Cisco 1- and 2-port T1/E1 Multiflex Voice/WAN Interface Cards for the Cisco 1751 and Cisco 1760 Routers

This document describes the Cisco 1- and 2-port T1/E1 multiflex interface cards, and provides instructions on how you can configure these cards. The following sections are included in this document:

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Overview

The Cisco 1- and 2-port T1/E1 multiflex interface cards support generic single- or dual-port T1 or E1 trunk interfaces for voice, data, and integrated voice and/or data applications. These cards provide basic structured T1 service, as well as structured and unstructured E1 services.

The cards can be used as trunk interfaces for voice and/or data services, such as fractional *n* x 64-Kbps service for WANs (Frame Relay or leased line).

See Table 1 for a description of each card.

Table 1 T1/E1 Multiflex Voice/WAN Interface Cards

Description	Name
1-Port RJ-48 Multiflex Trunk, T1/E1	VWIC2-1MFT-T1/E1
2-Port RJ-48 Multiflex Trunk, T1/E1	VWIC2-2MFT-T1/E1
1-Port RJ-48 Multiflex Trunk, E1 G.703	VWIC2-1MFT-G703
2-Port RJ-48 Multiflex Trunk, E1 G.703	VWIC2-2MFT-G703
1-Port RJ-48 Multiflex Trunk, T1/E1 (voice-only)	VIC2-1MFT-T1/E1
2-Port RJ-48 Multiflex Trunk, T1/E1 (voice-only)	VIC2-2MFT-T1/E1

Platform Limitations

The following limitations apply when the Cisco 1- and 2-port T1/E1 multiflex interface cards are installed in Cisco 1751 and Cisco 1760 routers:

- A maximum of 30 voice channels per platform are supported on the routers.
- A maximum of 8 digital signal processors (DSPs) are supported on the Cisco 1751 router.
- A maximum of 10 DSPs are supported on the Cisco 1760 router.

Related Documentation

This document provides updated information on Cisco 1- and 2-port T1/E1 multiflex interface cards and supplements the *Cisco Interface Cards Hardware Installation Guide*.

Use this document with the following guides:

- *Cisco 1751 Router Hardware Installation Guide*
- *Cisco 1760 Modular Access Router Hardware Installation Guide*

- *Cisco Interface Cards Hardware Installation Guide*
- *Clock Configuration for Cisco 1751/1760 Routers*
- *Cisco 1700 Series Router Software Configuration Guide*
- *Cisco IOS Voice, Video, and Fax Configuration Guide, Release 12.2*
- *Cisco IOS Voice, Video, and Fax Command Reference, Release 12.2*
- *Cisco IOS Dial Technologies Configuration Guide, Release 12.2 Signaling Configuration*
- *Regulatory Compliance and Safety Information for Cisco 1600 and Cisco 1700 Routers*

The platform documents for the 1700 series routers are available at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/1700/index.htm

The IOS documents are available at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/index.htm

Software Configuration Information

This section provides pointers to information that is useful for configuring the interface cards.

- T1/E1

  WAN Data Traffic Configuration on Digital T1/E1 Packet Voice Trunk Network Modules

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121limit/121x/121xh/121xh_2/t1e1wan.htm

  Configuring T1/E1 High Capacity Digital Voice Port Adapters

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120xe/120xe5/t1_vo_xe.htm

- G.703

  G.703 Configuration for Multiflex Voice/WAN Interface Cards

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121t/121t1/dtg703.htm

- Clocking

  Clock Configuration for Cisco 1751/1760 Routers

  http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/1700/1700cnts/tdmdesc.htm

- EADI

  T1/E1 Multiflex VWIC Enhancements

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121limit/121x/121xh/121xh_2/dteadi.htm

- T1 Channel-Associated Signaling, drop-and-insert

  Configuring Digital T1 Packet Voice Trunk Network Modules on Cisco 2600 and Cisco 3600 Series Routers

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120t/120t7/t1_vo_t6.htm

Configuring 1- and 2-Port T1/E1 Multiflex Voice/WAN Interface Cards on Cisco 2600 and 3600 Series Routers

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120xk/1205xk/t1_mf_xk.htm

Configuring Voice Ports for Voice over IP

http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121cgcr/multi_c/mcprt1/mcd5voip.htm#xtocid979655

- E1 R2

  E1 R2 and Channel-Associated Signaling Configuration

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121limit/121x/121xh/121xh_2/hdv_r2.htm

- Primary Rate Interface

  Q.931 User-Side and Network-Side Switch Support

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121limit/121x/121xh/121xh_2/hdv_isdn.htm

- QSIG

  QSIG Protocol Support

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120xk/1207xk/qsig_7xk.htm

1-Port Multiflex Trunk Interface Cards

This section describes the following Cisco 1-port multiflex trunk interface cards:

- 1-Port T1/E1 Multiflex Trunk Interface Card (VWIC2-1MFT-T1/E1)
- 1-Port E1 Multiflex Trunk Interface Card with G.703 support (VWIC2-1MFT-G703)
- 1-Port T1/E1 Multiflex Trunk Interface Card with voice-only support (VIC2-1MFT-T1/E1)

The Cisco 1-port T1/E1 multiflex interface cards provide voice and data access to the public switched telephone network (PSTN) domain through time-division multiplexing (TDM) ports. The multiflex trunk interface cards are single-port trunk interfaces for voice, data, and integrated voice and/or data applications. These cards provide basic structured service for T1/E1 networks. The cards include an integrated data service unit/channel service unit (DSU/CSU).

The E1 multiflex VWICs with G.703 support allow unstructured E1 traffic that conforms to the ITU-T G.703 standard.

You can distinguish among multiflex interface cards by looking at the labeling on the faceplates. The interface card type is shown with a label on the bottom left corner of the face plate. Figure 1 shows a sample 1-port multiflex trunk interface card.

Figure 1 1-Port T1/E1 Multiflex Trunk Interface Card (VWIC2-1MFT-T1/E1)

Connecting the 1-Port Multiflex Trunk Interface Card

Follow these steps to connect a 1-port multiflex trunk interface card using a straight-through RJ-48C-to-RJ-48C cable:

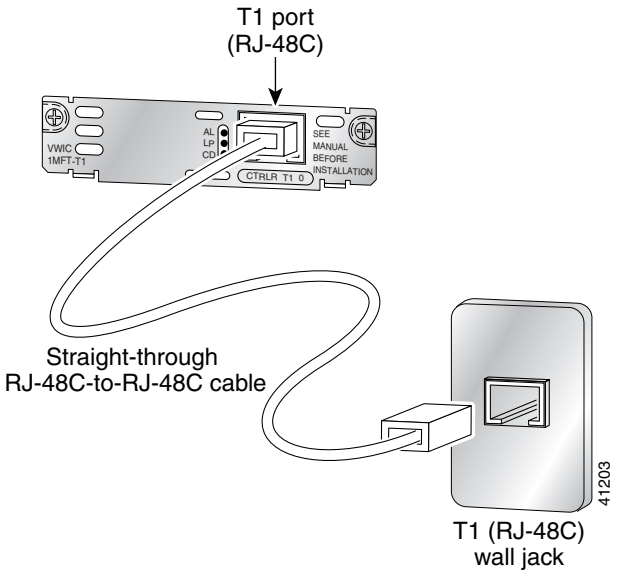
Step 1 Make sure that the router is turned off.

Step 2 Connect one end of the cable to the T1 or E1 port on the card.

Note Shielded cables [STP Cat 5] should be used on E1 ports.

Step 3 Connect the other end of the cable to the T1 or E1 wall jack (RJ-48C) at your site, as shown in Figure 2 on page 5.

Figure 2 Connecting the 1-Port Multiflex Trunk Interface Card to the T1 Wall Jack



Step 4 Turn on power to the router.

Step 5 Check that the CD LED goes on, indicating that the internal DSU/CSU is communicating with the DSU/CSU at the T1 or E1 service provider's central office (CO).

1-Port Multiflex Trunk Interface Card LEDs

The Cisco 1-port T1/E1 multiflex interface cards each have three LEDs, which are described in Table 2.

Table 2 LEDs on 1-Port Multiflex Trunk Interface Card

LED	Description	Color
AL LED	On means that there is a local or remote alarm state. This LED is off during normal operation.	Yellow
LP LED	On means that loopback mode is set remotely or is manually set by the user. This LED is off during normal operation.	Yellow
CD LED	On means that a carrier has been detected and the internal DSU/CSU in the WAN interface card is communicating with another DSU/CSU. This LED is on during normal operation.	Green

2-Port Multiflex Trunk Interface Cards

This section describes the Cisco 2-port T1/E1 multiflex interface cards:

- 2-Port T1/E1 Multiflex Trunk Interface Card (VWIC2-2MFT-T1/E1)
- 2-Port E1 Multiflex Trunk Interface Card with G.703 support (VWIC2-2MFT-G703)
- 2-Port T1/E1 Multiflex Trunk Interface Card with voice-only support (VIC2-2MFT-T1/E1)

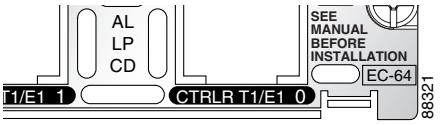
The Cisco 2-port T1/E1 multiflex interface cards provide voice and data access to the PSTN domain through TDM ports. They are dual-port trunk interfaces for voice, data, and integrated voice and/or data applications. These cards provide basic structured service for T1 or E1 networks and unstructured service for fractional E1 networks. The cards include an integrated DSU/CSU. Some cards also support the drop-and-insert process, which adds data to a T1 or E1 data stream, or which terminates data from a T1 or E1 data stream to other devices connected to the drop-and-insert equipment.

The E1 VWICs with G.703 support allow unstructured E1 traffic that conforms to the ITU-T G.703 standard.

You can distinguish among T1 and E1 interface cards by looking at the labeling on the faceplates. The interface card type is shown with a label on the bottom left corner of the face plate. Figure 3 shows a sample 2-port multiflex trunk interface card..

See Figure 3 for a sample 2-port multiflex trunk interface card.

Figure 3 2-Port T1/E1 Multiflex Trunk Interface Card (VWIC2-2MFT-T1/E1)



Connecting the 2-Port Multiflex Trunk Interface Card

Follow these steps to connect a 2-port multiflex trunk interface card using a straight-through RJ-48C-to-RJ-48C cable:

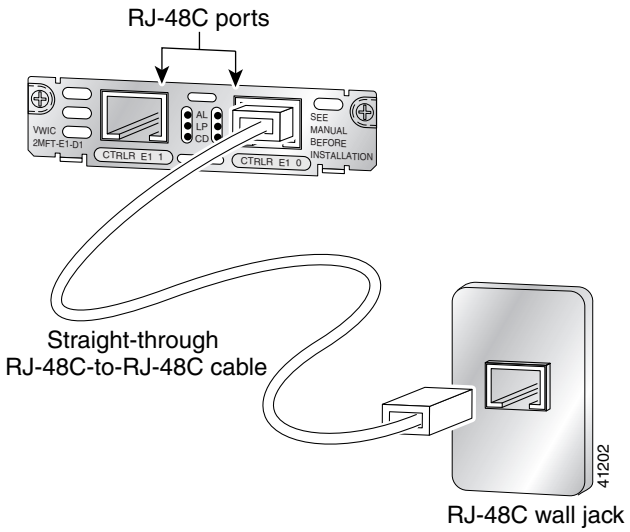
Step 1 Make sure that the router is turned off.

Step 2 Connect one end of the cable to the T1 or E1 port on the card.

Note Shielded cables [STP Cat 5] should be used on E1 ports.

Step 3 Connect the other end to the T1 or E1 wall jack (RJ-48C) at your site, as shown in Figure 4 on page 7.

Figure 4 Connecting the 2-Port Multiflex Trunk Interface Card



Step 4 Turn on power to the router.

Step 5 Check that the CD LED comes on, which means that the internal DSU/CSU is communicating with the DSU/CSU at the T1 or E1 service provider CO.

2-Port Multiflex Trunk Interface Card LEDs

The 2-port multiflex trunk interface cards each have three LEDs, which are described in Table 3.

Table 3 LEDs on the T1/E1 Multiflex Trunk Interface Card

LED	Description	Color
AL LED	On means that there is a local or remote alarm state. This LED is off during normal operation.	Yellow
LP LED	On means that loopback is set remotely or is manually set by the user. This LED is off during normal operation.	Yellow
CD LED	On means that a carrier has been detected and the internal DSU/CSU in the WAN interface card is communicating with another DSU/CSU. This LED is on during normal operation.	Green

Note The following configuration tasks assume that you have properly configured the clock source for the T1/E1 controller. For detailed information about the TDM clock configuration, please refer to the *Clock Configuration for Cisco 1751/1760 Routers* online document. See the "Software Configuration Information" section on page 3 for additional documentation resources.

T1/E1 Data Configuration

The procedures in this section describe how to configure your digital T1/E1 VWIC for WAN data traffic.

For detailed information about configuring voice ports on a Digital T1/E1 Packet Voice Trunk Network Module, refer to the *Configuring Digital T1 Packet Voice Trunk Network Modules on Cisco 2600 and 3600 Series Routers* online document and the *Configuring Digital E1 Packet Voice Trunk Network Modules on Cisco 2600 and 3600 Series Routers* online document. See the "Software Configuration Information" section on page 3 for additional documentation resources.

Repeat the following procedure for each controller:

	Command	Purpose
Step 1	Router#**configure terminal**	Enters global configuration mode. Skip this step if you are already in terminal configuration mode.
Step 2	Router(config)# **card type** {**t1** | **e1**} *subslot*	Sets or changes the card type to support either T1 (t1) or E1 (e1) circuits. • *subslot* Specifies the VWIC slot number. Range can be 0 to 3, depending on host module or platform. • 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.

	Command	Purpose
Step 3	Router(config)#**controller** {**T1** | **E1**} *slot/port*	Enters controller configuration mode for T1 or E1 controller at the *slot/port* location specified. Skip this step if you are already in controller configuration mode.
Step 4	Router(config-controller)#**framing** {**esf** | **sf**} or Router(config-controller)#**framing** {**crc4** | **no-crc4**}	Specifies the framing type designated by your service provider. Extended Superframe (ESF) and Super Frame (SF) are for T1 circuits whereas cyclic redundancy check 4 (CRC4) and NO-CRC4 are for E1 circuits. The default setting for T1 Framing is esf. The default setting for E1 framing is crc4.
Step 5	Router(config-controller)#**linecode** {**ami** | **b8zs**} or Router(config-controller)#**linecode hdb3**	Specifies the line code type designated by your service provider. Alternate mark inversion (AMI) is used on older T1 circuits and references signal transitions with a binary 1, or *mark*. Binary 8 zero substitution (B8ZS), a more reliable method, is more popular; B8ZS is recommended for PRI configurations as well. B8ZS encodes a sequence of eight zeros in a unique binary sequence to detect line-coding violations. High density binary 3 (HDB3) is used on E1 circuits. The default setting for the T1 line code is **b8Zs**.

	Command	Purpose

Step 6	Router(config-controller)# **clock source** {**line** [**primary** | **bits**] | **internal**} [**independent**]	Specifies the clock source:
		• 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** 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.
		– The optional keywords **primary** and **bits** have no effect on this feature.
		• NMSI Mode:
		– The **independent** keyword expands on the **clock source internal** and **clock source line** to specify that the port can operate on an independent clocking domain. Currently, on a 2-port VWIC-MFT, if both ports are configured as **clock source line**, the 2-port is really looped, which means that it's getting the clock from the first port. With NMSI mode, this dependency no longer exists, so the keyword **independent** means that both ports can be independently clocked.
		Note When NMSI mode is configured, the controller will support only one channel-group. If you try to configure more than one channel-group, the following error message will occur:
		`router(config-controller)#channel-group 2 timeslots 3`
		`%Channel-group already created.`
		`%Only 1 channel-group can be configured with independent clocking.`
		`%Insufficient resources to create channel group`
		When configuring between **clock source independent** and **no clock source independent**, the channel-group has to be removed.

	Command	Purpose
Step 7	Router(config-controller)#**channel-group** *channel-group-no* **timeslots** *timeslot-list*	Enter this command to set up channel groups for WAN data services. The *channel-group-no* parameter is a value from 0 to 23 for T1 and from 0 to 30 for E1. The *timeslot-list* parameter is a single number, numbers separated by commas, or a pair of numbers separated by a hyphen to indicate a range of time slots. The valid range is from 1 to 24 for T1. For E1, the range is from 1 to 31. **Note** Only a speed of 64-Kbps is supported on Cisco 1700 series routers.
Step 8	Router(config-controller)#**no shutdown**	Activates the controller.
Step 9	Router(config-controller)#**exit**	Exits configuration mode.
Step 10	Router(config)#**interface serial** *slot/port:channel-group-no*	Enters interface configuration mode for a serial interface that you specify by slot and port. The *channel-group-no* portion of the command is required only for channelized T1 or E1 interfaces.
Step 11	Router(config-if)#**encapsulation** {**atm-dxi** | **frame-relay** | **hdlc** | **lapb** | **ppp** | **smds** | **x25**}	Configures synchronous serial encapsulation. The default encapsulation is hdlc.
Step 12	Router(config-if)#**ip address** *ip-address mask*	Assigns the IP address and subnet mask to the interface.
Step 13	Router(config-if)#**end**	Exits interface configuration mode.

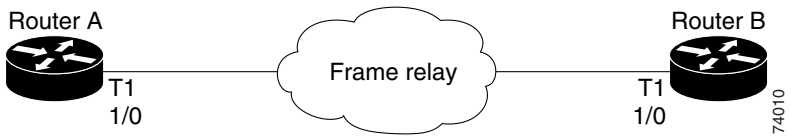
T1/E1 Data Configuration Examples

This section shows an example of a digital T1/E1 VWIC configured for WAN data traffic.

The **channel-group 0** command is configured so that the service provider can send Frame Relay link management information (LMI) on the T1 or E1 controller for Frame Relay data services. This command automatically creates serial interface 1/0:0.

Interface **Serial 1/0:0** is where all the WAN and Layer 3 protocol details are configured; for example, Frame Relay encapsulation or IP addresses. See Figure 5 for a diagram of the examples.

Figure 5 Configuration Example for T1/E1 WAN



T1 Configuration Example

This section shows a T1 configuration example for Router A, a Cisco 1700 series router. (See Figure 5.)

```
card type t1 0
controller T1 1/0
```

```
  framing esf
  linecode b8zs
  channel-group 0 timeslots 1-24
!
interface Serial 1/0:0
  no ip address
  encapsulation frame-relay
  no keepalive
!
interface Serial 1/0:0.1 point-to-point
  ip address 209.165.200.252 255.255.255.224
  frame-relay interface-dlci 100
!
interface FastEthernet0/0
  ip address 209.165.200.250 255.255.255.224
!
router eigrp 1
  network 209.165.200.224
```

This section shows a T1 configuration example for Router B, a Cisco 3600 series router. (See Figure 5.)

```
controller T1 1/0
  framing esf
  linecode b8zs
  channel-group 0 timeslots 1-24 speed 64
!
interface Serial 1/0:0
  no ip address
  encapsulation frame-relay
  no keepalive
!
interface Serial 1/0:0.1 point-to-point
  ip address 209.165.200.253 255.255.255.224
  frame-relay interface-dlci 100
!
interface FastEthernet0/0
  ip address 209.165.201.1 255.255.255.224
!
router eigrp 1
  network 209.165.200.224
  network 209.165.201.0
```

E1 Configuration Example

This section shows an E1 configuration example for Router A, a Cisco 1700 series router. (See Figure 5.)

```
card type e1 0
controller E1 1/0
  framing crc4
  linecode hdb3
  channel-group 0 timeslots 1-31
!
interface Serial 1/0:0
  no ip address
  encapsulation frame-relay
  no keepalive
!
interface Serial 1/0:0.1 point-to-point
  ip address 209.165.200.252 255.255.255.224
  frame-relay interface-dlci 100
!
interface FastEthernet0/0
  ip address 209.165.200.250 255.255.255.224
```

```
!
router eigrp 1
  network 209.165.200.224
```

This section shows an E1 configuration example for Router B, a Cisco 3600 series router. (See Figure 5.)

```
controller E1 1/0
  framing crc4
  linecode hdb3
  channel-group 0 timeslots 1-31
!
interface Serial 1/0:0
  no ip address
  encapsulation frame-relay
  no keepalive
!
interface Serial 1/0:0.1 point-to-point
  ip address 209.165.200.253 255.255.255.224
  frame-relay interface-dlci 100
!
interface FastEthernet0/0
  ip address 209.165.201.1 255.255.255.224
!
router eigrp 1
  network 209.165.200.224
  network 209.165.201.0
```

Verifying Controller Settings

The **show controllers t1/e1** command displays the status of T1 or E1 controllers, clock sources, and other settings for the ports. See the sample output below:

```
Router#show controller t1 1/0
T1 1/0 is up.
  Applique type is Channelized T1
  Cablelength is long gain36 0db
  No alarms detected.
  alarm-trigger is not set
  Version info Firmware: 20011109, FPGA: 15
  Framing is ESF, Line Code is B8ZS, Clock Source is Line.
  Data in current interval (130 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs

Router#show controller e1 1/0
E1 1/0 is up.
  Applique type is Channelized E1 - balanced
  No alarms detected.
  alarm-trigger is not set
  Version info Firmware: 20011109, FPGA: 15
  Framing is CRC4, Line Code is HDB3, Clock Source is Line.
  Data in current interval (17 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
```

Verifying a Serial Interface Configuration

To verify a serial interface configuration, enter the **show interfaces serial** command. This command shows the status of all serial interfaces or of a specific serial interface. You can use this command to check the encapsulation, IP addressing, and other settings. For example:

```
Router#show interfaces serial1/0:0
Serial1/0:0 is up, line protocol is up
  Hardware is DSX1
  MTU 1500 bytes, BW 1536 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation FRAME-RELAY, loopback not set
  Keepalive not set
  FR SVC disabled, LAPF state down
  Broadcast queue 0/64, broadcasts sent/dropped 1/0, interface broadcasts 0
  Last input 00:00:37, output 00:00:19, output hang never
  Last clearing of "show interface" counters 00:00:47
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/1000/64/0 (size/max total/threshold/drops)
     Conversations  0/1/256 (active/max active/max total)
     Reserved Conversations 0/0 (allocated/max allocated)
     Available Bandwidth 1152 kilobits/sec
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     1 packets input, 314 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     1 packets output, 328 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
```

T1 CAS Configuration

The following steps configure your T1 VWIC for channel associated signaling (CAS) voice capability. Skip Step 1 and Step 4 if you are already in controller configuration mode.

For detailed information about configuring voice ports on a Digital T1 Packet Voice Trunk Network Module, see the *Configuring Digital T1 Packet Voice Trunk Network Modules on Cisco 2600 and 3600 Series Routers* online document. See the "Software Configuration Information" section on page 3 for additional documentation resources.

Repeat the following procedure for each controller:

	Command	Purpose
Step 1	Router#**configure terminal**	Enters global configuration mode. Skip this step if you are already in terminal configuration mode.
Step 2	Router(config)#**card type T1** *sub_slot-num*	Defines the card type. This step must be performed during the initial configuration of the VWIC2-1MFT-T1/E1 or the VWIC2-2MFT-T1/E1 before you can gain access to the controller.

	Command	Purpose
Step 3	Router(config)#**tdm clock T1** *slot/port* **both** {**export** | **import**}	Configures the TDM clock for the T1 controller at the *slot/port* location specified. **Note** The payload type for the TDM clock must be configured as **both** to create a pri-group. For detailed information about TDM clock configuration, please refer to the *Clock Configuration for Cisco 1751/1760 Routers* online document.
Step 4	Router(config)#**controller T1** *slot/port*	Enters controller configuration mode for T1 controller at the *slot/port* location specified. Skip this step if you are already in controller configuration mode.
Step 5	Router(config-controller)#**framing** {**esf** | **sf**}	Specifies the framing type designated by your service provider, Extended Superframe (ESF) and Super Frame (SF). The default setting for the T1 framing is **esf**.
Step 6	Router(config-controller)#**linecode** {**ami** | **b8zs**}	Specifies the line code type designated by your service provider. Alternate mark inversion (AMI) is used on older T1 circuits and references signal transitions with a binary 1, or *mark*. Binary 8 zero substitution (B8ZS), a more reliable method, is more popular; B8ZS is recommended for PRI configurations as well. B8ZS encodes a sequence of eight zeros in a unique binary sequence to detect line coding violations. The default setting for the T1 line code is **b8Zs**.

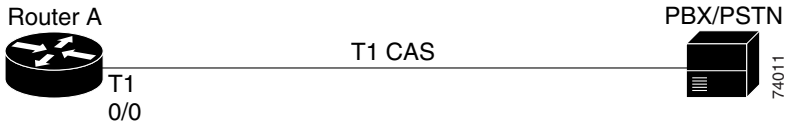
	Command	Purpose
Step 7	Router(config-controller)#**ds0-group** *ds0-group-no* **timeslots** *timeslot-list* [**type** {**e&m-delay-dial** | **e&m-immediate-start** | **e&m-wink-start** | **fxo-ground-start** | **fxo-loop-start** | **fxs-ground-start** | **fxs-loop-start**}]	Defines the T1 channels and the signaling method the router uses to connect to the PBX or CO for use by voice calls. The *ds0-group-no* is a value from 0 to 23 that identifies the DS0 group. The **ds0-group** command automatically creates a logical voice port that is numbered as follows: With the *slot/port:ds0-group-no* parameter, although only one voice port is created, applicable calls are routed to any channel in the group. The *timeslot-list* parameter is a single number, numbers separated by commas, or a pair of numbers separated by a hyphen that indicates a range of time slots. For T1, allowable values are from 1 to 24. To map individual DS0 time slots, define additional groups. The system maps additional voice ports for each defined group. Selection of the signaling method type depends on the connection that you are making. **E&M** allows connection for PBX trunk lines (tie lines) and telephone equipment. The wink and delay settings both specify confirming signals between the transmitting and receiving ends, whereas the immediate setting stipulates no special off-hook/on-hook signals. **FXO** connects a CO to a standard PBX interface, where permitted by local regulations; the interface is often used for off-premises extensions. **FXS** allows the connection of basic telephone equipment and PBXs. Loop-start is a way of signaling that a line is seized by allowing current to flow through the 2 wires (tip and ring) to get dial tone. Ground-start signals that a line is seized by momentarily grounding one of the wires, typically the ring wire. If you do not specify the **type** keyword, the default setting for the time slot **type** is **e&m-wink-start**.
Step 8	Router(config-controller)#**end**	Exits to the privileged EXEC mode.

Note To change or delete the configuration of the ds0-group, you must shut down the voice port, and then use the **no ds0-group** command.

T1 CAS Configuration Example

This section shows a sample configuration for a digital T1 VWIC that connects to a PBX/PSTN using T1 CAS. See Figure 6 for a diagram of the example.

Figure 6 Configuration Example for T1 CAS



This section shows the example configuration for Router A, a Cisco 1700 series router. (See Figure 6.)

```
card type t1 0
controller T1 0/0
  framing esf
  linecode b8zs
  ds0-group 0 timeslots 1-24 type e&m-wink-start
!
voice-port 0/0:0
!
dial-peer voice 408 pots
 description T1 CAS to PBX/PSTN
 destination-pattern 408.....
 port 0/0:0
```

Verifying Controller Settings

The **show controllers t1** command displays the status of T1 controllers and displays information about the ports, as shown in the sample output below:

```
Router#show controller t1 0/0
T1 0/0 is up.
  Applique type is Channelized T1
  Cablelength is long gain36 0db
  No alarms detected.
  alarm-trigger is not set
  Version info Firmware: 20011109, FPGA: 15
  Framing is ESF, Line Code is B8ZS, Clock Source is Line.
  Data in current interval (130 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
```

The **show voice port summary** command displays the status of the voice port:

```
Router#show voice port summary
                                          IN      OUT
PORT    CH    SIG-TYPE    ADMIN OPER STATUS    STATUS    EC
====== == ============ ===== ==== ======== ======== ==
2/0     --   fxs-ls      up    dorm on-hook  idle     y
2/1     --   fxs-ls      up    dorm on-hook  idle     y
0/0:0   01   e&m-wnk     up    dorm idle     idle     y
0/0:0   02   e&m-wnk     up    dorm idle     idle     y
0/0:0   03   e&m-wnk     up    dorm idle     idle     y
0/0:0   04   e&m-wnk     up    dorm idle     idle     y
0/0:0   05   e&m-wnk     up    dorm idle     idle     y
0/0:0   06   e&m-wnk     up    dorm idle     idle     y
0/0:0   07   e&m-wnk     up    dorm idle     idle     y
```

```
0/0:0   08  e&m-wnk     up    dorm idle     idle     y
0/0:0   09  e&m-wnk     up    dorm idle     idle     y
0/0:0   10  e&m-wnk     up    dorm idle     idle     y
0/0:0   11  e&m-wnk     up    dorm idle     idle     y
0/0:0   12  e&m-wnk     up    dorm idle     idle     y
0/0:0   13  e&m-wnk     up    dorm idle     idle     y
0/0:0   14  e&m-wnk     up    dorm idle     idle     y
0/0:0   15  e&m-wnk     up    dorm idle     idle     y
0/0:0   16  e&m-wnk     up    dorm idle     idle     y
0/0:0   17  e&m-wnk     up    dorm idle     idle     y
0/0:0   18  e&m-wnk     up    dorm idle     idle     y
0/0:0   19  e&m-wnk     up    dorm idle     idle     y
0/0:0   20  e&m-wnk     up    dorm idle     idle     y
0/0:0   21  e&m-wnk     up    dorm idle     idle     y
0/0:0   22  e&m-wnk     up    dorm idle     idle     y
0/0:0   23  e&m-wnk     up    dorm idle     idle     y
0/0:0   24  e&m-wnk     up    dorm idle     idle     y
```

T1/E1 Drop-and-Insert Configuration

Drop-and-insert technology is one way to integrate old PBX technologies with Voice over IP (VoIP). Drop-and-insert technology is sometimes called *TDM cross-connect*.

With VoIP, you can digitally cross-connect 64-Kbps DS0 channels on one T1/E1 to 64-Kbps DS0 channels on another T1/E1 within the same slot. With drop-and-insert, individual 64-Kbps DS0 channels can be transparently passed and uncompressed between T1/E1 ports, without passing through a DSP. The channel traffic is sent between a PBX and a CO switch (PSTN) or other telephony device, allowing the use of some PBX channels for long-distance service through the PSTN, while the router compresses other channels for interoffice VoIP calls.

In addition, drop-and-insert can cross-connect a telephony switch (from the CO or PSTN) to a channel bank to provide external analog connectivity.

Note For detailed information about configuring voice ports, see the *Configuring Digital T1 Packet Voice Trunk Network Modules on Cisco 2600 and 3600 Series Routers* online document and the *Configuring Digital E1 Packet Voice Trunk Network Modules on Cisco 2600 and 3600 Series Routers* online document.

See the "Software Configuration Information" section on page 3 for a list of additional documentation.

The following steps configure your T1/E1 VWIC for drop-and-insert capability.

Repeat the following procedure for each controller:

	Command	Purpose
Step 1	Router#**configure terminal**	Enters global configuration mode. Skip this step if you are already in terminal configuration mode.
Step 2	Router(config)# **card type** {**t1** | **e1**} *subslot*	Sets or changes the card type to support either T1 (t1) or E1 (e1) circuits. • *subslot* Specifies the VWIC slot number. Range can be 0 to 3, depending on host module or platform. • 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 3	Router(config)#**controller** {**T1** | **E1**} *slot/port*	Enters controller configuration mode for T1 or E1 controller at the *slot/port* location specified. Skip this step if you are already in controller configuration mode.

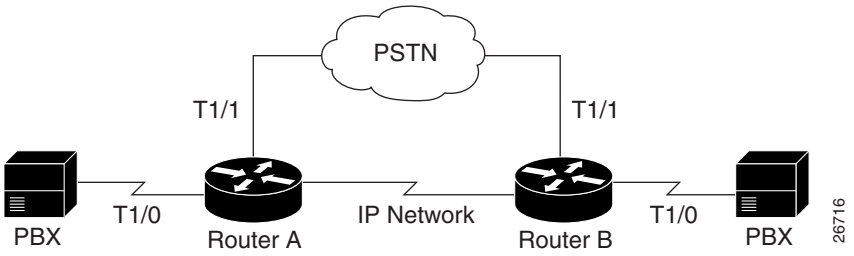
	Command	Purpose
Step 4	Router(config-controller)# **tdm-group** *tdm-group-no* **timeslots** *timeslot-list* [**type** {**e&m** | **fxo** [**ground-start** | **loop-start**] | **fxs** [**ground-start** | **loop-start**]}]	Used only when you need TDM groups for the drop-and-insert (also called *TDM cross-connect*) function with a 2-port T1/E1 trunk multiflex interface card. The *tdm-group-no* parameter is a value from 0 to 23 for T1, and from 0 to 30 for E1. The *timeslot-list* parameter is a single number, numbers separated by commas, or a pair of numbers separated by a hyphen that 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 number of time slots must be the same on both ports for them to be cross-connected. If you do not specify the **type** keyword, the tdm-group can only be used for drop-and-insert clear channel (data). Selection of the signaling method for **type** depends on the connection that you are making. The **fxs** and **fxo** options allow you to specify a ground-start or loop-start line. Loop-start is a way of signaling that a line is seized by allowing current to flow through the 2 wires (tip and ring) to get dial tone. Ground-start signals that a line is seized by momentarily grounding one of the wires, typically the ring wire. **E&M** allows connection for PBX trunk lines (tie lines) and telephone equipment. The wink and delay settings both specify confirming signals between the transmitting and receiving ends, whereas the immediate setting stipulates no special off-hook/on-hook signals. **FXO** connects a CO to a standard PBX interface, where permitted by local regulations; the interface is often used in order for off-premises extensions. **FXS** allows the connection of basic telephone equipment and PBXs. **Note** The group numbers for controller groups must be unique. For example, a TDM group should not have the same ID number as a DS0 group.
Step 5	Router(config-controller)#**no shutdown**	Activates the controller.
Step 6	Router(config-controller)#**exit**	Exits controller configuration mode.

	Command	Purpose
Step 7	Router(config)#**connect** *id* {**T1** | **E1**} *slot/port tdm-group-no-1* {**T1** | **E1**} *slot/port tdm-group-no-2*	This global configuration command sets up the connection between two T1/E1 TDM groups of time slots on the trunk interfaces—for the drop-and-insert capability. The *id* parameter is a name for the connection. Identify each T1/E1 controller by its slot/port location. The *tdm-group-no-1* and *tdm-group-no-2* parameters identify the TDM group numbers (from 1 to 31) on the specified controller. (These groups were set up in Step 4.) **Note** The cross-connection must occur on the same slot, but different ports.
Step 8	Router(config-tdm-conn)#**end**	Exits to privileged EXEC mode.

Drop-and-Insert Configuration Example

This section shows a sample configuration of a digital T1 VWIC that connects to a PBX and PSTN using T1 drop-and-insert. See Figure 7 for a diagram of the example.

Figure 7 Configuration Example for Drop-and-Insert



The following is the configuration for Router A, a Cisco 1700 series router. (See Figure 7.)

```
card type t1 0
controller T1 1/0
  framing esf
  linecode b8zs
  ds0-group 1 timeslots 1-12 type e&m-wink-start
  tdm-group 2 timeslots 13-24 type e&m
!
controller T1 1/1
  framing esf
  linecode b8zs
  tdm-group 3 timeslots 13-24 type e&m
!
voice-port 1/0:1
!
dial-peer voice 1 voip
  destination-pattern 4....
  codec g723r63
  dtmf-relay h245-alphanumeric
  session target ipv4:192.168.100.2
!
```

```
dial-peer voice 2 pots
  destination-pattern 5....
  prefix 5
  port 1/0:1
!
interface Serial 0/0
  encapsulation ppp
  ip address 192.168.100.1 255.255.255.0
!
connect tdm1 T1 1/0 2 T1 1/1 3
```

The following is the configuration for Router B, a Cisco 3600 series router. (See Figure 7.)

```
controller T1 1/0
  framing esf
  linecode b8zs
  ds0-group 1 timeslots 1-12 type e&m-wink-start
  tdm-group 2 timeslots 13-24 type e&m
!
controller T1 1/1
  framing esf
  linecode b8zs
  tdm-group 3 timeslots 13-24 type e&m
!
voice-port 1/0:1
!
dial-peer voice 1 voip
  destination-pattern 5....
  codec g723r63
  dtmf-relay h245-alphanumeric
  session target ipv4:192.168.100.1
!
dial-peer voice 2 pots
  destination-pattern 4....
  prefix 4
  port 1/0:1
!
interface Serial 0/0
  encapsulation ppp
  ip address 192.168.100.2 255.255.255.0
!
connect tdm1 T1 1/0 2 T1 1/1 3
```

Please note the following:

- The **tdm-group 2 timeslots 13-24 type e&m** command defines drop-and-insert capability by setting the time slots from each T1 that will be used in the digital cross-connect.
- If you include the **type** keyword with a signaling type, the drop-and-insert cross-connect ensures that the specified signaling (on-hook and off-hook) is passed between the DS0s. It also uses the signaling bits to signal busyout if one of the T1s goes down.
- If you do not use the **type** keyword, the drop-and-insert cross-connect is clear-channel (data) and does not interpret any signaling.
- The **connect tdm1 T1 1/0 2 T1 1/1 3** command activates the drop-and-insert digital cross-connect between the T1s. The *tdm1* parameter is just a name for the cross-connect, and the name can be any word, any number, or any series of letters.
- The Activity LED does not light when the port is using the drop-and-insert feature.
- You can verify drop-and-insert connections by using the **show connection** command.

Verifying Controller Settings

The **show controllers t1/e1** command displays the status of T1 or E1 controllers and displays information about clock sources for the ports, as shown in the sample output below:

```
Router#show controller t1
T1 1/0 is up.
  Applique type is Channelized T1
  Cablelength is long gain36 0db
  No alarms detected.
  alarm-trigger is not set
  Version info Firmware: 20011109, FPGA: 15
  Framing is ESF, Line Code is B8ZS, Clock Source is Internal.
  Data in current interval (708 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
T1 1/1 is up.
  Applique type is Channelized T1
  Cablelength is long gain36 0db
  No alarms detected.
  alarm-trigger is not set
  Version info Firmware: 20011109, FPGA: 15
  Framing is ESF, Line Code is B8ZS, Clock Source is line.
  Data in current interval (708 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
```

Verifying Drop-and-Insert Configuration

To verify the drop-and-insert configuration, enter the **show connection all** command as shown below:

Router#**show connection all**

```
ID  Name    Segment 1    Segment 2   State
=============================================
1   tdm1    T1 1/0 02    T1 1/1 03   UP
```

T1/E1 PRI Configuration

The following steps configure your T1/E1 VWIC for PRI capability. For detailed information about configuring voice ports for T1/E1 PRI, refer to the *Configuring ISDN Interfaces for Voice* online document. See the "Software Configuration Information" section on page 3 for a list of additional resources.

Note T1/E1 PRI supports only voice calls. Data calls are not supported. The pri-group can only be configured in slot 0 and slot 1.

Repeat the following procedure for each controller:

	Command	Purpose
Step 1	Router#**configure terminal**	Enters global configuration mode. Skip this step if you are already in terminal configuration mode.
Step 2	Router(config)#**card type** {**T1** | **E1**} *sub_slot-num*	Defines the card type. This step must be performed during the initial configuration of the VWIC2-1MFT-T1/E1 or the VWIC2-2MFT-T1/E1 before you can gain access to the controller.
Step 3	Router(config)#**tdm clock** {**T1** | **E1**} *slot/port* **both** {**export** | **import**}	Configures the TDM clock for the T1 or E1 controller at the *slot/port* location specified. **Note** The payload type for the TDM clock must be configured as **both** to create a pri-group. For detailed information about TDM clock configuration, please refer to the *Clock Configuration for Cisco 1751/1760 Routers* online document.
Step 4	Router(config)#**isdn switch-type** *switch-type*	Select a service provider switch type that accommodates the PRI. The switch types are as follows: • *primary-4ess* Lucent 4ESS switch type for the U.S. • *primary-5ess* Lucent 5ESS switch type for the U.S. • *primary-dms100* Northern Telecom DMS-100 switch type for the U.S. • *primary-net5* NET5 switch type for UK, Europe, Asia, and Australia • *primary-ni* National ISDN Switch type for the U.S. • *primary-ntt* NTT switch type for Japan • *primary-qsig* QSIG switch type
Step 5	Router(config)#**controller** {**T1** | **E1**} *slot/port*	Enters controller configuration mode for T1 or E1 controller at the specified *slot/port* location. Skip this step if you are already in controller configuration mode.
Step 6	Router(config-controller)#**framing** {**esf** | **sf**} or Router(config-controller)#**framing** {**crc4** | **no-crc4**}	Specifies the framing type designated by your service provider. Extended Superframe (ESF) and Super Frame (SF) are for T1 circuits, whereas cyclic redundancy check 4 (CRC4) and NO-CRC4 are for E1 circuits. The default setting for T1 framing is **esf**. The default setting for E1 framing is **crc4**.

	Command	Purpose
Step 7	Router(config-controller)#**linecode** {**ami** | **b8zs**} or Router(config-controller)#**linecode hdb3**	Specifies the line code type designated by your service provider. Alternate mark inversion (AMI) is used on older T1 circuits and references signal transitions with a binary 1, or *mark*. Binary 8 zero substitution (B8ZS), a more reliable method, is more popular; B8ZS is recommended for PRI configurations as well. B8ZS encodes a sequence of eight zeros in a unique binary sequence to detect line-coding violations. The default setting for T1 line code is **b8zs**. High density binary 3 (HDB3) is used on E1 circuits.
Step 8	Router(config-controller)#**pri-group timeslots** *range*	Configures the PRI group for either T1 or E1 to carry voice traffic. For T1, available time slots are from 1 to 24 (with time slot 24 used for D-channel signaling). For E1, the available time slots are from 1 to 31 (with time slot 16 used for D-channel signaling). You can configure the PRI group to include all the time slots available, or you can configure a select group of time slots for the PRI group. For example, if only time slots 1 through 10 are in the PRI group, enter *pri-group timeslots 1-10*. If the PRI group includes all the channels available for T1 (channels 1 through 24), enter *pri-group timeslots 1-24*. If the PRI group includes all channels available for E1 (channels 1 through 31), enter *pri-group timeslots 1-31*. When a PRI group is configured, T1 time slot 24 or E1 time slot 16 is automatically assigned to handle D-channel signaling.
Step 9	Router(config-controller)#**interface serial** *slot/port:n*	Specifies the D-channel interface. For *n*, the D-channel number, use: • *slot/port*:**23** on a T1 PRI • *slot/port*:**15** on an E1 PRI
Step 10	Router(config-if)#**isdn switch-type** {**primary-4ess** | **primary-5ess** | **primary-dms100** | **primary-net5** | **primary-ni** | **primary-ntt** | **primary-qsig** | **primary-ts014**}	Selects a service provider switch type that accommodates PRI. This will override the ISDN switch type in the global configuration mode for this interface. **Note** Only **primary-net5**, **primary-qsig**, and **primary-ni** switch types support network side configuration.

	Command	Purpose
Step 11	Router(config-if)#**isdn protocol-emulate** {**user** | **network**}	Configures the Layer 2 and Layer 3 port protocol emulation as appropriate. Enter **user** to configure the port as a slave. This is the default setting. Enter **network** to configure the port as a master. **Note**
Step 12	Router(config-if)#**no shutdown**	Activates the interface.
Step 13	Router(config-if)#**end**	Exits to the privileged EXEC mode.

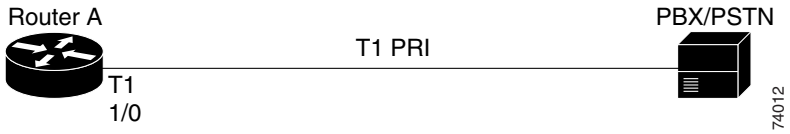
Please note the following caveats:

- NFAS (Non-Facility Associated Signaling) is not supported on Cisco 1700 series routers.
- If you create a pri-group and there are insufficient DSPs, you are still allowed to create all the time slots, but some of the voice ports are not created. Therefore, calls cannot be placed on those channels. You must remove those time slots or mark them as out of service by using the **isdn service b_chan <channel> state 2** command on the serial interface.

T1/E1 PRI Configuration Example

This section shows a sample configuration for a digital T1 VWIC that connects to a PBX/PSTN using T1 PRI. See Figure 8 for a diagram of the example.

Figure 8 Configuration Example: T1 PRI



The following is the configuration for Router A, a Cisco 1700 series router. (See Figure 8.)

```
tdm clock T1 1/0 both export line
!
isdn switch-type primary-ni
!
controller T1 1/0
 framing esf
 linecode b8zs
 pri-group timeslots 1-24
!
interface Serial1/0:23
 no ip address
 no logging event link-status
 isdn switch-type primary-ni
 isdn T321 0 isdn T306 30000
!
voice-port 3/0
!
voice-port 3/1
!
```

```
voice-port 1/0:23
!
dial-peer voice 1 pots
 destination-pattern 130
 port 3/0
!
dial-peer voice 2 pots
 destination-pattern 131
 port 3/1
!
dial-peer voice 13 pots
 destination-pattern 2..
 port 1/0:23
 forward-digits all
```

Verifying the PRI Configuration

To display information about the switch type and ISDN status, use the **show controller**, **show serial**, **show isdn status**, **show isdn service**, and **show voice port summary** commands, as shown in the sample output below:

```
RouterA#show controller t1 1/0
T1 1/0 is up.
  Applique type is Channelized T1
  Cablelength is long gain36 0db
  No alarms detected.
  alarm-trigger is not set
  Version info Firmware: 20011109, FPGA: 15
  Framing is ESF, Line Code is B8ZS, Clock Source is Line.
  Data in current interval (122 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs


RouterA#show interface serial 1/0:23
Serial1/0:23 is up, line protocol is up (spoofing)
  Hardware is DSX1
  MTU 1500 bytes, BW 64 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set
  Last input 00:00:25, output 00:00:25, output hang never
  Last clearing of "show interface" counters 00:02:06
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/1000/64/0 (size/max total/threshold/drops)
     Conversations  0/1/256 (active/max active/max total)
     Reserved Conversations 0/0 (allocated/max allocated)
     Available Bandwidth 48 kilobits/sec
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     4 packets input, 16 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     4 packets output, 16 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
```

```
RouterA#show isdn status
Global ISDN Switchtype = primary-ni
ISDN Serial1/0:23 interface
        dsl 0, interface ISDN Switchtype = primary-ni
    Layer 1 Status:
        ACTIVE
    Layer 2 Status:
        TEI = 0, Ces = 1, SAPI = 0, State = MULTIPLE_FRAME_ESTABLISHED
    Layer 3 Status:
        0 Active Layer 3 Call(s)
    Active dsl 0 CCBs = 0
    The Free Channel Mask:  0x807FFFFF
    Number of L2 Discards = 0, L2 Session ID = 1
    Total Allocated ISDN CCBs = 0


RouterA#show isdn service
PRI Channel Statistics:
ISDN Se1/0:23, Channel [1-24]
  Configured Isdn Interface (dsl) 0
   Channel State (0=Idle 1=Proposed 2=Busy 3=Reserved 4=Restart 5=Maint_Pend)
    Channel :  1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4
    State   :  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 3
   Service State (0=Inservice 1=Maint 2=Outofservice)
    Channel :  1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4
    State   :  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2


RouterA#show voice port summary
                                          IN       OUT
PORT      CH   SIG-TYPE   ADMIN OPER STATUS   STATUS   EC
========= == ============ ===== ==== ======== ======== ==
1/0:23    01  isdn-voice  up    dorm none     none     y
1/0:23    02  isdn-voice  up    dorm none     none     y
1/0:23    03  isdn-voice  up    dorm none     none     y
1/0:23    04  isdn-voice  up    dorm none     none     y
1/0:23    05  isdn-voice  up    dorm none     none     y
1/0:23    06  isdn-voice  up    dorm none     none     y
1/0:23    07  isdn-voice  up    dorm none     none     y
1/0:23    08  isdn-voice  up    dorm none     none     y
1/0:23    09  isdn-voice  up    dorm none     none     y
1/0:23    10  isdn-voice  up    dorm none     none     y
1/0:23    11  isdn-voice  up    dorm none     none     y
1/0:23    12  isdn-voice  up    dorm none     none     y
1/0:23    13  isdn-voice  up    dorm none     none     y
1/0:23    14  isdn-voice  up    dorm none     none     y
1/0:23    15  isdn-voice  up    dorm none     none     y
1/0:23    16  isdn-voice  up    dorm none     none     y
1/0:23    17  isdn-voice  up    dorm none     none     y
1/0:23    18  isdn-voice  up    dorm none     none     y
1/0:23    19  isdn-voice  up    dorm none     none     y
1/0:23    20  isdn-voice  up    dorm none     none     y
1/0:23    21  isdn-voice  up    dorm none     none     y
1/0:23    22  isdn-voice  up    dorm none     none     y
1/0:23    23  isdn-voice  up    dorm none     none     y
```

T1/E1 QSIG Configuration

This section shows a sample configuration of a digital E1 VWIC that the router connects to a PBX or PSTN using E1 QSIG. For detailed information about configuring voice ports for T1/E1 QSIG, refer to the *Configuring ISDN Interfaces for Voice* online document. See the "Software Configuration Information" section on page 3 for a list of additional resources.

Repeat the following procedure for each controller:

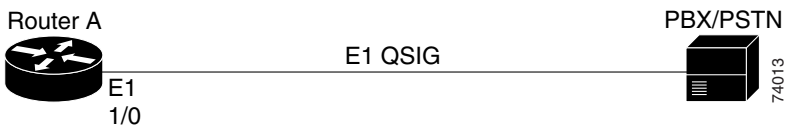
	Command	Purpose
Step 1	Router#**configure terminal**	Enters global configuration mode. Skip this step if you are already in terminal configuration mode.
Step 2	Router(config)#**card type** {**T1** | **E1**} *sub_slot-num*	Defines the card type. This step must be performed during the initial configuration of the VWIC2-1MFT-T1/E1 or the VWIC2-2MFT-T1/E1 before you can gain access to the controller.
Step 3	Router(config)#**tdm clock** {**T1** | **E1**} *slot/port* **both** {**export** | **import**}	Configures the TDM clock for T1 or E1 controller at the *slot/port* location specified. **Note** The payload type for the TDM clock must be configured as **both** in order to create a pri-group. For detailed information about TDM clock configuration, please refer to the *Clock Configuration for Cisco 1751/1760 Routers* online document.
Step 4	Router(config)#**isdn switch-type primary-qsig**	Configures the ISDN switch type to support QSIG signaling.
Step 5	Router(config)#**controller** {**T1** | **E1**} *slot/port*	Enters controller configuration mode for T1 or E1 controller at the specified *slot/port* location. Skip this step if you are already in controller configuration mode.
Step 6	Router(config-controller)#**framing** {**esf** | **sf**} or Router(config-controller)#**framing** {**crc4** | **no-crc4**}	Specifies the framing type designated by your service provider. Extended Superframe (ESF) and Super Frame (SF) are for T1 circuits, whereas cyclic redundancy check 4 (CRC4) and NO-CRC4 are for E1 circuits. The default setting for T1 framing is **esf**. The default setting for E1 framing is **crc4**.
Step 7	Router(config-controller)#**linecode** {**ami** | **b8zs**} or Router(config-controller)#**linecode hdb3**	Specifies the line code type designated by your service provider. Alternate mark inversion (AMI) is used on older T1 circuits and references signal transitions with a binary 1, or *mark*. Binary 8 zero substitution (B8ZS), a more reliable method, is more popular; B8ZS is recommended for PRI configurations as well. B8ZS encodes a sequence of eight zeros in a unique binary sequence to detect line-coding violations. The default setting for T1 linecode is **b8zs**. High density binary 3 (HDB3) is used on E1 circuits.

	Command	Purpose
Step 8	Router(config-controller)#**pri-group timeslots** *range*	Configures the PRI group for either T1 or E1 to carry voice traffic. For T1, the available time slots are from 1 to 24 (with time slot 24 used for D-channel signaling). For E1, the available time slots are from 1 to 31 (with time slot 16 used for D-channel signaling). You can configure the PRI group to include all the time slots available, or you can configure a select group of time slots for the PRI group. For example, if only time slots 1 through 10 are in the PRI group, enter *pri-group timeslots 1-10*. If the PRI group includes all the channels available for T1 (channels 1 through 24), enter *pri-group timeslots 1-24*. If the PRI group includes all channels available for E1 (channels 1 through 31), enter *pri-group timeslots 1-31*. When a PRI group is configured, T1 time slot 24 or E1 time slot 16 is automatically assigned to handle D-channel signaling.
Step 9	Router(config-controller)#**no shutdown**	Activates the controller.
Step 10	Router(config-controller)#**interface serial** *slot/port:n*	Specify the D-channel interface. For *n*, the D-channel number, use: • *slot/port*:**23** on a T1 QSIG • *slot/port*:**15** on an E1 QSIG
Step 11	Router(config-if)#**isdn switch-type primary-qsig**	Configures the ISDN switch type to support QSIG signaling. This overrides the switch type in the global configuration mode.
Step 12	Router(config-if)#**isdn protocol-emulate** {**user** | **network**}	Configures the Layer 2 and Layer 3 port protocol emulation. Enter **user** to configure the port as a slave. This is the default setting. Enter **network** to configure the port as a master.
Step 13	Router(config-if)#**no shutdown**	Activates the interface.
Step 14	Router(config-if)#**end**	Exits to the privileged EXEC mode.

T1/E1 QSIG Configuration Example

This section shows a sample configuration of a digital E1 VWIC that the router connects back-to-back to a PBX or PSTN using E1 QSIG. See Figure 9 for a diagram of the example.

Figure 9 Configuration Example: E1 QSIG



The following is an example configuration for Router A, a Cisco 1700 series router. (See Figure 9.)

```
tdm clock E1 1/0 both export line
!
 isdn switch-type primary-qsig
!
controller E1 1/0
 pri-group timeslots 1-31
!
interface Serial1/0:15
 no ip address
 no logging event link-status
 isdn switch-type primary-qsig
 isdn incoming-voice voice
 no isdn T309-enable
 isdn bchan-number-order ascending
 no cdp enable
!
dial-peer voice 1 pots
 destination-pattern 1...
 port 1/0:15
```

Verifying T1/E1 QSIG Configurations

To see information about the switch type and the ISDN status, enter the **show isdn** {**service** | **status**} command. See the "Verifying the PRI Configuration" section on page 27 for more information.

E1 R2 Signaling Configuration

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

Many countries and regions have their own E1 R2 variant specifications, which supplement the International Telecommunications Union (ITU-T) Q.400-Q.490 recommendation for R2 signaling. Unique E1 R2 signaling parameters for specific countries and regions are set by issuing the **cas-custom channel-no** command followed by the **country name** command.

Cisco's implementation of R2 signaling has dialed number identification service (DNIS) support turned on by default. If you enable the **ani** option, the DNIS information is still collected. Specifying the **ani** option does not disable DNIS collection. DNIS is the number being called. ANI is the number from which the call is placed. For example, if you are configuring router A to call router B, the DNIS number is assigned to router B, and the ANI number is assigned to router A. ANI is similar to caller ID.

Repeat the following procedure for each E1 controller:

	Command	Purpose
Step 1	Router#**configure terminal**	Enters global configuration mode. Skip this step if you are already in terminal configuration mode.
Step 2	Router(config)#**card type** {**T1** | **E1**} *sub_slot-num*	Defines the card type. This step must be performed during the initial configurationbefore you can gain access to the controller.

	Command	Purpose
Step 3	Router(config)#**controller E1** *slot/port*	Enters controller configuration mode for E1 controller at the specified *slot/port* location. Skip this step if you are already in controller configuration mode.
Step 4	Router(config-controller)#**ds0-group** *ds0-group-no* **timeslots** *timeslot-list* **type** *signal-type*	Configures R2 channel-associated signaling on the E1 controller. Replace the *signal-type* variable with any of the following choices for R2 analog, R2 digital, or R2 pulse: **r2-analog** [**dtmf** | **r2-compelled** | **r2-non-compelled** | **r2-semi-compelled**] or **r2-digital** [**dtmf** | **r2-compelled** | **r2-non-compelled** | **r2-semi-compelled**] or **r2-pulse** [**dtmf** | **r2-compelled** | **r2-non-compelled** | **r2-semi-compelled**] **timeslots (1-31)**
Step 5	Router(config-controller)#**cas-custom** *channel-no*	Enters cas-custom mode. In this mode, you can localize E1 R2 signaling parameters, such as specific R2 country settings for Hong Kong. The *channel-no* parameter specifies a single channel group number, which can be from 0 through 30. For the customization to take effect, the channel number used in the **cas-custom** command must match the channel number specified by the **ds0-group** command.
Step 6	Router(config-ctrl-cas)#**framing** {**crc4** | **no-crc4**}	Specifies the framing type designated by your service provider. Cyclic redundancy check 4 (CRC4) and NO-CRC4 are for E1 circuits. The default setting for E1 framing is **crc4**.
Step 7	Router(config-ctrl-cas)#**linecode hdb3**	Specifies the line code type designated by your service provider. High density binary 3 (HDB3) is used on E1 circuits.
Step 8	Router(config-ctrl-cas)#**no shutdown**	Activates the controller.
Step 9	Router(config-ctrl-cas)#**country** *name* **use-defaults**	Specifies the local country, region, or corporation to use with R2 signaling. Replaces the *name* variable with one of the supported country names. Cisco strongly recommends that you include the **use-defaults** option, which engages the default settings for a specific country. The default setting for all countries is ITU.

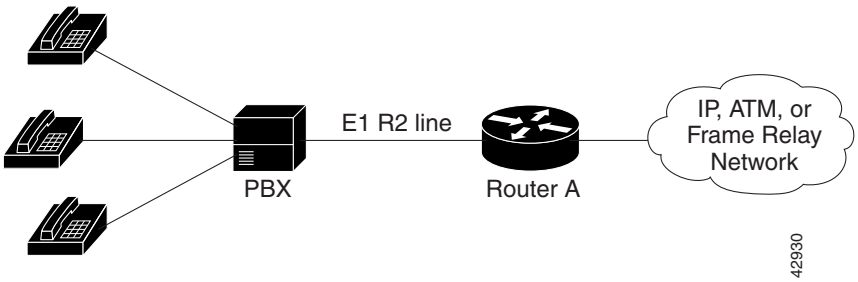
	Command	Purpose
Step 10	Router(config-ctrl-cas)#**ani-digits** Router(config-ctrl-cas)#**answer-signal** Router(config-ctrl-cas)#**caller-digits** Router(config-ctrl-cas)#**category** Router(config-ctrl-cas)#**default** Router(config-ctrl-cas)#**dnis-digits** Router(config-ctrl-cas)#**invert-abcd** Router(config-ctrl-cas)#**ka** Router(config-ctrl-cas)#**kd** Router(config-ctrl-cas)#**metering** Router(config-ctrl-cas)#**nc-congestion** Router(config-ctrl-cas)#**unused-abcd** Router(config-ctrl-cas)#**request-category** Router(config-ctrl-cas)#**ani-timeout** Router(config-ctrl-cas)#**answer-guard-time** Router(config-ctrl-cas)#**dnls-complete** Router(config-ctrl-cas)#**groupa-calledid-end**	(Optional) Further customizes the R2 signaling parameters. Some switch types require you to fine tune your R2 settings. Do not change these parameters unless you understand your switch requirements. For nearly all network scenarios, the **country** *name* **use-defaults** command configures your country's local settings. You should not need to perform this step.

Note To change or delete the configuration of the ds0-group, you must shut down the voice port, and then use the **no ds0-group** command.

E1 R2 Signaling Configuration Example

This section shows an example of an E1 R2 signaling configuration. See Figure 10 for a diagram of the example.

Figure 10 Configuration Example: E1 R2



The following is an example configuration for Router A, a Cisco 1700 series router. (See Figure 10.)

```
controller E1 1/0
ds0-group 0 timeslots 1-31 type r2-digital r2-compelled ani
 cas-custom 0
  country australia use-defaults
!
voice-port 1/0:0
 cptone AU
!
dial-peer voice 250 pots
 destination-pattern 25..
 direct-inward-dial
 port 1/0:0
 prefix 25
```

Verifying E1 R2 Signaling Configuration

The **show voice port** command displays the status of the voice port configured for E1 R2 signaling, as shown in the sample output below:

```
Router#show voice port 1/0:0
R2 Slot is 1, Sub-unit is 0, Port is 0
 Type of VoicePort is R2
 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
 Non Linear Mute is disabled
 Non Linear Threshold is -21 dB
 Music On Hold Threshold is Set to -38 dBm
 In Gain is Set to 0 dB
 Out Attenuation is Set to 3 dB
 Echo Cancellation is enabled
 Echo Cancellation NLP mute is disabled
 Echo Cancellation NLP threshold is -21 dB
 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
 Playout-delay Minimum mode is set to default, value 40 ms
 Playout-delay Fax is set to 300 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
 Call Disconnect Time Out is set to 60 s
 Ringing Time Out is set to 180 s
 Wait Release Time Out is set to 30 s
 Companding Type is A-law
 Rx  A bit no conditioning set
 Rx  B bit no conditioning set
 Rx  C bit no conditioning set
 Rx  D bit no conditioning set
 Tx  A bit no conditioning set
 Tx  B bit no conditioning set
 Tx  C bit no conditioning set
 Tx  D bit no conditioning set
 Region Tone is set for AU
 Station name None, Station number None
```

```
Voice card specific Info Follows:
Line Signalling Type is r2-digital
Register Signalling Type is r2-compelled
Country setting is australia
Answer Signal is group-b 6
Category is set to 1
NC Congestion is set to 4
KA is set to 0
KD is set to 0
Caller Digits is set to 1
Request Category is set to 0
End of DNIS is set to False
DNIS Digits min is 0 and max is 0
ANI Digits min is 0 and max is 0
Group A Callerid End is set to False
Metering is off
Release Ack is set to False
Unused ABCD Bits Mask configured: 0 0 0 0
Inverting ABCD Bits Mask configured: 0 0 0 0
Debounce Time is set to 40ms
Release Guard Time is set to 2000ms
Seizure Ack Time is set to 100ms
Answer Guard Time is set to 0ms
ANI Timeout is set to 0s

DS0 channel specific status info:
                                    IN      OUT
   PORT   CH  SIG-TYPE    OPER STATUS   STATUS    TIP     RING
   1/0:0  01  r2-digital  dorm idle     idle
   1/0:0  02  r2-digital  dorm idle     idle
   1/0:0  03  r2-digital  dorm idle     idle
   1/0:0  04  r2-digital  dorm idle     idle
   1/0:0  05  r2-digital  dorm idle     idle
   1/0:0  06  r2-digital  dorm idle     idle
   1/0:0  07  r2-digital  dorm idle     idle
   1/0:0  08  r2-digital  dorm idle     idle
   1/0:0  09  r2-digital  dorm idle     idle
   1/0:0  10  r2-digital  dorm idle     idle
   1/0:0  11  r2-digital  dorm idle     idle
   1/0:0  12  r2-digital  dorm idle     idle
   1/0:0  13  r2-digital  dorm idle     idle
   1/0:0  14  r2-digital  dorm idle     idle
   1/0:0  15  r2-digital  dorm idle     idle
   1/0:0  17  r2-digital  dorm idle     idle
   1/0:0  18  r2-digital  dorm idle     idle
   1/0:0  19  r2-digital  dorm idle     idle
   1/0:0  20  r2-digital  dorm idle     idle
   1/0:0  21  r2-digital  dorm idle     idle
   1/0:0  22  r2-digital  dorm idle     idle
   1/0:0  23  r2-digital  dorm idle     idle
   1/0:0  24  r2-digital  dorm idle     idle
   1/0:0  25  r2-digital  dorm idle     idle
   1/0:0  26  r2-digital  dorm idle     idle
   1/0:0  27  r2-digital  dorm idle     idle
   1/0:0  28  r2-digital  dorm idle     idle
   1/0:0  29  r2-digital  dorm idle     idle
   1/0:0  30  r2-digital  dorm idle     idle
   1/0:0  31  r2-digital  dorm idle     idle
```

E1 G.703 Unstructured Configuration

The following steps configure your E1 G.703 VWIC for unstructured G.703 capability.

For detailed information about configuring unstructured service for E1 networks, see the *G.703 Configuration for Multiflex Voice/WAN Interface Cards on Cisco 2600 and 3600 Series Routers* online document. See the "Software Configuration Information" section on page 3 for additional resources.

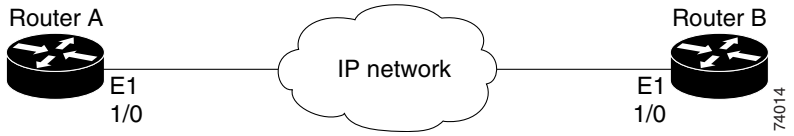
Repeat the following procedure for each E1 controller:

	Command	Purpose
Step 1	Router#**configure terminal**	Enters global configuration mode. Skip this step if you are already in terminal configuration mode.
Step 2	Router(config)# **card type e1** *subslot*	Sets or changes the card type to support E1 circuits. • *subslot* Specifies the VWIC slot number. Range can be 0 to 3, depending on host module or platform. • 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 3	Router(config)#**controller E1** *slot/port*	Enters controller configuration mode for E1 controller at the specified *slot/port* location. Skip this step if you are already in controller configuration mode.
Step 4	Router(config-controller)#**channel-group** *channel-group-no* **unframed**	Enter this command to set up channel groups for unframed WAN data services with an MFT-G703 interface card. The *channel-group-no* parameter is a value from 0 to 30 for E1. Specify **unframed** for G.703 support.
Step 5	Router(config-controller)#**no shutdown**	Activates the controller.
Step 6	Router(config-controller)#**exit**	Exits controller configuration mode.
Step 7	Router(config)#**interface serial** *slot/port:channel-group-no*	Enters interface configuration mode for a serial interface that you specify by slot and port. The *channel-group-no* portion of the command is required only for channelized E1 interfaces.
Step 8	Router(config-if)#**ip address** *ip-address mask*	Assigns the IP address and subnet mask to the interface.
Step 9	Router(config-if)#**end**	Exits to the privileged EXEC mode.

E1 G.703 Configuration Example

This section shows a sample configuration of an E1 G.703. See Figure 11 for a diagram of the example.

Figure 11 Configuration Example: E1 G.703



The following is the configuration for Router A, a Cisco 1700 series router. (See Figure 11.)

```
card type e1 0
controller E1 1/0
 channel-group 0 unframed
!
interface Serial 1/0:0
  ip address 209.165.200.252 255.255.255.224
```

The following is the configuration for Router B, a Cisco 3600 series router:

```
controller E1 1/0
 channel-group 0 unframed
!
interface Serial 1/0:0
  ip address 209.165.200.253 255.255.255.224
```

Verifying Controller Settings

The **show controllers e1** command displays the status of E1 controllers and displays information about clock sources for the ports, as shown in the sample output below:

```
Router#show controller e1 1/0
E1 1/0 is up.
  Applique type is Channelized E1 - balanced
  No alarms detected.
  alarm-trigger is not set
  Version info Firmware: 20011109, FPGA: 15
  Framing is UNFRAMED, Line Code is HDB3, Clock Source is Line.
  Data in current interval (48 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
```

Verifying a Serial Interface Configuration

To verify a serial interface configuration, enter the **show interfaces serial** command, which shows the status of all serial interfaces or the status of a specific serial interface. You can use this command to check the encapsulation, IP addressing, and other parameters:

```
Router#show interfaces serial1/0:0
Serial1/0:0 is up, line protocol is up
  Hardware is DSX1
  Internet address is 209.165.200.252/27
  MTU 1500 bytes, BW 2048 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set
```

```
Keepalive set (10 sec)
Last input 00:00:01, output 00:00:03, output hang never
Last clearing of "show interface" counters 00:00:25
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: weighted fair
Output queue: 0/1000/64/0 (size/max total/threshold/drops)
   Conversations  0/1/256 (active/max active/max total)
   Reserved Conversations 0/0 (allocated/max allocated)
   Available Bandwidth 1536 kilobits/sec
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
   4 packets input, 400 bytes, 0 no buffer
   Received 4 broadcasts, 0 runts, 0 giants, 0 throttles
   0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
   3 packets output, 72 bytes, 0 underruns
   0 output errors, 0 collisions, 0 interface resets
   0 output buffer failures, 0 output buffers swapped out
   0 carrier transitions
```

Q.931 User-Side and Network-Side Switch Support

Cisco platforms support Q.931 user- and network-side switch types for ISDN call processing. User-side PRI enables the Cisco platform to provide a standard ISDN PRI user-side interface to the PSTN. Network-side PRI enables the Cisco platform to provide a standard Digital T1/E1 Packet voice Trunk Network Module.

For a description of the commands used to configure VoIP, refer to the “Voice-Related Commands” chapter in the *Multiservice Applications Command Reference*. For complete VoIP configuration instructions, refer to the Cisco IOS Release 12.1 *Multiservice Applications Configuration Guide*.

Configuring Switch Types for ISDN PRI Q.931 Support

The QSIG protocol provides signaling for Private Integrated services Network Exchange (PINX) devices. It is based on the ISDN Q.931 standard. Using QSIG PRI signaling, the router can route incoming voice calls from a PINX across a WAN to a peer router, which can then transport the signaling and voice packets to a second PINX.

To configure QSI signaling support, complete the following steps beginning in global configuration mode:

Configuring Protocol Emulation for ISDN PRI Support

Routers and PBXs are traditionally customer premises equipment (CPE) with respect to the PSTN interfaces. For VoIP applications, it is desirable to interface access servers to PBXs with the access server representing the PSTN.

This feature enables the access server to provide a standard ISDN PRI network-side and user-side interface to the PBXs and to mimic the behavior of legacy phone switches. To a PBX, the access server functions as a Net5 PRI switch. No change in PBX capability or behavior is required.

To configure ISDN PRI network-side and user-side support, complete the following steps beginning in global configuration mode:

Configuration Example

The example below shows how a Cisco 1700 series router can be configured for E1 and PRI with network-side support using VoIP. All commands used with this feature are documented in the IOS command references. The **isdn protocol-emulate** command was revised in Cisco IOS Release 12.1 for configuration of Q.931 PRI signaling.

The following example shows a router configuration for ISDN PRI signaling:

```
1760_r1#sho run
Building configuration...

Current configuration : 1590 bytes
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname 1760_r1
!
memory-size iomem 25
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
tdm clock E1 1/0 both export line
tdm clock T1 0/0 both import E1 1/0 internal
ip subnet-zero
!
isdn switch-type primary-net5
!
controller T1 0/0
 framing esf
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 0/1
 framing esf
 linecode b8zs
!
controller E1 1/0
 pri-group timeslots 1-31
!
controller E1 1/1
!
interface FastEthernet0/0
 no ip address
 shutdown
 speed auto
!
interface Serial0/0:23
 no ip address
 no logging event link-status
 isdn switch-type primary-ni
 isdn protocol-emulate network
 isdn incoming-voice voice
 isdn T310 30000
 no cdp enable
!
interface Serial1/0:15
 no ip address
 no logging event link-status
```

```
 isdn switch-type primary-net5
 isdn overlap-receiving
 isdn protocol-emulate network
 isdn incoming-voice voice
 no cdp enable
!
ip classless
no ip http server
ip pim bidir-enable
!
call rsvp-sync
!
voice-port 0/0:23
!
voice-port 2/0
!
voice-port 2/1
!
voice-port 1/0:15
!
dial-peer cor custom
!
dial-peer voice 1 pots
 destination-pattern 100
 port 2/0
!
dial-peer voice 2 pots
 destination-pattern 101
 port 2/1
!
dial-peer voice 3 pots
 destination-pattern 2..
 direct-inward-dial
 port 1/0:15
 forward-digits all
!
dial-peer voice 4 pots
 destination-pattern 3..
 direct-inward-dial
 port 0/0:23
 forward-digits all
!
line con 0
 exec-timeout 0 0
line aux 0
line vty 0 4
 login
!
end
```

Obtaining Documentation

Cisco documentation and additional literature are available on Cisco.com. Cisco also provides several ways to obtain technical assistance and other technical resources. These sections explain how to obtain technical information from Cisco Systems.

Cisco.com

You can access the most current Cisco documentation at this URL:

http://www.cisco.com/univercd/home/home.htm

You can access the Cisco website at this URL:

http://www.cisco.com

You can access international Cisco websites at this URL:

http://www.cisco.com/public/countries_languages.shtml

Documentation DVD

Cisco documentation and additional literature are available in a Documentation DVD package, which may have shipped with your product. The Documentation DVD is updated regularly and may be more current than printed documentation. The Documentation DVD package is available as a single unit.

Registered Cisco.com users (Cisco direct customers) can order a Cisco Documentation DVD (product number DOC-DOCDVD=) from the Ordering tool or Cisco Marketplace.

Cisco Ordering tool:

http://www.cisco.com/en/US/partner/ordering/

Cisco Marketplace:

http://www.cisco.com/go/marketplace/

Ordering Documentation

You can find instructions for ordering documentation at this URL:

http://www.cisco.com/univercd/cc/td/doc/es_inpck/pdi.htm

You can order Cisco documentation in these ways:

- Registered Cisco.com users (Cisco direct customers) can order Cisco product documentation from the Ordering tool:

  http://www.cisco.com/en/US/partner/ordering/

- Nonregistered Cisco.com users can order documentation through a local account representative by calling Cisco Systems Corporate Headquarters (California, USA) at 408 526-7208 or, elsewhere in North America, by calling 1 800 553-NETS (6387).

Documentation Feedback

You can send comments about technical documentation to bug-doc@cisco.com.

You can submit comments by using the response card (if present) behind the front cover of your document or by writing to the following address:

Cisco Systems
Attn: Customer Document Ordering
170 West Tasman Drive
San Jose, CA 95134-9883

We appreciate your comments.

Cisco Product Security Overview

Cisco provides a free online Security Vulnerability Policy portal at this URL:

http://www.cisco.com/en/US/products/products_security_vulnerability_policy.html

From this site, you can perform these tasks:

- Report security vulnerabilities in Cisco products.
- Obtain assistance with security incidents that involve Cisco products.
- Register to receive security information from Cisco.

A current list of security advisories and notices for Cisco products is available at this URL:

http://www.cisco.com/go/psirt

If you prefer to see advisories and notices as they are updated in real time, you can access a Product Security Incident Response Team Really Simple Syndication (PSIRT RSS) feed from this URL:

http://www.cisco.com/en/US/products/products_psirt_rss_feed.html

Reporting Security Problems in Cisco Products

Cisco is committed to delivering secure products. We test our products internally before we release them, and we strive to correct all vulnerabilities quickly. If you think that you might have identified a vulnerability in a Cisco product, contact PSIRT:

- Emergencies—security-alert@cisco.com
- Nonemergencies—psirt@cisco.com

Tip We encourage you to use Pretty Good Privacy (PGP) or a compatible product to encrypt any sensitive information that you send to Cisco. PSIRT can work from encrypted information that is compatible with PGP versions 2.*x* through 8.*x*.

Never use a revoked or an expired encryption key. The correct public key to use in your correspondence with PSIRT is the one that has the most recent creation date in this public key server list:

http://pgp.mit.edu:11371/pks/lookup?search=psirt%40cisco.com&op=index&exact=on

In an emergency, you can also reach PSIRT by telephone:

- 1 877 228-7302
- 1 408 525-6532

Obtaining Technical Assistance

For all customers, partners, resellers, and distributors who hold valid Cisco service contracts, Cisco Technical Support provides 24-hour-a-day, award-winning technical assistance. The Cisco Technical Support Website on Cisco.com features extensive online support resources. In addition, Cisco Technical Assistance Center (TAC) engineers provide telephone support. If you do not hold a valid Cisco service contract, contact your reseller.

Cisco Technical Support Website

The Cisco Technical Support Website provides online documents and tools for troubleshooting and resolving technical issues with Cisco products and technologies. The website is available 24 hours a day, 365 days a year, at this URL:

http://www.cisco.com/techsupport

Access to all tools on the Cisco Technical Support Website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a user ID or password, you can register at this URL:

http://tools.cisco.com/RPF/register/register.do

Note Use the Cisco Product Identification (CPI) tool to locate your product serial number before submitting a web or phone request for service. You can access the CPI tool from the Cisco Technical Support Website by clicking the **Tools & Resources** link under Documentation & Tools. Choose **Cisco Product Identification Tool** from the Alphabetical Index drop-down list, or click the **Cisco Product Identification Tool** link under Alerts & RMAs. The CPI tool offers three search options: by product ID or model name; by tree view; or for certain products, by copying and pasting **show** command output. Search results show an illustration of your product with the serial number label location highlighted. Locate the serial number label on your product and record the information before placing a service call.

Submitting a Service Request

Using the online TAC Service Request Tool is the fastest way to open S3 and S4 service requests. (S3 and S4 service requests are those in which your network is minimally impaired or for which you require product information.) After you describe your situation, the TAC Service Request Tool provides recommended solutions. If your issue is not resolved using the recommended resources, your service request is assigned to a Cisco TAC engineer. The TAC Service Request Tool is located at this URL:

http://www.cisco.com/techsupport/servicerequest

For S1 or S2 service requests or if you do not have Internet access, contact the Cisco TAC by telephone. (S1 or S2 service requests are those in which your production network is down or severely degraded.) Cisco TAC engineers are assigned immediately to S1 and S2 service requests to help keep your business operations running smoothly.

To open a service request by telephone, use one of the following numbers:

Asia-Pacific: +61 2 8446 7411 (Australia: 1 800 805 227)
EMEA: +32 2 704 55 55
USA: 1 800 553-2447

For a complete list of Cisco TAC contacts, go to this URL:

http://www.cisco.com/techsupport/contacts

Definitions of Service Request Severity

To ensure that all service requests are reported in a standard format, Cisco has established severity definitions.

Severity 1 (S1)—Your network is "down," or there is a critical impact to your business operations. You and Cisco will commit all necessary resources around the clock to resolve the situation.

Severity 2 (S2)—Operation of an existing network is severely degraded, or significant aspects of your business operation are negatively affected by inadequate performance of Cisco products. You and Cisco will commit full-time resources during normal business hours to resolve the situation.

Severity 3 (S3)—Operational performance of your network is impaired, but most business operations remain functional. You and Cisco will commit resources during normal business hours to restore service to satisfactory levels.

Severity 4 (S4)—You require information or assistance with Cisco product capabilities, installation, or configuration. There is little or no effect on your business operations.

Obtaining Additional Publications and Information

Information about Cisco products, technologies, and network solutions is available from various online and printed sources.

- Cisco Marketplace provides a variety of Cisco books, reference guides, and logo merchandise. Visit Cisco Marketplace, the company store, at this URL:

  http://www.cisco.com/go/marketplace/

- *Cisco Press* publishes a wide range of general networking, training and certification titles. Both new and experienced users will benefit from these publications. For current Cisco Press titles and other information, go to Cisco Press at this URL:

  http://www.ciscopress.com

- *Packet* magazine is the Cisco Systems technical user magazine for maximizing Internet and networking investments. Each quarter, Packet delivers coverage of the latest industry trends, technology breakthroughs, and Cisco products and solutions, as well as network deployment and troubleshooting tips, configuration examples, customer case studies, certification and training information, and links to scores of in-depth online resources. You can access Packet magazine at this URL:

  http://www.cisco.com/packet

- *iQ Magazine* is the quarterly publication from Cisco Systems designed to help growing companies learn how they can use technology to increase revenue, streamline their business, and expand services. The publication identifies the challenges facing these companies and the technologies to help solve them, using real-world case studies and business strategies to help readers make sound technology investment decisions. You can access iQ Magazine at this URL:

  http://www.cisco.com/go/iqmagazine

- *Internet Protocol Journal* is a quarterly journal published by Cisco Systems for engineering professionals involved in designing, developing, and operating public and private internets and intranets. You can access the Internet Protocol Journal at this URL:

  http://www.cisco.com/ipj

- World-class networking training is available from Cisco. You can view current offerings at this URL:

  http://www.cisco.com/en/US/learning/index.html

This document is to be used in conjunction with the documents listed in the "Related Documentation" section.