High-Density Analog (FXS/DID/FXO) and Digital (BRI) Extension Module for Voice/Fax (EVM-HD)

The High-Density Analog (FXS/DID/FXO) and Digital (BRI) Extension Module for Voice/Fax (EVM-HD) feature delivers a higher-density integrated analog/digital voice interface. The EVM-HD-8FXS/DID baseboard network module provides eight Foreign Exchange Station (FXS) or direct inward dialing (DID) ports. This network module accesses digital signal processor (DSPs) modules on the motherboard, instead of using onboard DSPs. You can increase the port density by plugging in up to two optional expansion modules in any combination:

- EM-HDA-8FXS—8-port FXS voice/fax expansion module
- EM-HDA-3FXS/4FXO—3-port FXS and 4-port FXO voice/fax expansion module
- EM-HDA-6FXO—6-port FXO voice/fax expansion module
- EM-4BRI-NT/TE—4-port ISDN BRI expansion module

PVDM2 DSP modules are used in combination with the EVM-HD-8FXS/DID baseboard and its expansion modules. PVDM2 modules are available separately and installed in the DSP module slots located inside the router chassis.

Feature History for the High-Density Analog (FXO/FXS/ DID) and Digital (BRI) Extension Module for Voice/Fax (EVM-HD) Feature

Release	Modification
12.3(8)T4	This feature was introduced on the Cisco 2800 series routers.
12.3(11)T	This feature was integrated into Cisco IOS Release 12.3(11)T. Support was added for the Cisco 3800 series routers and the EM-HDA-3FXS/4FXO and EM-HDA-6FXO expansion modules to provide FXO capability.
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.

CISCO SYSTEMS

Corporate Headquarters:
Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134-1706 USA

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.

Contents

Prerequisites for High-Density Analog and Digital Extension Module for Voice/Fax

- Insert the network modules in the correct slots of the router at your installation. For instructions on hardware installation for this feature, refer to the *Cisco Network Modules Hardware Installation Guide*.
- Install DSPs on the baseboard and configure the DSPs with a voice-enabled image of Cisco IOS Release 12.3(8)T4 or 12.3(11)T or a later release.
- The minimum Cisco IOS Release for this feature is Release 12.3(8)T4. For optimum results, use Cisco IOS Release 12.3(11)T2.

Restrictions for High-Density Analog and Digital Extension Module for Voice/Fax

Patch Panel Installation

For the BRI interface port, you must install an appropriate patch panel. Patch panels are generally available from multiple cable and network adapter vendors:

- If you are using the digital voice module EM-4BRI-NT/TE, you may, at your sole discretion, consider using the JPM2194A patch panel from the Black Box Corporation.
- The EVM-HD-8FXS/DID baseboard has an RJ-21 connector. The Black Box JPM2194A patch panel accommodates RJ-11 and RJ-45 combinations possible on Cisco high-density expansion modules, and offers flexibility for expansion module upgrades (either analog or digital).

Note **Mention of non-Cisco products or services is for information purposes only and constitutes neither an endorsement nor a recommendation.**

For more information about the patch panel, see the *Cisco Network Modules Hardware Installation Guide*.

Impedance Coefficient Settings

For EVM-HD-8FXS/DID, adjacent ports 0/1, 2/3, 4/5, and 6/7 share the same impedance-coefficient settings within each pair. This pairing is especially important when you are configuring some ports for DID mode and others for FXS mode. DID installations may require different impedance selections resulting from off-premises loop characteristics.

If you change an impedance setting, a message alerts you to the change.

These impedance settings apply to the baseboard (EVM-HD-8FXS/DID) only—not to EM-HDA-8FXS. Setting the impedance on the EM-HDA-8FXS changes only the impedance for the port being configured.

Cisco CallManager Support

Before you can run the High-Density Analog (FXS/DID/FXO) and Digital (BRI) Extension Module for Voice/Fax (EVM-HD) feature, you must install a voice-enabled image of Cisco IOS Release 12.3(8)T4, Release 12.3(11)T, or a later release.

When the High-Density Analog (FXS/DID/FXO) and Digital (BRI) Extension Module for Voice/Fax (EVM-HD) feature is used in a Cisco CallManager network, Release 4.1.2, Release 4.0.2a SR1, or Release 3.3.5 of Cisco CallManager must be installed.

If this feature is used in a Cisco CallManager Express network, Release 3.1 of Cisco CallManager Express must be installed.

EM-HDA-8FXS Ring Signal Has a Maximum of 46 Vrms for 1 REN

FXS ports on the EM-HDA-8FXS have a ring signal of about 46 Vrms with a 1-REN load. If you increase the voltage by reprogramming the PCM codec filters, a false ring-trip occurs. The SLIC ring-trip detection point is determined by the amount of current flowing into the loop, so an increase in voltage increases the current for a given load. This increase in current causes an undesirable false ring trip at a REN of 1 or 2.

Port Numbering on the EM-HDA-3FXS/4FXO Expansion Module

If your installation includes EM-HDA-3FXS/4FXO expansion modules, note that the port numbering on these modules is not consecutive. One port number is "skipped" in the numbering between the FXO and FXS interfaces. This is important when you are defining the port numbers. Table 1 provides an example port-numbering scheme for FXS and FXO ports on EM-HDA-3FXS/4FXO modules installed in slots EM0 and EM1.

Table 1 Example Port-Numbering Scheme for EM-HDA-3FXS/4FXO

EM0		EM1	
2/0/8	FXS	2/0/16	FXS
2/0/9	FXS	2/0/17	FXS
2/0/10	FXS	2/0/18	FXS
2/0/12	FXO	2/0/20	FXO

Table 1 Example Port-Numbering Scheme for EM-HDA-3FXS/4FXO

EM0		EM1	
2/0/13	FXO	2/0/21	FXO
2/0/14	FXO	2/0/22	FXO
2/0/15	FXO	2/0/23	FXO

Information About High-Density Analog and Digital Extension Module for Voice/Fax

This section provides information about the following:

Key Features

The High-Density Analog and Digital Extension Module for Voice/Fax supports the following:

- Analog FXS, analog Foreign Exchange Office (FXO), DID, and digital BRI S/T NT/TE
- Generic DSPware feature support: silent suppression, tone detection, voice codec
- The following *new* expansion modules:
  - EM-HDA-3FXS/4FXO—3-port FXS and 4-port FXO voice/fax expansion module
  - EM-HDA-6FXO—6-port FXO voice/fax expansion module
  - EM-4BRI-NT/TE—4-port ISDN BRI expansion module
- The *existing* EM-HDA-8FXS expansion module
- G.168 ECAN echo-cancellation support
- Signaling types:
  - FXO and FXS: Ground-start and loop-start
  - DID: Wink-start, immediate-start, and delay-start
- VoX (Voice over Packet) protocol support:
  - VoIP for H.323, Media Gateway Control Protocol (MGCP), Session Initiation Protocol (SIP) as supported by Cisco IOS software
  - VoFR or VoATM as supported by Cisco IOS software
- Channel-bank emulation and cross connect
- Hairpinning:
  - Digital to digital (same card)
  - Analog to digital (same card)
- BRI ports with inline power support

- BRI S/T NT/TE support, clock distribution, synchronization
- REN support: five RENs per port

FXS and FXO Interfaces

An FXS interface connects the router or access server to end-user equipment such as telephones, fax machines, or modems. The FXS interface supplies ring, voltage, and dial tone to the station. An FXO interface is used for trunk, or tie line, connections to a PSTN CO or to a PBX. This interface is of value for off-premises station applications.

FXO and FXS interfaces indicate on-hook or off-hook status and the seizure of telephone lines by one of two access signaling methods: loop-start or ground-start. The type of access signaling is determined by the type of service from the CO; standard home telephone lines use loop-start, but business telephones can use ground-start lines instead.

Loop-start is the more common of the access signaling techniques. When a handset is picked up (the telephone goes off-hook), this action closes the circuit that draws current from the telephone company CO and indicates a change in status, which signals the CO to provide dial tone. An incoming call is signaled from the CO to the handset by a standard on/off pattern signal, which causes the telephone to ring.

For information related to the hardware connections, refer to the hardware documents listed in the "Related Documents" section on page 22.

Network Clock Timing

Voice systems that pass digitized pulse-code modulation (PCM) speech have always relied on the clocking signal being embedded in the received bit stream. This technique 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 keeps 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 eight continuous binary 1s may be interpreted as nine continuous 1s. If this data is then resent to further downstream devices that use varying timing references, the error can be compounded. When you make sure that each device in the network uses the same clocking signal, the integrity of the traffic can be trusted.

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 BRI interface sends traffic inside repeating bit patterns called frames. Each frame is a fixed number of bits. This means that the receiving device knows exactly when to expect the end of a frame simply by counting the bits as they arrive. 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 you can configure Cisco IOS software to control the clocking on these devices, 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 uses its internal clock source to pass traffic across the backplane and other interfaces.

For data applications, this internal clock sourcing generally does not present a problem because 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. 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 uses the external clocking for the received bit stream. However, this bit stream is not necessarily using the same reference as the router backplane, meaning the DSPs can misinterpret the data that is coming in from the controller.

This clocking mismatch is seen on the router's BRI 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, you must change the default clocking behavior through Cisco IOS configuration commands. It is *absolutely critical* to set up the clocking commands properly.

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

network-clock-participate [**slot** *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 and synchronize the onboard clock to the same reference.

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

How to Configure High-Density Analog and Digital Extension Module for Voice/Fax

This section describes how to configure the High-Density Analog (FXS/DID/FXO) and Digital (BRI) Extension Module for Voice/Fax (EVM-HD) feature. It contains the following information:

- Configuring Analog FXS/FXO and DID Voice Ports, page 6
- Configuring ISDN BRI Digital Interfaces, page 13

Configuring Analog FXS/FXO and DID Voice Ports

Perform this task to configure analog FXS/FXO and DID voice ports.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **voice-port** *slot/subunit/port*
4. **shutdown**
5. **signal** {**loopStart** | **groundStart**}

   or

   signal did {**immediate-start** | **wink-start** | **delay-start**}
6. **cptone** *locale*
7. **compand-type** {**u-law** | **a-law**}
8. **input gain** *decibels*
9. **output attenuation** *decibels*
10. **echo-cancel enable**
11. **echo-cancel coverage** {**24** | **32** | **48** | **64**}
12. **timeouts initial** *seconds*
13. **timeouts interdigit** *seconds*
14. **impedance** {**600c** | **600r** | **900c** | **900r** | **complex1** | **complex2**}
15. **ring frequency** {**25** | **50**}
16. **ring cadence** {**pattern01** | **pattern02** | **pattern03** | **pattern04** | **pattern05** | **pattern06** | **pattern07** | **pattern08** | **pattern09** | **pattern10** | **pattern11** | **pattern12** | **define** *pulse interval*}
17. **description** *string*
18. **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.

	Command or Action	Purpose
Step 3	**voice-port** *slot*/*subunit*/*port* **Example:** `Router(config)# voice-port 2/0/0`	Enters voice-port configuration mode. • The arguments are as follows: – *slot*—Specifies the number of the router slot where the voice network module is installed. – *subunit*—Specifies the location of the Cisco High-Density Analog Voice/Fax Network Module (EVM-HD). For this feature, the only valid entry is 0. – *port*—Indicates the voice port. **Note** A slash must be entered between arguments. • Valid entries vary by router platform; enter the **show voice port summary** command for available values.
Step 4	**shutdown** **Example:** `Router(config-voiceport)# shutdown`	Shuts down the specified port so that it is offline when the configuration commands are entered.
Step 5	**signal** {**loopStart** | **groundStart**} or **signal did** (**immediate-start** | **wink-start** | **delay-start**} **Example:** `Router(config-voiceport)# signal groundStart` or `Router(config-voiceport)# signal did immediate-start`	Selects the access signaling type to match that of the telephony connection you are making. • FXS voice ports: – **loopStart**—(default) Uses a closed circuit to indicate off-hook status; used for residential loops. – **groundStart**—Uses ground and current detectors; preferred for PBXs and trunks. or • DID support (applies only to the base voice module). – **immediate-start**—Enables immediate-start signaling on the DID voice port. – **wink-start**—Enables wink-start signaling on the DID voice port. – **delay-start**—Enables delay-start signaling on the DID voice port. • To disable DID and reset to loop-start signaling, use the **no signal did** command.
Step 6	**cptone** *locale* **Example:** `Router(config-voiceport)# cptone au`	Specifies the two-letter locale for the voice-call progress tones and other locale-specific parameters to be used on this voice port. • Cisco routers comply with the ISO 3166 locale name standards. To see valid choices, enter a question mark (**?**) following the **cptone** command. • The default is **us**.

	Command or Action	Purpose
Step 7	**compand-type** {**u-law** | **a-law**} **Example:** `Router(config-voiceport)# compand type u-law`	Specifies the companding standard used. • This command is used in cases when the DSP is not used, such as local cross-connects, and overwrites the compand-type value set by the **cptone** command. • The default for E1 is **a-law**. • The default for T1 is **u-law**. **Note** If you have a Cisco 3660 router, the **compand-type a-law** command must be configured on the analog ports only. The Cisco 2660, 3620, and 3640 routers do not require the **compand-type a-law** command to be configured; however, if you request a list of commands, the **compand-type a-law** command displays.
Step 8	**input gain** *decibels* **Example:** `Router(config-voiceport)# input gain 0`	Configures a specific input gain, in decibels, to be inserted at the receiver side of the interface. • Range is integers from –14 to +6. • The default is 0.
Step 9	**output attenuation** *decibels* **Example:** `Router(config-voiceport)# output attenuation 0`	Configures a specific output attenuation, in decibels, at the transmit side of the interface. • Range is integers from –6 to +14. • The default is 0.
Step 10	**echo-cancel enable** **Example:** `Router(config-voiceport)# echo-cancel enable`	Enables the cancellation of voice that is sent out the interface and received on the same interface.
Step 11	**echo-cancel coverage** {**24** | **32** | **48** | **64**} **Example:** `Router(config-voiceport)# echo-cancel coverage 48`	Adjusts the echo canceller by the specified number of ms. • The default is 64.
Step 12	**timeouts initial** *seconds* **Example:** `Router(config-voiceport)# timeouts initial 5`	Specifies the number of seconds for which the system waits for the caller to input the first digit of the dialed digits. • Range is from 0 to 120. • The default is 10.
Step 13	**timeouts interdigit** *seconds* **Example:** `Router(config-voiceport)# timeouts interdigit 5`	Specifies the number of seconds for which the system will wait (after the caller has input the initial digit) for the caller to input a subsequent digit of the dialed digits. • Range is from 0 to 120. • The default is 10.

	Command or Action	Purpose
Step 14	**impedance** {**600c** | **600r** | **900c** | **900r** | **complex1** | **complex2**} **Example:** `Router(config-voiceport)# impedance complex1`	Specifies the terminating impedance of a voice-port interface for FXS only. Keywords are as follows: • **600c**—600 ohms (complex) • **600r**—600 ohms (real) • **900c**—900 ohms (complex) • **900r**—900 ohms (real) • **complex1**—Complex 1 • **complex2**—Complex 2 The default is 600r. **Note** For EVM-HD-8FXS/DID, adjacent ports 0/1, 2/3, 4/5, and 6/7 share the same impedance coefficient settings within each pair. If you change an impedance setting, a message alerts you to the change. This behavior applies only to EVM-HD-8FXS/DID. It does not apply to EM-HDA-8FXS.
Step 15	**ring frequency** {**25** | **50**} **Example:** `Router(config-voiceport)# ring frequency 50`	(Optional) Selects the ring frequency, in Hz, used on the FXS interface. • The default is 25. • This number must match the connected telephony equipment and may be country-dependent. • If not set properly, the attached telephony device may not ring or it may buzz.
Step 16	**ring cadence** {[**pattern01** | **pattern02** | **pattern03** | **pattern04** | **pattern05** | **pattern06** | **pattern07** | **pattern08** | **pattern09** | **pattern10** | **pattern11** | **pattern12**] | **define** *pulse interval*} **Example:** `Router(config-voiceport)# ring cadence pattern04`	(Optional) Specifies an existing pattern for ring, or defines a new one. • Each pattern specifies a ring-pulse time and a ring-interval time. • The keywords and arguments are as follows: – **pattern01** to **pattern12**—Preset ring cadence patterns. Enter **ring cadence ?** to display ring pattern explanations. – **define** *pulse interval*—User-defined pattern: *pulse* is a number (one or two digits, from 1 to 50) specifying ring pulse (on) time in hundreds of milliseconds, and *interval* is a number (one or two digits from 1 to 50) specifying ring interval (off) time in hundreds of milliseconds. • The default is the pattern specified by the **cptone** locale that has been configured.

	Command or Action	Purpose
Step 17	**description** *string* **Example:** `Router(config-voiceport)# description alpha central`	Attaches a text string to the configuration that describes the connection for this voice port. • *string*—Character string from 1 to 255 characters in length. • The default is no text string (describing the voice port) attached to the configuration.
Step 18	**no shutdown** **Example:** `Router(config-voiceport)# no shutdown`	Activates the voice port. • If a voice port is not being used, shut the voice port down with the **shutdown** command.

Troubleshooting Tips

In some rare instances, if you have installed the EM-HDA-3FXS/4FXO or the EM-HDA-6FXO 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.

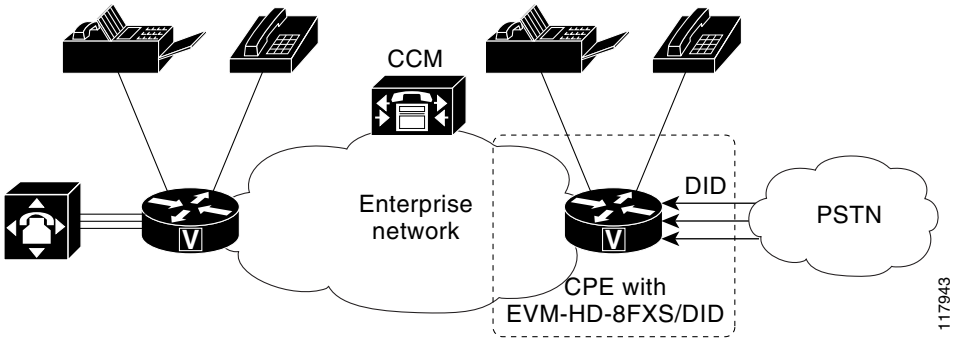
If this problem still occurs, you must enable the **groundstart auto-tip** command in the configuration of the FXO voice port. When you are placing outgoing calls, this ensures that the circuit detects a tip-ground acknowledgment from the far end and completes the connection within the time-out parameter. For information about the **groundstart auto-tip** command, refer to the "groundstart auto-tip" section on page 24.

For more information about this problem, see the document *Troubleshoot Analog FXO GroundStart Outbound Call Failures*. This document is available on Cisco.com.

Examples

This section shows a sample topology (see Figure 1) and configuration for the EVM-HD-8FXS/DID used as an analog DID voice gateway connecting to the PSTN.

Figure 1 Analog DID Voice Gateway Connecting to PSTN for DID Application



The following sample shows the configuration commands used for DID signaling:

```
!
```

```
!
voice-port 2/0/0
  signal did immediate
!
voice-port 2/0/1
!
  signal did wink-start
  timing wait-wink 550 <--  sets max time to wait for wink signaling after outgoing
                              seizure is sent. Default is 550 ms.

  timing wink-wait 200 <--  sets the maximum time to wait before sending wink signal after
                              an incoming seizure is detected. Default is 200 ms.

  timing wink-duration 200 <--  sets duration of wink-start signal. Default is 200 ms.
!
voice-port 2/0/2
!
  signal did delay-dial
  timing delay-duration 200 <--  sets duration of the delay signal. Default is 200 ms.
  timing delay-start 300 <--  sets delay interval after incoming seizure is detected.
Default is 300 ms.

!
```

Output of the show voice port Command: Example

The following output is based on the sample configuration:

```
Router# show voice port 2/0/1

Foreign Exchange Station with Direct Inward Dialing (FXS-DID) 2/0/0 Slot is 2, Sub-unit
is 0, Port is 0
 Type of VoicePort is DID-IN
 Operation State is DORMANT
 Administrative State is UP
 No Interface Down Failure
 Description is not set
 Noise Regeneration is enabled
 Non Linear Processing is enabled
 Music On Hold Threshold is Set to -38 dBm
 In Gain is Set to 0 dB
 Out Attenuation is Set to 0 dB
 Echo Cancellation is enabled
 Echo Cancel Coverage is set to 8 ms
 Playout-delay Mode is set to default
 Playout-delay Nominal is set to 60 ms
 Playout-delay Maximum is set to 200 ms
 Connection Mode is normal
 Connection Number is not set
 Initial Time Out is set to 10 s
 Interdigit Time Out is set to 10 s
 Ringing Time Out is set to 180 s
 Companding Type is u-law
 Region Tone is set for US
Analog Info Follows:
 Currently processing none
 Maintenance Mode Set to None (not in mtc mode)
 Number of signaling protocol errors are 0
 Impedance is set to 600r Ohm
 Wait Release Time Out is 30 s
 Station name None, Station number None
Voice card specific Info Follows:
 Signal Type is wink-start
 Dial Type is dtmf
```

```
In Seizure is inactive
Out Seizure is inactive
Digit Duration Timing is set to 100 ms
InterDigit Duration Timing is set to 100 ms
Pulse Rate Timing is set to 10 pulses/second
InterDigit Pulse Duration Timing is set to 750 ms
Clear Wait Duration Timing is set to 400 ms
Wink Wait Duration Timing is set to 200 ms
Wait Wink Duration Timing is set to 550 ms
Wink Duration Timing is set to 200 ms
Delay Start Timing is set to 300 ms
Delay Duration Timing is set to 2000 ms
Dial Pulse Min. Delay is set to 140 ms
Percent Break of Pulse is 60 percent
Auto Cut-through is disabled
Dialout Delay for immediate start is 300 ms
```

Configuring ISDN BRI Digital Interfaces

To configure the ISDN BRI digital interfaces, perform this task.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **isdn switch-type** *switch-type*
4. **network-clock-participate slot** *slot-number*
5. **network-clock-select** *priority* {**bri** | **t1** | **e1**} *slot*/*port*
6. **interface bri** *slot*/*port*
   or
   interface bri *slot*/*subslot*/*port*
7. **isdn overlap-receiving**
8. **isdn twait-disable**
9. **isdn spid1** *spid-number* [*ldn*]
10. **isdn spid2** *spid-number* [*ldn*]
11. **isdn incoming-voice voice**
12. **shutdown**
13. **isdn layer1-emulate** {**user** | **network**}
14. **line-power**
    or
    no line-power
15. **no shutdown**
16. **isdn protocol-emulate** {**user** | **network**}
17. **isdn sending-complete**
18. **isdn static-tei** *tei-number*
19. **end**

20. **clear interface** *slot/port*

	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	**isdn switch-type** *switch-type* **Example:** `Router(config)# isdn switch-type basic-qsig`	Configures the global ISDN switch type. • Switch types for an NT interface are **basic-net3** and **basic-qsig**.
Step 4	**network-clock-participate slot** *slot-number* **Example:** `Router(config)# network-clock-participate slot 2`	Allows the ports on a specified network module or VWIC to use the network clock for timing. • *slot-number*—the network module slot number on the router chassis.
Step 5	**network-clock-select** *priority* {**bri** | **t1** | **e1**} *slot/port* **Example:** `Router(config)# network-clock-select 1 bri 2/0`	(Optional) Allows backplane TDM PLL circuitry to select recovered timing references from operating digital links according to a defined priority. • The *priority* 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 *slot* argument is the slot number identifying the controller that is the clock source. • The *port* argument is the port number identifying the controller that is the clock source. – The range is from 0 to 7.

Step 6	**interface bri** *slot*/*port* or **interface bri** *slot*/*subslot*/*port* **Example:** `Router(config)# interface bri 2/0` or `Router(config)# interface bri 0/1/0`	Enters interface configuration mode for the specified interface. • *slot*—Identifies the location of the voice network module in the router. • *port*—Identifies the location of the BRI VIC in the voice network module. Range is 0 to 7: – Port 0 to 3 for EM-4BRI installed in EM0. – Port 4 to 7 for EM-4BRI installed in EM1. **Note** For the Cisco 2800 series, there are two kinds of port numbering: *slot*/*port* and *slot*/*subslot*/*port*. The first example shows that the network module is in slot 2. The second example shows that the VIC2-2BRI is in HWIC slot 1. The first 0 means the module is on the motherboard, the 1 means it is in HWIC slot 1, and the last 0 means it is the first BRI interface on VIC2-2BRI.
Step 7	**isdn overlap-receiving** **Example:** `Router(config-if)# isdn overlap-receiving`	(Optional) Activates overlap signaling to send to the destination PBX. • In this mode, the interface waits for possible additional call-control information.
Step 8	**isdn twait-disable** **Example:** `Router(config-if)# isdn twait-disable`	(Optional) Delays a National ISDN BRI switch a random time before activating the Layer 2 interface when the switch starts up. • Use this command when the ISDN switch type is basic-ni1.
Step 9	**isdn spid1** *spid-number* [*ldn*] **Example:** `Router(config-if)# isdn spid1 12`	(Optional) Specifies a SPID and optional local directory number for the B1 channel. **Note** This command applies to TE configuration only. • The *spid-number* argument identifies the service to which you have subscribed. This value is assigned by the ISDN service provider and is usually a 10-digit telephone number with additional digits such as 40855501000101. • (Optional) The *ldn* argument is a seven-digit number assigned by the service provider. You can optionally specify a second and third LDN. • Only the DMS-100 and NI-1 switch types require SPIDs. • Although some switch types might support a SPID, Cisco recommends that you set up ISDN service without SPIDs.

Step 10	**isdn spid2** *spid-number* [*ldn*] **Example:** `Router(config-if)# isdn spid2 13`	(Optional) Specifies a SPID and optional local directory number for the B2 channel. **Note** This command applies to TE configuration only. • The *spid-number* argument identifies the service to which you have subscribed. This value is assigned by the ISDN service provider and is usually a ten-digit telephone number with additional digits such as 40855501000101. • (Optional) The *ldn* argument is a seven-digit number assigned by the service provider. You can optionally specify a second and third LDN.
Step 11	**isdn incoming-voice voice** **Example:** `Router(config-if)# isdn incoming-voice voice`	Configures the port to treat incoming ISDN voice calls as voice calls that are handled by either a modem or a voice DSP, as directed by the call-switching module.
Step 12	**shutdown** **Example:** `Router(config-if)# shutdown`	(Optional) Resets the interface. • Do this before setting the port emulation.
Step 13	**isdn layer1-emulate** {**user** | **network**} **Example:** `Router(config-if)# isdn layer1-emulate network`	(Optional) Configures the Layer-1 port-mode emulation and clock settings. • Enter **user** to configure the port as TE and to function as a clock slave. This is the default. • Enter **network** to configure the port as NT and to function as a clock master.
Step 14	**line-power** or **no line-power** **Example:** `Router(config-if)# line-power` or `Router(config-if)# no line-power`	Turns on or off the power supplied from an NT-configured port to a TE device.
Step 15	**no shutdown** **Example:** `Router(config-if)# no shutdown`	Activates the interface.

Step 16	**isdn protocol-emulate** {**user** | **network**} **Example:** `Router(config-if)# isdn protocol-emulate network`	Configures the Layer 2 and Layer 3 port protocol emulation. Keywords are as follows: • **user**—Configures the port as TE; the PBX is the master. This is the default. • **network**—Configures the port as NT; the PBX is the slave.
Step 17	**isdn sending-complete** **Example:** `Router(config-if)# isdn sending-complete`	(Optional) Configures the voice port to include the Sending Complete information element in the outgoing call setup message. • This command is used in some geographic locations, such as Hong Kong and Taiwan, where the sending complete information element is required in the outgoing call setup message.
Step 18	**isdn static-tei** *tei-number* **Example:** `Router(config-if)# isdn static-tei 33`	(Optional) Configures a static ISDN Layer 2 terminal-endpoint identifier (TEI). The argument is as follows: • *tei-number*—Range is 0 to 64.
Step 19	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode.
Step 20	**clear interface** *slot*/*port* **Example:** `Router# clear interface 2/0`	(Optional) Resets the interface. • The interface needs to be reset if the static TEI number has been configured in Step 18. Arguments are as follows: – *slot*—Location of the voice network module in the router. – *port*—Location of the BRI VIC in the voice network module. Range is from 0 to 7.

Configuration Examples for High-Density Analog and Digital Extension Module for Voice/Fax

This section provides the following configuration examples.

show running-config Command: Example

This example shows the result of a **show running-config** command used with a base voice module (8FXS/DID) and one 4BRI expansion module:

```
Router1# show running-config

isdn switch-type basic-dms100
!
voice-card 0
 no dspfarm
!
interface GigabitEthernet0/0
 ip address 10.0.0.0 255.255.0.0
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface BRI2/0
 no ip address
 isdn switch-type basic-dms100
 isdn incoming-voice voice
!
interface BRI2/1
 no ip address
!
interface BRI2/2
 no ip address
!
interface BRI2/3
 no ip address
!
voice-port 2/0/0
 signal did wink-start
!
voice-port 2/0/1
 signal did wink-start
!
voice-port 2/0/2
 caller-id enable
!
voice-port 2/0/3
 caller-id enable
!
voice-port 2/0/4
 caller-id enable
!
voice-port 2/0/5
 caller-id enable
!
voice-port 2/0/6
 caller-id enable
!
voice-port 2/0/7
 caller-id enable
!
voice-port 2/0/8
!
```

```
voice-port 2/0/9
!
voice-port 2/0/10
!
voice-port 2/0/11
!
voice-port 2/0/17
 caller-id enable
 signal groundStart
!
voice-port 2/0/18
 caller-id enable
!
voice-port 2/0/19
 caller-id enable
!
dial-peer voice 1 pots
 destination-pattern 202
 port 2/0/2
!
dial-peer voice 2 pots
 destination-pattern 203
 port 2/0/3
!
dial-peer voice 3 pots
 destination-pattern 204
 port 2/0/4
!
dial-peer voice 4 pots
 destination-pattern 205
 port 2/0/5
!
dial-peer voice 5 pots
 destination-pattern 206
 port 2/0/6
!
dial-peer voice 6 pots
 destination-pattern 207
 port 2/0/7
!
end
```

show running-config Command: Example with Base Voice Module and Two 4BRI Expansion Modules

This example shows the result of a **show running-config** command used with base voice module (8FXS/DID) and two 4BRI expansion modules. Note that the BRI interfaces are from BRI 2/0 to BRI 2/7, but that the voice ports for those BRIs are from 2/0/8 to 2/0/11 and 2/0/16 to 2/0/19.

```
version 12.3

network-clock-participate slot 2
network-clock-select 1 BRI2/2
network-clock-select 2 BRI2/3
network-clock-select 3 BRI2/4
network-clock-select 4 BRI2/5
network-clock-select 5 BRI2/6
network-clock-select 6 BRI2/7
!
```

```
isdn switch-type basic-net3
voice-card 0
 no dspfarm
!
interface BRI2/0
 no ip address
 isdn switch-type basic-net3
 isdn protocol-emulate network
 isdn layer1-emulate network
 isdn incoming-voice voice
 isdn skipsend-idverify
!
interface BRI2/1
 no ip address
 isdn switch-type basic-net3
 isdn protocol-emulate network
 isdn layer1-emulate network
 isdn incoming-voice voice
 isdn skipsend-idverify
!
interface BRI2/2
 no ip address
 isdn switch-type basic-net3
 isdn incoming-voice voice
!
interface BRI2/3
 no ip address
 isdn switch-type basic-net3
 isdn incoming-voice voice
!
interface BRI2/4
 no ip address
 isdn switch-type basic-net3
 isdn incoming-voice voice
!
interface BRI2/5
 no ip address
 isdn switch-type basic-net3
 isdn incoming-voice voice
!
interface BRI2/6
 no ip address
 isdn switch-type basic-net3
 isdn incoming-voice voice
!
interface BRI2/7
 no ip address
 isdn switch-type basic-net3
 isdn incoming-voice voice
!
voice-port 2/0/0
 cptone IT
!
voice-port 2/0/1
 cptone IT
!
voice-port 2/0/2
 cptone IT
!
voice-port 2/0/3
 cptone IT
!
voice-port 2/0/4
 cptone IT
```

```
!
voice-port 2/0/5
 cptone IT
!
voice-port 2/0/6
 cptone IT
!
voice-port 2/0/7
 cptone IT
!
voice-port 2/0/8
 cptone IT
!
voice-port 2/0/9
 cptone IT
!
voice-port 2/0/10
 cptone IT
!
voice-port 2/0/11
 cptone IT
!
voice-port 2/0/16
 cptone IT
!
voice-port 2/0/17
 cptone IT
!
voice-port 2/0/18
 cptone IT
!
voice-port 2/0/19
 cptone IT
!
dial-peer voice 200 pots
 destination-pattern 200
 port 2/0/0
!
dial-peer voice 201 pots
 destination-pattern 201
 port 2/0/1
!
dial-peer voice 202 pots
 destination-pattern 202
 port 2/0/2
!
dial-peer voice 203 pots
 destination-pattern 203
 port 2/0/3
!
dial-peer voice 204 pots
 destination-pattern 204
 port 2/0/4
!
dial-peer voice 205 pots
 destination-pattern 205
 port 2/0/5
!
dial-peer voice 206 pots
 destination-pattern 206
 port 2/0/6
!
dial-peer voice 207 pots
 destination-pattern 207
```

```
 port 2/0/7
!
end
```

Additional References

The following sections provide references related to the High-Density Analog (FXS/DID/FXO) and Digital (BRI) Extension Module for Voice/Fax 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 command	*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
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

RFCs

RFCs	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	—

MIBs

MIBs	MIBs Link
• CISCO-ENTITY-VENDORTYPE-OID-MIB • OLD-CISCO-CHASSIS-MIB	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 the following modified commands.

- **groundstart auto-tip**
- **network-clock-select**
- **signal**
- **signal did**
- **voice-port**

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. This new command is not supported on the Cisco 1700 series platform.

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.

network-clock-select

To name a source to provide timing for the network clock and to specify the selection priority for this clock source, use the **network-clock-select** command in global configuration mode. To cancel the network clock selection, use the **no** form of this command.

network-clock-select *priority* {**bri** | **t1** | **e1**} *slot/port*

no network-clock-select *priority* {**bri** | **t1** | **e1**} *slot/port*

Syntax Description

priority	Selection priority for the clock source (1 is the highest priority). The clock with the highest priority is selected to drive the system time-division multiplexing (TDM) clocks. When the higher-priority clock source fails, the next-higher-priority clock source is selected. Ranges are as follows: • Cisco 2600 series: 1 to 4 • Cisco 3660: 1 to 8 • Cisco 2800 series: 1 to 8
bri	Slot is configured as BRI.
t1	Slot is configured as T1.
e1	Slot is configured as E1.
slot	Slot number identifying the controller that is the clock source. • Cisco 2600 series or Cisco 2600XM—0 (built-in WIC slot) or 1 (network module slot) • Cisco 3660, Cisco 3725, and Cisco 3745—1 to 6 • Cisco 2800 series—0, 1, or 2
port	Port number identifying the controller that is the clock source. The range is from 0 to 3. For the Cisco 2800 series, the range is from 0 to 7 (for example, BRI interface can be from 2/0 to 2/7).
/ (slash character)	The slash is a required part of the syntax, used to separate the arguments.

Defaults

Cisco 2600 series and Cisco 2600XM

The network clock source is the Advanced Integration Module (AIM) phase-locked loop (PLL) with priority 5, which indicates that the network clock is in free-running mode.

Cisco 3660, Cisco 3725, and Cisco 3745

The network clock source is the backplane PLL with priority 9, which indicates that the network clock is in free-running mode.

Note Default clock values can fall outside the configurable range if they are derived from an external source.

Command Modes

Global configuration

Command History

Release	Modification
11.3 MA	This command was introduced on the Cisco MC3810.
12.0(3)XG	The BVM as a possible network clock source was added.
12.1(5)XM	This command was implemented on the Cisco 3660. The **t1** and **e1** keywords were introduced.
12.2(4)T	This command was integrated into Cisco IOS Release 12.2(4)T.
12.2(2)XB	This command was implemented on the Cisco 2600 series and Cisco 3660 with AIMs installed.
12.2(8)T	This command was integrated into Cisco IOS Release 12.2(8)T.
12.2(15)T	This command was implemented on the Cisco 2600XM, Cisco 2691, Cisco 3725, and Cisco 3745 routers.
12.3(8)T4	This command was integrated into Cisco IOS Release 12.3(8)T4 and the **bri** keyword was added. Support was also added for the Cisco 2800 series routers.
12.3(11)T	This command was integrated into Cisco IOS Release 12.3(11)T and support was also added for the Cisco 3800 series routers.

Usage Guidelines

When an active clock source fails, the system chooses the next-lower-priority clock source specified by this command. When a higher-priority clock becomes available, the system automatically reselects the higher-priority clock source.

Cisco 2600 Series and Cisco 3660

This command is used on Cisco 2600 series and Cisco 2600XM with AIMs installed or on the Cisco 3660 with Multiservice Interchange (MIX) modules installed. This command names a controller to provide clocking signals to the backplane, which then provides the names to all the network modules that participate in network clocking.

Examples

The following example shows how to select the controller in slot 5, port 1, to provide the clock at priority 3:

```
network-clock-select 3 t1 5/1
```

Related Commands

Command	Description
network-clock-participate	Configures a network module to participate in network clocking.
network-clock-switch	Configures the switch delay time to the next-priority network clock source when the current network clock source fails or a higher priority clock source is up and available.
show network-clocks	Displays the network clock configuration and current primary clock source.

signal

To specify the type of signaling for a voice port, use the **signal** command in voice-port configuration mode. To reset to the default, use the **no** form of this command.

signal {**loopStart** | **groundStart**}

no signal {**loopStart** | **groundStart**}

Syntax Description

loopStart	Selects loop-start signaling. Used for FXS interfaces. With loop-start signaling, only one side of a connection can hang up. This is the default setting for FXS voice ports.
groundStart	Selects ground-start signaling. Used for FXS interfaces. Ground-start signaling allows both sides of a connection to place a call and to hang up.

Defaults

Loop-start signaling

Command Modes

Voice-port configuration

Command History

Release	Modification
11.3(1)T	This command was introduced on the Cisco 3600 series.
12.2(11)T	This command was modified to support ANI transmission.

Usage Guidelines

This command applies to analog voice ports only.

Examples

The following example configures ground-start signaling on the Cisco 3600 series as the signaling type for a voice port, which means that both sides of a connection can place a call and hang up:

```
voice-port 1/1/1
 signal groundStart
```

Related Commands

Command	Description
ani mapping	Preprograms the NPA, or area code, into a single MF digit.
voice-port	Enters voice-port configuration mode.

signal did

To enable Direct Inward Dialing (DID) on a voice port, use the **signal did** command in voice-port configuration mode. To disable DID and reset to loop-start signaling, use the **no** form of this command.

signal did {**immediate-start** | **wink-start** | **delay-start**}

no signal did

Syntax Description

immediate-start	Immediate-start signaling on the DID voice port.
wink-start	Wink-start signaling on the DID voice port.
delay-start	Delay-dial signaling on the DID voice port.

Defaults

No default behavior or values

Command Modes

Voice-port configuration

Command History

Release	Modification
12.1(5)XM	This command was introduced on the Cisco 2600 series and Cisco 3600 series.
12.2(8)T	This command was integrated into Cisco IOS Release 12.2(8)T and implemented on the Cisco IAD2420 series.

Examples

The following example configures a voice port with immediate-start signaling enabled:

```
Router# voice-port 1/17
Router (config-voiceport)# signal did immediate-start
```

voice-port

To enter voice-port configuration mode, use the **voice-port** command in global configuration mode.

voice-port *slot-number/subunit-number/port*

Syntax Description

slot-number	Number of the slot in the router in which the EVM is installed.
subunit-number	Number of the subunit on the EVM. On an EVM, this number is always 0.
port	Voice port number. Range is from 0 to 23.
/ (slash character)	The slash is a required part of the syntax, used to separate the arguments.

Defaults

No default behavior or values

Command Modes

Global configuration

Command History

Release	Modification
11.3(1)T	This command was introduced.
11.3(3)T	This command was implemented on the Cisco 2600 series.
12.0(3)T	This command was implemented on the Cisco AS5300.
12.0(7)T	This command was implemented on the Cisco AS5800, Cisco 7200 series, and Cisco 1750. Arguments were added for the Cisco 2600 series and Cisco 3600 series.
12.2(8)T	This command was implemented on Cisco 1751 and Cisco 1760. This command was modified to accommodate the additional ports of the NM-HDA on the Cisco 2600 series, Cisco 3640, and Cisco 3660.
12.2(2)XN	Support for enhanced MGCP voice gateway interoperability was added to Cisco CallManager Version 3.1 for the Cisco 2600 series, Cisco 3600 series, and Cisco VG200.
12.2(11)T	This command was integrated into the Cisco IOS Release 12.2(11)T and Cisco CallManager Version 3.2 and implemented on the Cisco IAD2420 series.
12.2(13)T	This command was integrated into Cisco IOS Release 12.2(13)T.

Usage Guidelines

Use the **voice-port** command to switch to voice-port configuration mode from global configuration mode. Use the **exit** command to exit voice-port configuration mode and return to global configuration mode.

Note This command does not support the extended echo canceller (EC) feature on the Cisco AS5300 or the Cisco AS5800.

Examples

The following example accesses voice-port configuration mode for port 0, located on subunit 0 on an EVM installed in slot 2 of a Cisco 2800 series router:

```
voice-port 2/0/0
```

Related Commands

Command	Description
dial-peer voice	Enters dial-peer configuration mode and specifies the method of voice encapsulation.

Glossary

ATM—Asynchronous Transfer Mode.

BRI—Basic Rate Interface.

codec—coder/decoder—physical analog/digital for voice ports.

DID—direct inward dialing.

DSP—digital signal processor.

DTMF—dual-tone multifrequency. Tones used to send phone number digits to and from a switch. DTMF tones identify the numbers 0 to 9 and the * and # symbols.

ECAN—echo cancellation. A voice-operated device placed in the four-wire portion of the circuit used for reducing near-end echo present on the send path by subtracting an estimation of that echo from the near-end echo. Note that echo cancellation can also be used in an all-digital network.

EM—expansion module.

EVM—enhanced voice module.

FXO—foreign exchange office.

FXS—foreign exchange station. An FXS interface connects directly to a standard telephone, providing basics such as ring voltage and dial tone.

H.323—ITU-T recommendation for visual telephony systems and equipment for LANs that provide a nonguaranteed quality of service.

ISDN—Integrated Services Digital Network.

MGCP—Media Gateway Control Protocol.

REN—ringer-equivalent number.

SIP—Session Initiation Protocol.

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