port RJ-48 multiflex trunk—E1
	VWIC-2MFT-E1-D1	2-port RJ-48 multiflex trunk—E1 with drop and insert
VWIC-1MFT-G703	1-port RJ-48 multiflex trunk—G.703	
VWIC-2MFT-G703	2-port RJ-48 multiflex trunk—G.703	

Table 2 Channel Availability for PVDM2 Modules Based on Codec Complexity

Module Name	Number of DSPs	Maximum Number of Channels		
		High Complexity ¹	Medium Complexity ²	Flexi Complexity ³
PVDM2-8	1	4	4	8
PVDM2-16	1	6	8	16
PVDM2-32	2	12	16	32
PVDM2-48	3	18	24	48
PVDM2-64	4	24	32	64

1. Supports G.711, G.726, G.729, G.723.1, G.728, GSM-EFR, and Fax Relay.
2. Supports G.711, G.726, G.729a, GSM, and Fax Relay.
3. Highest call densities are for G.711, so these values reflect optimum conditions.

DSP Resource Sharing

When one IP Communications High-Density Digital Voice/Fax Network Module does not have enough DSP resources, it can use DSPs from other NM-HDV2s on the same router, or DSPs available on the motherboard of the Cisco 2800 series and Cisco 3800 series Integrated Services Routers. This is referred to as DSP sharing. By default, the NM-HDV2s and the onboard PVDM2 DSPs on the Cisco 2800s and Cisco 3800s are configured for "no sharing," and must be turned on to share or export their resources. An NM-HDV2 that needs to import DSPs does not need any special configuration.



Note

T1/E1 digital ports can share DSP resources on the motherboard and vice versa. However, the network modules must participate in the network clocking of the motherboard before the DSP sharing can occur. The analog interfaces and BRI interfaces cannot "share" DSP resources in this manner; these interfaces must use DSP in its own domain. For example, when BRI or FXS/FXO is on a network module, there must be DSPs on the network modules to support these interfaces.

Search Order for DSPs

All available DSPs that are configured for sharing are pooled together in the search. An NM-HDV2 without any DSP resources will begin searching first on the motherboard (supported only on the Cisco 2800 and Cisco 3800 platforms), followed by other NM-HDV2 modules. Network modules are searched according to slot number. The **network-clock participate** command must be configured on the network modules that are sharing resources and need DSP resources.

Codec Combinations for DSP Sharing

When network modules or PVDM2s on the motherboard are configured for DSP sharing, the codec complexity has to match. A local resource sharing or importing from a remote network module must match its characteristics, that is, a high-complexity network module can only share from another high-complexity network module, whereas a flex-complexity network module can share DSPs from both high-complexity and flex-complexity network modules. [Table 3](#) summarizes the codec combinations for DSP-sharing.

Table 3 **Codec Complexity Settings for DSP Resource Sharing Between Local and Remote Sources**

Local DSP resource (import)	Remote DSP resource (export)		
	High complexity	Medium complexity	Flexible complexity
High complexity	yes	no	no
Medium complexity	yes	yes	no
Flexible complexity	yes	no	yes



Caution

If you are configuring a Cisco 2600 XM router, you should not use the **network-clock-participate** command for slot 1 of the router. This may cause a disruption in service to the router.

Single-Point Configuration of MGCP Voice Gateways in AVVID Networks

When using a Cisco IOS voice gateway in conjunction with MGCP and Cisco CallManager, you can complete the necessary configuration for a given gateway on the Cisco CallManager server and download the configuration to that gateway through a TFTP server. To enable this configuration on the NM-HDV2 modules, the **card type** command must be used first:

```
card type {t1 | e1} slot subslot
```

Configuring E1 Ports for Normal or Wet Mode

On the NM-HDV2-1T1/E1 and NM-HDV2-2T1/E1 network modules, there is a jumper block for each built-in T1/E1 port that controls whether the port supports normal or wet current mode. Depending on how your E1 line is provisioned, you might have to change the jumper setting on the network module to allow proper operation.

The jumper blocks are identified on the printed circuit board of the NM-HDV2-1T1/E1 and NM-HDV2-2T1/E1 network modules as J6 and J7. (See [Figure 1](#).) J6 is the jumper block for T1/E1 controller 1 and J7 is the jumper block for T1/E1 controller 0. The pins on each jumper block are numbered 1 to 3 from right to left.

- To configure an E1 port for normal mode, set the jumper to pins 2 and 3.
- To configure an E1 port for wet mode, set the jumper to pins 1 and 2.

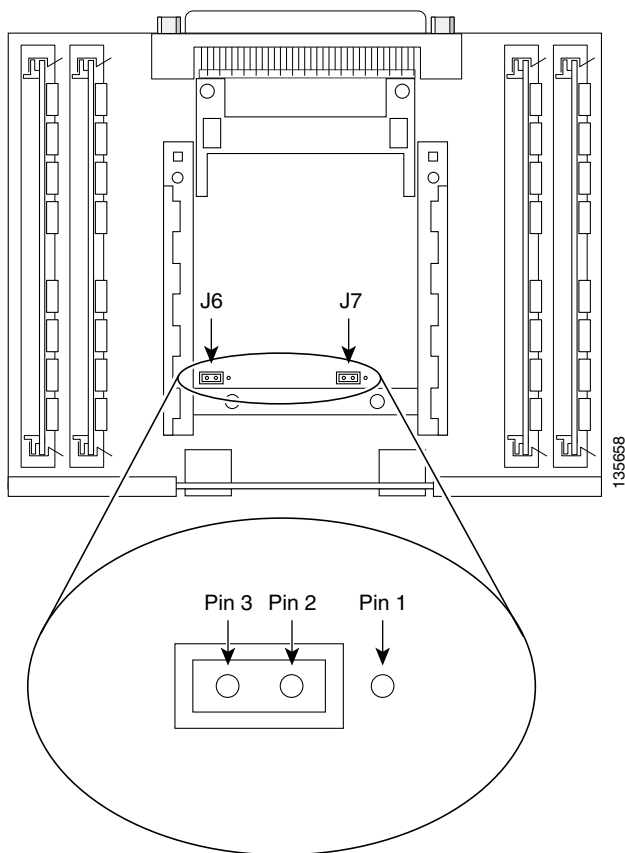
[Figure 1](#) shows the jumper block configured for normal mode, with the jumper set to pins 2 and 3.



Tip

If you are unsure whether your E1 line is configured for normal or wet mode, check with your provider. You can also use the **show controllers E1** command to look for line code violations and path code violations. These errors can indicate that the jumper is not set correctly.

Figure 1 *NM-HDV2-2T1/E1 Jumpers Configured for Normal Mode*



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Network Clock Timing

Voice systems that pass digitized (pulse code modulation or PCM) speech have always relied on the clocking signal being embedded in the received bit stream. This reliance allows connected devices to recover the clock signal from the bit stream, and then use this recovered clock signal to ensure that data on different channels keep the same timing relationship with other channels.

If a common clock source is not used between devices, the binary values in the bit streams may be misinterpreted because the device samples the signal at the wrong moment. As an example, if the local timing of a receiving device is using a slightly shorter time period than the timing of the sending device, a string of 8 continuous binary 1s may be interpreted as 9 continuous 1s. If this data is then re-sent to further downstream devices that used varying timing references, the error could be compounded. By ensuring that each device in the network uses the same clocking signal, you can ensure the integrity of the traffic.

If timing between devices is not maintained, a condition known as clock slip can occur. Clock slip is the repetition or deletion of a block of bits in a synchronous bit stream due to a discrepancy in the read and write rates at a buffer.

Slips are caused by the inability of an equipment buffer store (or other mechanisms) to accommodate differences between the phases or frequencies of the incoming and outgoing signals in cases where the timing of the outgoing signal is not derived from that of the incoming signal.

A T1 or E1 interface sends traffic inside repeating bit patterns called frames. Each frame is a fixed number of bits, allowing the device to see the start and end of a frame. The receiving device also knows exactly when to expect the end of a frame simply by counting the appropriate number of bits that have come in. Therefore, if the timing between the sending and receiving device is not the same, the receiving device may sample the bit stream at the wrong moment, resulting in an incorrect value being returned.

Even though Cisco IOS software can be used to control the clocking on these platforms, the default clocking mode is effectively free running, meaning that the received clock signal from an interface is not connected to the backplane of the router and used for internal synchronization between the rest of the router and its interfaces. The router will use its internal clock source to pass traffic across the backplane and other interfaces.

For data applications, this clocking generally does not present a problem as a packet is buffered in internal memory and is then copied to the transmit buffer of the destination interface. The reading and writing of packets to memory effectively removes the need for any clock synchronization between ports.

Digital voice ports have a different issue. It would appear that unless otherwise configured, Cisco IOS software uses the backplane (or internal) clocking to control the reading and writing of data to the DSPs. If a PCM stream comes in on a digital voice port, it will obviously be using the external clocking for the received bit stream. However, this bit stream will not necessarily be using the same reference as the router backplane, meaning the DSPs will possibly misinterpret the data that is coming in from the controller.

This clocking mismatch is seen on the router's E1 or T1 controller as a clock slip—the router is using its internal clock source to send the traffic out the interface but the traffic coming in to the interface is using a completely different clock reference. Eventually, the difference in the timing relationship between the transmit and receive signal becomes so great that the controller registers a slip in the received frame.

To eliminate the problem, change the default clocking behavior through Cisco IOS configuration commands. It is *absolutely critical* to set up the clocking commands properly.

Even though these commands are optional, we strongly recommend you enter them as part of your configuration to ensure proper network clock synchronization:

```
network-clock-participate [slot slot number | wic wic-slot | aim aim-slot-number]
network-clock-select priority {bri | t1 | e1} slot/port
```

The **network-clock-participate** command allows the router to use the clock from the line via the specified slot/wic/aim and synchronize the onboard clock to the same reference.

If multiple VWICS are installed, the commands must be repeated for each installed card. The system clocking can be confirmed using the **show network clocks** command.



Caution

If you are configuring a Cisco 2600 XM voice gateway with an NM-HDV2 or NM-HD-2VE installed in slot 1, do not use the **network-clock-participate slot 1** command in the configuration. In this particular hardware scenario, the **network-clock-participate slot 1** command is not necessary.

If the **network-clock-participate slot 1** command is configured, voice and data connectivity on interfaces terminating on the NM-HDV2 or NM-HD-2VE network module may fail to operate properly. Data connectivity to peer devices may not be possible at all, and even loopback plug tests to the serial interface spawned via a channel-group configured on the local T1/E1 controller will fail. Voice groups such as CAS ds0-groups and ISDN pri-groups may fail to signal properly. The T1/E1 controller may accumulate large amounts of timing slips as well as Path Code Violations (PCVs) and Line Code Violations (LCVs).

How to Configure IP Communications High-Density Digital Voice/Fax Network Module

This section contains the following procedures:

- [Configuring the Voice Card for IP Communications High-Density Digital Voice/Fax Network Module, page 9](#)
- [Configuring Digital Interfaces for IP Communications High-Density Digital Voice/Fax Network Module, page 12](#)
- [Configuring Echo Cancellation for IP Communications High-Density Digital Voice/Fax Network Module, page 18](#)
- [Configuring DSP Sharing for IP Communications High-Density Digital Voice/Fax Network Module, page 19](#)
- [Configuring Channel Bank Support for IP Communications High-Density Digital Voice/Fax Network Module, page 20](#)
- [Configuring Drop and Insert for the IP Communications High-Density Digital Voice/Fax Network Module, page 25](#)

Configuring the Voice Card for IP Communications High-Density Digital Voice/Fax Network Module



To enable the IP Communications High-Density Digital Voice/Fax Network Module feature, configure the voice card.

SUMMARY STEPS

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

DETAILED STEPS

	Command or Action	Purpose
Step 1	<p>enable</p> <p>Example: Router> enable</p>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	<p>configure terminal</p> <p>Example: Router# configure terminal</p>	<p>Enters global configuration mode.</p>
Step 3	<p>voice-card slot</p> <p>Example: Router(config)# voice-card 1</p>	<p>Enters voice-card configuration mode and specifies the slot location.</p> <ul style="list-style-type: none"> For the <i>slot</i> argument, specify a value from 1 to 4, depending on your router.

Command or Action	Purpose
<p>Step 4</p> <pre>codec complexity {flex [reservation-fixed {high medium}] high medium}</pre> <p>Example:</p> <pre>Router(config-voicecard)# codec complexity flex</pre>	<p>Specifies the codec complexity based on the codec standard you are using.</p> <ul style="list-style-type: none"> • 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. In this mode, reservation for analog VICs may be needed for certain applications such as CAMA E-911 calls because oversubscription of DSPs is possible. If this is true, then the reservation-fixed option may be enabled. There is no reservation by default. <ul style="list-style-type: none"> – reservation-fixed—Appears as an option only when there is an analog VIC present. Ensures that sufficient DSP resources are available to handle a call. If you enter this keyword, then specify if the complexity should be high or medium. • 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, GSMEFR, and fax relay. <p> Note High-complexity codecs support lower call density than do medium-complexity codecs.</p> • 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. • You cannot change codec complexity while DS0 groups are defined. If they are already set up, follow these steps: <ul style="list-style-type: none"> – Shut down the voice port associated with the controller. – Remove the DS0 group or PRI group under the T1 or E1 controller. – Enter the voice-card slot command, and then change the codec complexity. <p> Note This procedure to change codec complexity applies only to T1 and E1 controllers. This is not valid for analog voice ports.</p>

	Command or Action	Purpose
Step 5	local-bypass Example: Router(config-voicecard) # local-bypass	Configures local calls to bypass the DSP. This is the default. <ul style="list-style-type: none"> Using this command enables intra-network-module hairpinning (no DSPs). Note For POTS-to-POTS calls between two network modules, hairpinning is not supported. If the connection manager in IOS software does not automatically handle this, it might be necessary to disable local-bypass so that DSPs are used for these calls.
Step 6	exit Example: Router(config-voicecard) # exit	<ul style="list-style-type: none"> Exits voice-card configuration mode and returns the router to global configuration mode.

Configuring Digital Interfaces for IP Communications High-Density Digital Voice/Fax Network Module

To configure the built-in digital T1/E1 interfaces available on the NM-HDV2-1T1/E1 and NM-HDV2-2T1/E1, follow the procedure in this section.



Note

For the VWIC and VIC cards that fit into the single VIC/VWIC slot (that is, the interfaces that are not built-in), the interfaces are automatically recognized and no CLI configuration is needed.

SUMMARY STEPS

- enable
- configure terminal
- card type {t1 | e1} slot subslot
- controller {t1 | e1} slot/port
- clock source {line [primary] | internal}
- framing {sf | esf}
or
framing {crc4 | no-crc4}
- linecode {b8zs | ami}
or
linecode {ami | hdb3}
- cablelength long {gain26 | gain36} {-15db | -22.5db | -7.5db | 0db}
or
cablelength short {133 | 266 | 399 | 533 | 655}
- 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]}

```


10. no shutdown



11. end


DETAILED STEPS

	Command or Action	Purpose
Step 1	<pre>enable</pre> <p>Example: Router> enable </p>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	<pre>configure terminal</pre> <p>Example: Router# configure terminal </p>	<p>Enters global configuration mode.</p>
Step 3	<pre>card type {t1 e1} slot subslot</pre> <p>Example: Router(config)# card type t1 3 1 </p>	<p>Sets or changes the card type to either T1 or E1.</p> <ul style="list-style-type: none"> The <i>slot</i> argument specifies the slot number. Range can be 1 to 4, depending on the platform. The <i>subslot</i> argument specifies the VWIC slot number. <ul style="list-style-type: none"> Enter 0 for WIC controllers. Enter 1 for onboard controllers. When the command is used for the first time, the configuration takes effect immediately. A subsequent change in the card type will not take effect unless you enter the reload command or reboot the router.
Step 4	<pre>controller {t1 e1} slot/port</pre> <p>Example: Router(config)# controller t1 1/1 </p>	<p>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.</p> <ul style="list-style-type: none"> Valid values for the <i>slot</i> argument are 1 through 4. Valid values for the <i>port</i> argument are 0 and 1.

Command or Action	Purpose
<p>Step 5</p> <pre>clock source {line [primary] internal}</pre> <p>Example: Router(config-controller)# clock source line</p>	<p>Specifies the clock source.</p> <ul style="list-style-type: none"> The line keyword specifies that the clock source is derived from the active line. This is the default. <ul style="list-style-type: none"> 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.
<p>Step 6</p> <pre>framing {sf esf} or framing {crc4 no-crc4}</pre> <p>Example: Router(config-controller)# framing esf or</p> <p>Example: Router(config-controller)# framing crc4</p>	<p>Sets the framing according to your service provider's instructions.</p> <ul style="list-style-type: none"> For T1 controllers, enter either sf or esf. For E1 controllers, enter either crc4 or no-crc4. <p>Note If you will be configuring drop and insert, the T1 or E1 framing under the controllers involved (where the tdm-groups are configured), needs to be the same. If different framing types are used, the signaling bits may not be understood properly when a channel from one controller is dropped and inserted into a channel from another controller.</p>
<p>Step 7</p> <pre>linecode {b8zs ami} or linecode {ami hdb3}</pre> <p>Example: Router(config-controller)# linecode b8zs or</p> <p>Example: Router(config-controller)# linecode hdb3</p>	<p>Sets the line encoding according to your service provider's instructions.</p> <ul style="list-style-type: none"> The b8zs keyword encodes a sequence of eight zeros in a unique binary sequence to detect line coding violations. Valid for T1 controllers only. The ami keyword represents zeros using a 01 during each bit cell, and ones are represented by 11 or 00, alternately, during each bit cell. The hdb3 keyword specifies high density binary 3 (hdb3) as the line-code type. Valid for E1 controller only; the default for E1 lines.

Command or Action	Purpose
<p>Step 8</p> <pre>cablelength long {gain26 gain36} {-15db -22.5db -7.5db 0db}</pre> <p>or</p> <pre>cablelength short {133 266 399 533 655}</pre> <p>Example: Router(config-controller)# cablelength long gain36 -15db or</p> <p>Example: Router(config-controller)# cablelength short 266</p>	<p>Sets a cable length longer than 655 feet for a T1 link.</p> <ul style="list-style-type: none"> The gain26 keyword specifies the decibel pulse gain at 26. This is the default for pulse gain. The gain36 keyword specifies the decibel pulse gain at 36. The -15db keyword specifies the decibel pulse rate at -15. The -22.5db keyword specifies the decibel pulse rate at -22.5. The -7.5db keyword specifies the decibel pulse rate at -7.5. The 0db keyword specifies the decibel pulse rate at 0. This is the default for pulse rate. <p>or</p> <p>Sets a cable length of 655 feet or less for a T1 link.</p> <ul style="list-style-type: none"> There is no default for the cablelength short command. The 133 keyword specifies a cable length from 0 to 133 feet. The 266 keyword specifies a cable length from 134 to 266 feet. The 399 keyword specifies a cable length from 267 to 399 feet. The 533 keyword specifies a cable length from 400 to 533 feet. The 655 keyword specifies a cable length from 534 to 655 feet. <p> Note If you do not set the cable length, the system defaults to cablelength long gain26 0db.</p>

Command or Action	Purpose
<p>Step 9</p> <pre>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}</pre> <p>or</p> <pre>pri-group [timeslots range]</pre> <p>or</p> <pre>channel-group channel-group-number timeslots range [speed kbps]</pre> <p>or</p> <pre>tdm-group tdm-group-number timeslots timeslot-list type {e&m fxs [loop-start ground-start] fxo [loop-start ground-start]}</pre> <p>Example:</p> <pre>Router(config-controller)# ds0-group 10 timeslots 1,2, 7-9 type e&m-wink-start</pre> <p>or</p> <p>Example:</p> <pre>Router(config-controller)# pri-group timeslots 1-5</pre> <p>or</p> <p>Example:</p> <pre>Router(config-controller)# channel-group 0 timeslots 1-12</pre> <p>or</p> <p>Example:</p> <pre>Router(config-controller)# tdm-group 12 timeslots 1, 5-7, 23 type fxo loop-start</pre>	<p>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.</p> <hr/> <p> 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.</p> <hr/> <ul style="list-style-type: none"> • The ds0-group command automatically creates a logical voice port. • <i>ds0-group-number</i>—Value from 0 to 23 that identifies the DS0 group. • <i>timeslot-list</i>—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: <ul style="list-style-type: none"> – 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 central office to a standard PBX interface where permitted by local regulations. – FXS—Connects basic telephone equipment and PBXs. <hr/> <p> Note Operator ringback is not supported.</p> <hr/> <p>or</p> <p>Specifies that the controller should be set up as a PRI interface.</p> <ul style="list-style-type: none"> • 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
	<p>or</p> <p>Specifies a channel group number.</p> <ul style="list-style-type: none"> • 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 <i>range</i>—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 <i>kbps</i>—(optional) Specifies the speed of the underlying DS0s in kilobits per second. Valid values are 56 and 64. <ul style="list-style-type: none"> – The default line speed when configuring a T1 controller is 56 kbps. – The default line speed when configuring an E1 controller is 64 kbps. <p>or</p> <p>Specifies TDM channel groups for the drop-and-insert (also called TDM cross-connect) function with a two-port T1 multiflex trunk interface card.</p> <ul style="list-style-type: none"> • <i>tdm-group-number</i>—Value from 0 to 23 that identifies the TDM group. • <i>timeslot-list</i>—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. <p> 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.</p>
<p>Step 10 <code>no shutdown</code></p> <p>Example: Router(config-controller)# no shutdown</p>	<p>Activates the controller.</p>
<p>Step 11 <code>end</code></p> <p>Example: Router(config-controller)# end</p>	<p>Ends the current configuration session and returns to privileged EXEC mode.</p>

Configuring Echo Cancellation for IP Communications High-Density Digital Voice/Fax Network Module

This task configures the voice ports with echo cancellation.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **voice-port** *slot/port*
4. **echo-cancel enable**
5. **echo-cancel coverage** {24 | 32 | 48 | 64}
6. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	voice-port <i>slot/port</i> Example: Router(config)# voice-port 2/1	Enters voice-port configuration mode and identifies a slot and port for configuration parameters.
Step 4	echo-cancel enable Example: Router(config-voiceport)# echo-cancel enable	Enables the cancellation of voice that is sent out the interface and received back on the same interface.
Step 5	echo-cancel coverage {24 32 48 64} Example: Router (config-voiceport)# echo-cancel coverage 24	Adjusts the echo canceller by the specified number of milliseconds. <ul style="list-style-type: none"> • The default is 64.
Step 6	exit Example: Router(config-voiceport)# exit	Exits voice-port configuration mode and returns to global configuration mode.

Configuring DSP Sharing for IP Communications High-Density Digital Voice/Fax Network Module



This task adds a specified voice card to a DSP resource pool to participate in DSP sharing.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **controller {t1 | e1} slot/port**
4. **voice-card slot**
5. **dspfarm**
6. **exit**
7. **network-clock-participate [slot slot-number]**
8. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • 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. <ul style="list-style-type: none"> • Valid values for the <i>slot</i> argument are 1 through 4. • Valid values for the <i>port</i> argument are 0 and 1.
Step 4	voice-card slot Example: Router(config-controller)# voice-card 2	Enters voice-card configuration mode and identifies a slot for configuration parameters.
Step 5	dspfarm Example: Router(config-voicecard)# dspfarm	Adds a specified voice card to those participating in a DSP resource pool.

Command or Action	Purpose
<p>Step 6</p> <p><code>exit</code></p> <p>Example: Router(config-voicecard)# exit</p>	<p>Exits voice-card configuration mode and returns to global configuration mode.</p>
<p>Step 7</p> <p><code>network-clock-participate [slot slot-number]</code></p> <p>Example: Router(config)# network-clock-participate slot 2</p>	<p>Allows the ports on a specified network module to use the network clock for timing.</p> <ul style="list-style-type: none"> The <i>slot-number</i> argument identifies the slot location of the network module. <p> Note If more than one network module must be synchronized, use this command for each slot.</p> <p> Caution If you are configuring a Cisco 2600 XM voice gateway with an NM-HDV2 or NM-HD-2VE installed in slot 1, do not use the network-clock-participate slot 1 command in the configuration. In this particular hardware scenario, the network-clock-participate slot 1 command is not necessary.</p> <p>If the network-clock-participate slot 1 command is configured, voice and data connectivity on interfaces terminating on the NM-HDV2 or NM-HD-2VE network module may fail to operate properly. Data connectivity to peer devices may not be possible at all, and even loopback plug tests to the serial interface spawned via a channel-group configured on the local T1/E1 controller will fail. Voice groups such as CAS ds0-groups and ISDN pri-groups may fail to signal properly. The T1/E1 controller may accumulate large amounts of timing slips as well as Path Code Violations (PCVs) and Line Code Violations (LCVs).</p>
<p>Step 8</p> <p><code>end</code></p> <p>Example: Router(config)# end</p>	<p>Ends the current configuration session and returns to privileged EXEC mode.</p>

Configuring Channel Bank Support for IP Communications High-Density Digital 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-HDV2 using CAS signaling.

Restrictions

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 cannot be used for fractional PRI signaling.

Channel bank support requires that the analog and digital ports be located on the same network module.

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-immediate | e&m-delay | e&m-wink | fxs-ground-start | fxs-loop-start | fxo-ground-start | fxo-loop-start}**
5. **exit**
6. **voice-port slot/port**
7. **operation {2-wire | 4-wire}**
8. **type {1 | 2 | 3 | 5}**
9. **signal {loop-start | ground-start}**
or
signal {wink-start | immediate | delay-dial}
10. **exit**
11. **connect connection-name voice-port voice-port-number {t1 | e1} controller-number ds0-group-number**
12. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
Step 3	<p>controller {t1 e1} slot/port</p> <p>Example: Router(config)# controller t1 1/0</p>	<p>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.</p> <ul style="list-style-type: none"> Valid values for the <i>slot</i> argument are 1 through 4. Valid values for the <i>port</i> argument are 0 and 1.
Step 4	<p>ds0-group ds0-group-number 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}</p> <p>Example: Router(config-controller)# ds0-group 1 timeslots 1 type e&m-wink</p>	<p>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.</p> <ul style="list-style-type: none"> The ds0-group command automatically creates a logical voice port. <i>ds0-group-number</i>—Value from 0 to 23 that identifies the DS0 group. <i>timeslot-list</i>—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: <ul style="list-style-type: none"> 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, whereas 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.
Step 5	<p>exit</p> <p>Example: Router(config-controller)# exit</p>	<p>Exits controller configuration mode and returns to global configuration mode.</p>
Step 6	<p>voice-port slot/port</p> <p>Example: Router(config)# voice-port 2/1</p>	<p>Enters voice-port configuration mode and identifies a slot and port for configuration parameters.</p>

Command or Action	Purpose
<p>Step 7 <code>operation {2-wire 4-wire}</code></p> <p>Example: Router(config-voiceport)# operation 4-wire</p>	<p>Selects a specific cabling scheme for E&M ports only.</p> <ul style="list-style-type: none"> • 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.
<p>Step 8 <code>type {1 2 3 5}</code></p> <p>Example: Router(config-voiceport)# type 2</p>	<p>Specifies the E&M interface type.</p> <ul style="list-style-type: none"> • 1 specifies <ul style="list-style-type: none"> – E—Output, relay to ground – M—Input, referenced to ground • 2 specifies: <ul style="list-style-type: none"> – 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: <ul style="list-style-type: none"> – E—Output, relay to ground – M—Input, referenced to ground – SB—Connected to –48V – SG—Connected to ground • 5 specifies: <ul style="list-style-type: none"> – E—Output, relay to ground – M—Input, referenced to –48V

	Command or Action	Purpose
Step 9	<p>signal {loop-start ground-start}</p> <p>or</p> <p>signal (wink-start immediate delay-dial)</p> <p>Example: Router(config-voiceport)# signal loop-start or</p> <p>Example: Router(config-voiceport)# signal wink-start</p>	<p>FXO and FXS voice ports:</p> <ul style="list-style-type: none"> • 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. <p>or</p> <p>E&M voice ports:</p> <ul style="list-style-type: none"> • 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 10	<p>exit</p> <p>Example: Router(config-voiceport)# exit</p>	Exits voice-port configuration mode and returns to global configuration mode.
Step 11	<p>connect <i>connection-name</i> voice-port <i>voice-port-number</i> {t1 e1} <i>controller-number</i> <i>ds0-group-number</i></p> <p>Example: Router(config)# connect connect1 voice-port 1/1/0 t1 1/0 0</p>	Creates a named connection between two voice ports (one of which is an analog port) associated with T1 or E1 interfaces where you have already defined the groups by using the ds0-group command.
Step 12	<p>end</p> <p>Example: Router(config)# end</p>	Ends the current configuration session and returns to privileged EXEC mode.

Examples

To verify the channel bank connection, use the **show connection** command. In the following example, E&M port 2/0 is configured for a channel bank connection with time slot 1 on T1 1/0:

```
Router# show connection ?
```

```

all All Connections
elementsShow Connection Elements
id ID Number
name Connection Name
port Port Number

Router# show connection all

ID NameSegment 1Segment 2State =====
5 connect1voice-port 2/0T1 1/0 01 UP

```

Configuring Drop and Insert for the IP Communications High-Density Digital Voice/Fax Network Module

T1/E1 VWICs with drop-and-insert functionality connect other devices to a T1 or E1 data stream. Drop-and-insert technology is sometimes called *TDM cross-connect*.

This task configures a T1/E1 VWIC for drop-and-insert capability. Repeat the procedure for each controller.


Note that this feature supports both inter-network-module and intra-network-module drop and insert. If you configure inter-network-module drop and insert, you must also configure network clocking.


SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **controller {t1 | e1} slot/port**
4. **clock source {line [primary] | internal}**
5. **network-clock-participate slot slot number**
6. **network-clock-select priority {bri | t1 | e1} slot/port**
7. **framing {sf | esf}**
or
framing {crc4 | no-crc4}
8. **linecode {b8zs | ami}**
or
linecode {ami | hdb3}
9. **tdm-group tdm-group-number timeslots timeslot-list type {e&m | fxs [loop-start | ground-start] | fxo [loop-start | ground-start]}**
10. **no shutdown**
11. **exit**
12. **connect id {t1 | e1} slot/port-1 tdm-group-no-1 {t1 | e1} slot/port-2 tdm-group-no-2**
13. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	<pre>enable</pre> <p>Example: Router> enable </p>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	<pre>configure terminal</pre> <p>Example: Router# configure terminal </p>	<p>Enters global configuration mode.</p>
Step 3	<pre>controller {t1 e1} slot/port</pre> <p>Example: Router(config)# controller t1 1/1 </p>	<p>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.</p> <ul style="list-style-type: none"> • Valid values for the <i>slot</i> argument are 1 through 4. • Valid values for the <i>port</i> argument are 0 and 1.
Step 4	<pre>clock source {line [primary] internal}</pre> <p>Example: Router(config-controller)# clock source line </p>	<p>Specifies the clock source.</p> <ul style="list-style-type: none"> • The line keyword specifies that the clock source is derived from the active line. This is the default. <ul style="list-style-type: none"> – 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.

Command or Action	Purpose
<p>Step 5</p> <pre>network-clock-participate slot slot number</pre> <p>Example: Router(config)# network-clock-participate slot 2</p>	<p>Allows the ports on a specified network module or voice/WAN interface card (VWIC) to use the network clock for timing.</p> <ul style="list-style-type: none"> The <i>slot number</i> argument is the network module slot number on the router chassis. <p> Caution If you are configuring a Cisco 2600 XM voice gateway with an NM-HDV2 or NM-HD-2VE installed in slot 1, do not use the network-clock-participate slot 1 command in the configuration. In this particular hardware scenario, the network-clock-participate slot 1 command is not necessary.</p> <p>If the network-clock-participate slot 1 command is configured, voice and data connectivity on interfaces terminating on the NM-HDV2 or NM-HD-2VE network module may fail to operate properly. Data connectivity to peer devices may not be possible at all, and even loopback plug tests to the serial interface spawned via a channel-group configured on the local T1/E1 controller will fail. Voice groups such as CAS ds0-groups and ISDN pri-groups may fail to signal properly. The T1/E1 controller may accumulate large amounts of timing slips as well as Path Code Violations (PCVs) and Line Code Violations (LCVs).</p>
<p>Step 6</p> <pre>network-clock-select priority {bri t1 e1} slot/port</pre> <p>Example: Router(config)# network-clock-select 1 bri 2/0</p>	<p>(Optional) Allows backplane TDM PLL circuitry to select recovered timing references from healthy digital links according to a defined priority.</p> <ul style="list-style-type: none"> The <i>priority</i> argument specifies selection priority for the clock sources (1 is the highest priority). When the higher-priority clock source fails, the next-higher-priority clock source is selected. The bri keyword specifies that the slot is configured as BRI. The t1 keyword specifies that the slot is configured as T1. The e1 keyword specifies that the slot is configured as E1. The <i>slot</i> argument is the slot number identifying the controller that is the clock source. The <i>port</i> argument is the port number identifying the controller that is the clock source. <ul style="list-style-type: none"> The range is from 0 to 3.

	Command or Action	Purpose
Step 7	<pre>framing {sf esf} OR framing {crc4 no-crc4}</pre> <p>Example: Router(config-controller)# framing esf OR</p> <p>Example: Router(config-controller)# framing crc4</p>	<p>Sets the framing according to your service provider's instructions.</p> <ul style="list-style-type: none"> For T1 controllers, enter either sf or esf. For E1 controllers, enter either crc4 or no-crc4. <p>Note For drop and insert to work properly, the T1 or E1 framing under the controllers involved (where the tdm-groups are configured), needs to be the same. If different framing types are used, the signaling bits may not be understood properly when a channel from one controller is dropped and inserted into a channel from another controller.</p>
Step 8	<pre>linecode {b8zs ami} OR linecode {ami hdb3}</pre> <p>Example: Router(config-controller)# linecode b8zs OR</p> <p>Example: Router(config-controller)# linecode hdb3</p>	<p>Sets the line encoding according to your service provider's instructions.</p> <ul style="list-style-type: none"> The b8zs keyword encodes a sequence of eight zeros in a unique binary sequence to detect line coding violations. Valid for T1 controllers only. The ami keyword represents zeros using a 01 during each bit cell, and ones are represented by 11 or 00, alternately, during each bit cell. The hdb3 keyword specifies high density binary 3 (hdb3) as the line-code type. Valid for E1 controller only; the default for E1 lines.
Step 9	<pre>tdm-group tdm-group-number timeslots timeslot-list type {e&m fxs [loop-start ground-start] fxo [loop-start ground-start]}</pre> <p>Example: Router(config-controller)# tdm-group 12 timeslots 1, 5-7, 23 type fxo loop-start</p>	<p>Specifies TDM channel groups for the drop-and-insert (also called TDM cross-connect) function with a two-port T1 multiflex trunk interface card.</p> <ul style="list-style-type: none"> <i>tdm-group-number</i>—Value from 0 to 23 that identifies the TDM group. <i>timeslot-list</i>—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. <p> 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.</p>
Step 10	<pre>no shutdown</pre> <p>Example: Router(config-controller)# no shutdown</p>	<p>Activates the controller.</p>
Step 11	<pre>exit</pre> <p>Example: Router(config-controller)# exit</p>	<ul style="list-style-type: none"> Exits voice-card configuration mode and returns the router to global configuration mode.

	Command or Action	Purpose
Step 12	<pre>connect id {t1 e1} slot/port-1 tdm-group-no-1 {t1 e1} slot/port-2 tdm-group-no-2</pre> <p>Example:</p> <pre>Router(config)# connect connect1 t1 1/1 10 1/0 11</pre>	<p>Creates a named connection between two voice ports (one of which is an analog port) associated with T1 or E1 interfaces where you have already defined the groups by using the tdm-group command.</p> <ul style="list-style-type: none"> The <i>id</i> argument is a name for the connection. The <i>tdm-group-no-1</i> and <i>tdm-group-no-2</i> parameters identify the TDM group numbers (from 0 to 31) on the specified controller. (These groups were set up in Step 9.)
Step 13	<pre>end</pre> <p>Example:</p> <pre>Router(config)# end</pre>	<p>Ends the current configuration session and returns to privileged EXEC mode.</p>

Configuration Examples for IP Communications High-Density Digital Voice/Fax Network Module

This section provides the following configuration examples for the IP Communications High-Density Digital Voice/Fax Network Module:

- [Channel Bank Support: Example, page 29](#)
- [Normal VoIP Showing Some Calls: Example, page 30](#)
- [MGCP Configuration: Example, page 30](#)
- [Fax Relay Configuration: Example, page 31](#)

Channel Bank Support: Example

```
!
card type t1 3 1
!
!
controller T1 3/0
framing esf
linecode b8zs
ds0-group 0 timeslots 1 type fxo-loop-start
ds0-group 1 timeslots 2 type fxo-loop-start
!
!
connect test_1 voice-port 3/0/0 T1 3/0 0
!
!
connect test_2 voice-port 3/0/1 T1 3/0 1
!
!
!
voice-port 3/0/0
signal loopstart
description FXS LoopStart Port
!
```

```

voice-port 3/0/1
  signal loopstart
  description FXS LoopStart Port
!
```

Normal VoIP Showing Some Calls: Example

Originating Side

```

!
card type t1 2 1
!
controller T1 2/0
  framing esf
  linecode b8zs
  ds0-group 0 timeslots 1-24 type e&m-immediate-start
!
dial-peer voice 4100 pots
  destination-pattern 4100
  port 2/0:0
!
dial-peer voice 999 voip
  destination-pattern 99..
  session target ipv4:11.3.14.25
  codec gsmfr
!
```

Terminating Side

```

!
card type t1 1 1
!
controller T1 1/0
  framing esf
  clock source internal
  linecode b8zs
  ds0-group 0 timeslots 1-24 type e&m-immediate-start
!
dial-peer voice 999 pots
  destination-pattern 99..
  port 1/0:0
!
dial-peer voice 1111 voip
  incoming called-number 99..
  codec gsmfr
!
```

MGCP Configuration: Example

```

!
card type t1 4 1
!
controller T1 4/0
  framing esf
  linecode b8zs
  ds0-group 0 timeslots 1-24 type e&m-immediate-start
!
mgcp
```

```
mgcp call-agent 10.1.0.60 service-type mgcp version 0.1
mgcp package-capability rtp-package
no mgcp package-capability atm-package
no mgcp package-capability res-package
mgcp fax t38 inhibit
!
ccm-manager mgcp
!
call app alternate default <=== required for fall back
!
dial-peer voice 4000 pots
application mgcpapp
port 4/0:0!
```

Fax Relay Configuration: Example

The following examples provide configuration information for Fax Pass Through, Cisco Fax Relay and T.38:

Global Configuration for Fax Pass-Through

```
voice service voip
fax protocol passthrough g711ulaw
```

Dial-Peer Level Configuration for Fax Pass-Through

```
dial-peer voice 300 voip
destination-pattern 93...
session target ipv4:1.3.28.103
fax rate disable
fax protocol passthrough g711ulaw
```

Global Configuration for Fax Relay

```
voice service voip
fax protocol cisco ! this line will not show as it is default setting
```

Dial-Peer Level Configuration for Fax Relay

```
dial-peer voice 300 voip
destination-pattern 93...
session target ipv4:1.3.28.103
fax protocol cisco ! this line will not show as it is default setting
```

Global Configuration for T.38

```
voice service voip
fax protocol t.38
```

Dial-Peer Level Configuration for T.38

```
dial-peer voice 300 voip
destination-pattern 93...
session target ipv4:1.3.28.103
fax protocol t38
```

Additional References

The following sections provide references related to the IP Communications High-Density Digital Voice/Fax Network Module.

Related Documents

Related Topic	Document Title
Hardware installation instructions for the IP Communications High-Density Digital Voice/Fax Network Module feature	Network Module Installation

Standards

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

RFCs

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

MIBs

MIBs	MIBs Link
<ul style="list-style-type: none">• IF-MIB• ENTITY-MIB• DS1-MIB• OLD-CISCO-CHASSIS-MIB• CISCO-VOICE-IF-MIB• CISCO-VOICE-DIAL-CONTROL-MIB• CISCO-DIAL-CONTROL-MIB	<p>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:</p> <p>http://www.cisco.com/go/mibs</p>

Technical Assistance

Description	Link
<p>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.</p>	<p>http://www.cisco.com/public/support/tac/home.shtml</p>

Command Reference

This section documents the modified **codec complexity** command.

codec complexity

To specify call density and codec complexity according to the codec standard that is being used, use the **codec complexity** command in voice-card configuration mode. To reset the flex complexity default, use the **no** form of this command.

codec complexity {**flex** [**reservation-fixed** {**high** | **medium**}] | **high** | **medium**}

no codec complexity

Syntax Description

flex	<ul style="list-style-type: none"> When the flex keyword is used, 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. In this mode, reservation for analog VICs may be needed for certain applications such as CAMA E-911 calls because oversubscription of DSPs is possible. If this is true, then the reservation-fixed option may be enabled. There is no reservation by default. <ul style="list-style-type: none"> Oversubscription—When you have specified the flex keyword, 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.
reservation-fixed	(Optional) If you have specified the flex keyword, the reservation-fixed keyword ensures that sufficient DSP resources are available to handle a call. If you enter this keyword, then specify if the complexity should be high or medium . This option appears only when there is an analog VIC present.

high	<p>If you specify the high keyword to define the complexity, each DSP supports two voice channels encoded in any of the following formats:</p> <ul style="list-style-type: none"> • 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—G.726 24,000 bps. • g726r32—G.726 32,000 bps. • g728—G.728 16,000 bps. • g729r8—G.729 8000 bps. This is the default. • g729br8—G.729 Annex B 8000 bps. • fax relay—2400 bps, 4800 bps, 7200 bps, 9600 bps, 12 kbps, and 14.4 kbps. <p>Note Codecs G.723.1 and G.728 are not supported on Cisco 1750 and Cisco 1751 modular access routers for Cisco Hoot and Holler over IP applications.</p>
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medium	<p>If you specify the medium keyword to define the complexity, each DSP supports four voice channels encoded in any of the following formats:</p> <ul style="list-style-type: none"> • 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. Fax relay is the default.
---------------	---

Defaults	Flex complexity
-----------------	-----------------

Command Modes	Voice-card configuration
----------------------	--------------------------

Command History	Release	Modification
	12.0(5)XK	This command was introduced on the Cisco 2600 and Cisco 3600 series.
	12.0(7)T	This command was integrated into Cisco IOS Release 12.0(7)T.

Release	Modification
12.0(7)XK	This command was implemented on the Cisco MC3810 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(8)T	This command was implemented on the Cisco 1750 and Cisco 1751.
12.2(13)T	The ecan-extended keyword was added.
12.2(15)T	This command was integrated into Cisco IOS Release 12.2(15)T with support for the Cisco 2600 series, Cisco 2600XM, Cisco 3660, Cisco 3725, and Cisco 3745 routers. High codec complexity is supported for DSP processing on these platforms.
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.
12.3(7)T	This command was integrated into Cisco IOS Release 12.3(7)T and the reservation-fixed keyword was added.

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 reconciled 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.

To change codec complexity, all of the DSP voice channels must be in the idle state.

The **flex** keyword for configuring codec complexity allows the DSP to process up to 16 channels. In addition to continuing support for configuring a fixed number of channels per DSP, the **flex** keyword 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).

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.

The **high** keyword selects a higher codec complexity if that is required to support a particular codec or combination of codecs. When you use the **codec complexity high** command to change codec complexity, the system prompts you to remove all existing DS0 or PRI groups using the specified voice card, then all DSPs are reset, loaded with the specified firmware image, and released. Refer to the “*Configuring Echo Cancellation*” chapter of the *Cisco IOS Voice Port Configuration Guide* on Cisco.com for more information about removing and replacing DS0 or PRI groups.

The **medium** keyword selects 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.

Examples

The following example sets the codec complexity to high on voice card 1 in a Cisco 2600 or Cisco 3600 series router, and configures local calls to bypass the DSP:

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

local-bypass

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.

Glossary

AIM—Asynchronous Integration Module. An internal module with PCI and TDM access.

AMI—alternate mark inversion. Line-code type used on T1 and E1 circuits. Zeros are represented by 01 during each bit cell, and ones are represented by 11 or 00, alternately, during each bit cell. AMI requires that the sending device maintain ones density. Ones density is not maintained independent of the data stream.

CAS—channel-associated signaling for T1/E1 interfaces.

CCS—common channel signaling for T1/E1 interfaces.

DSP—digital signal processor.

E1—European equivalent of T1, 32 64-kbps channels. Includes one channel for framing and one channel for D channel information. Clock rate is 2.048 MHz.

ECAN—echo canceller.

ESF—extended superframe. Framing type used on T1 interfaces that consists of 24 frames of 192 bits each, with the 193rd bit providing timing and other functions. ESF is an enhanced version of the SF format.

FXO—Foreign Exchange Office. A voice interface emulating a PBX trunk line to a switch or telephone equipment to a PBX extension interface.

FXS—Foreign Exchange Station. A voice interface for connecting telephone equipment. Emulates the extension interface of a PBX or the subscriber interface for a switch.

HDLC—High-Level Data Link Control.

NM-HDV—A high-density packet voice trunk network module that support up to two T1/E1 interfaces.

SF—superframe. Common framing type used on T1 interfaces. SF consists of 12 frames of 192 bits each with the 193rd bit providing error checking and other functions. SF is superseded by ESF, but is still widely used. SF is also called D4 framing.

T1—1.544-Mbps serial interface that supports up to 24 64-kbps time slots.

TDM—time-division multiplexing. A method of dividing a serial interface into fixed time slots of fixed bandwidth.

VAD—voice activity detection (silence suppression).

VoIP—Voice over IP. Blanket term that generally denotes a standards-based approach to IP voice traffic.

**Note**

Refer to [Internetworking Terms and Acronyms](#) for terms not included in this glossary.

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