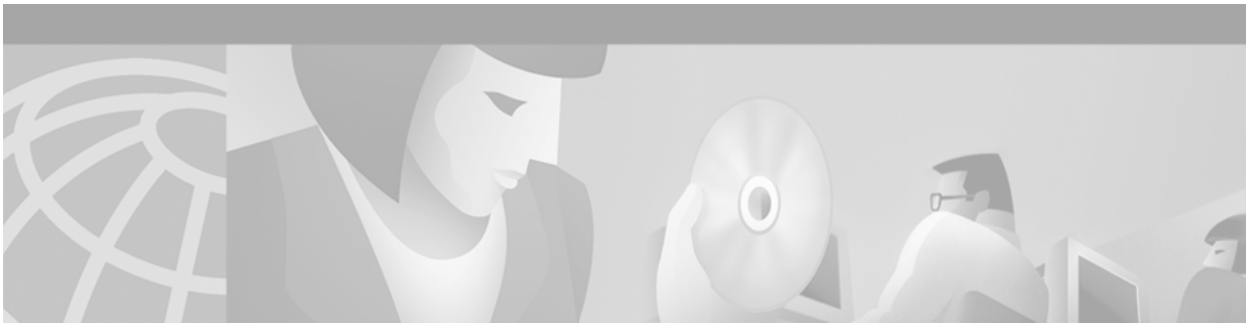


Cisco 1- and 2-port T1/E1 Multiflex Voice/WAN Interface Cards for the Cisco 1751 and Cisco 1760 Routers

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/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/data services, such as fractional *n* x 64-Kbps service for WANs (Frame Relay or leased line).

Table 1 describes and names each card.

Table 1 T1/E1 Multiflex Voice/WAN Interface Cards

Description	Name
1-Port RJ-48 Multiflex Trunk, T1	VWIC-1MFT-T1
2-Port RJ-48 Multiflex Trunk, T1	VWIC-2MFT-T1
2-Port RJ-48 Multiflex Trunk, T1 with Drop-and-Insert	VWIC-2MFT-T1-DI
1-Port RJ-48 Multiflex Trunk, E1	VWIC-1MFT-E1
2-Port RJ-48 Multiflex Trunk, E1	VWIC-2MFT-E1
2-Port RJ-48 Multiflex Trunk, E1 with Drop-and-Insert	VWIC-2MFT-E1-DI
1-Port RJ-48 Multiflex Trunk, E1 G.703	VWIC-1MFT-G703
2-Port RJ-48 Multiflex Trunk, E1 G.703	VWIC-2MFT-G703

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

Platform Limitations

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

- The routers support a maximum of 30 voice channels per platform.
- The Cisco 1751 router supports a maximum of 8 digital signal processors (DSPs).
- The Cisco 1760 router supports a maximum of 10 DSPs.

Related Documentation

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

Use this document with the following guides:

- *Cisco 1700 Router Hardware Installation Guide*
- *Cisco Interface Cards Hardware Installation Guide*
- *TDM Clock Configuration for Cisco 1700 Series Routers*
- *Cisco 1700 Series Router Software Configuration Guide*
- Cisco IOS Release 12.2 *Voice, Video, and FAX Configuration Guide*
- Cisco IOS Release 12.2 *Voice, Video, and FAX Command Reference*
- Cisco IOS Release 12.2 *Dial Services Configuration Guide: Signaling Configuration*
- *Regulatory Compliance and Safety Information for Cisco 1600 and Cisco 1700 Routers*

The platform documents 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/

Software Configuration Information

This section provides pointers to information useful for configuring the interface card.

- 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

  TDM Clock Configuration for Cisco 1700 Series Routers

  http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/1700/index.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 Cisco 1-port multiflex trunk interface cards:

- 1-Port T1 Multiflex Trunk Interface Card (VWIC-1MFT-T1)
- 1-Port E1 Multiflex Trunk Interface Card (VWIC-1MFT-E1)
- 1-Port E1 Multiflex Trunk Interface Card with G.703 support (VWIC-1MFT-G703)

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 generic single-port trunk interfaces for voice, data, and integrated voice/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 T1 and E1 interface cards by looking at the labeling on the faceplates, as shown in Figure 1 through Figure 3.

Figure 1 1-Port T1 Multiflex Trunk Interface Card (VWIC-1MFT-T1)

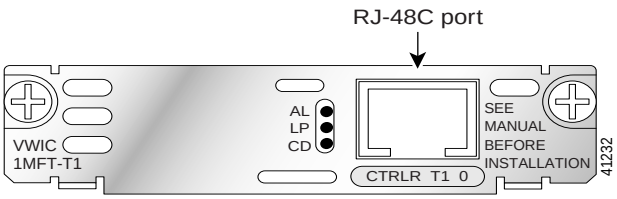


Figure 2 1-Port E1 Multiflex Trunk Interface Card (VWIC-1MFT-E1)

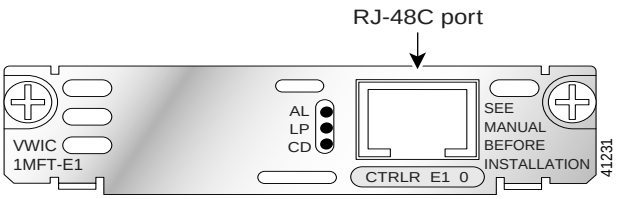
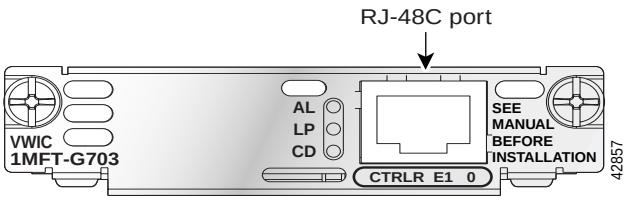


Figure 3 1-Port E1 Multiflex Trunk Interface Card with G.703 Support (VWIC-1MFT-G703)



Connecting the 1-Port Multiflex Trunk Interface Card

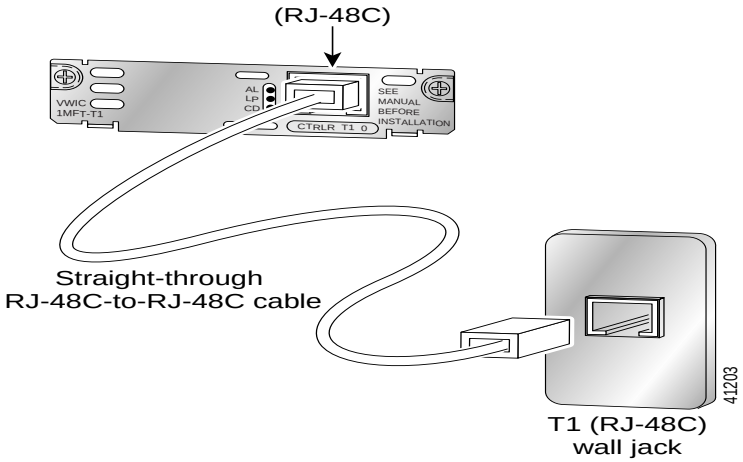
For this connection, use a straight-through RJ-48C-to-RJ-48C cable.

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. (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 4.

Figure 4 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 Cisco 2-port T1/E1 multiflex interface cards:

- 2-Port T1 Multiflex Trunk Interface Card (VWIC-2MFT-T1)
- 2-Port E1 Multiflex Trunk Interface Card (VWIC-2MFT-E1)
- 2-Port T1 Multiflex Trunk Interface Card with drop-and-insert (VWIC-2MFT-T1-DI)
- 2-Port E1 Multiflex Trunk Interface Card with drop-and-insert (VWIC-2MFT-E1-DI)
- 2-Port E1 Multiflex Trunk Interface Card with G.703 Support (VWIC-2MFT-G703)

Cisco 2-port T1/E1 multiflex interface cards provide voice and data access to the PSTN domain through TDM ports. They are generic dual-port trunk interfaces for voice, data, and integrated voice/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, as shown in Figure 5 through Figure 9.

Figure 5 2-Port T1 Multiflex Trunk Interface Card (VWIC-2MFT-T1)

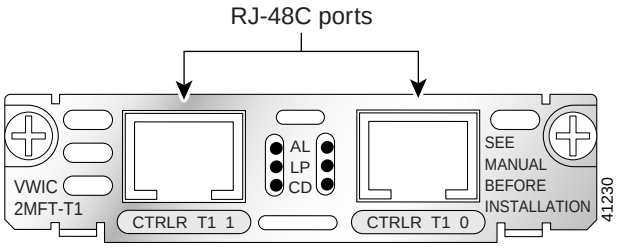


Figure 6 2-Port E1 Multiflex Trunk Interface Card (VWIC-2MFT-E1)

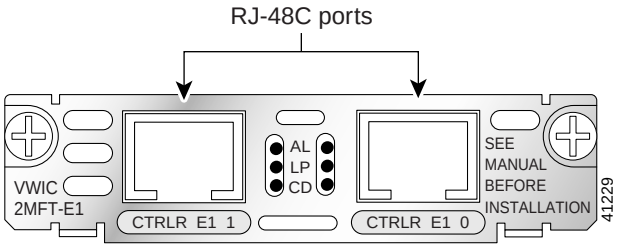


Figure 7 2-Port T1 Multiflex Trunk Interface Card with Drop-and-Insert (VWIC-2MFT-T1-DI)

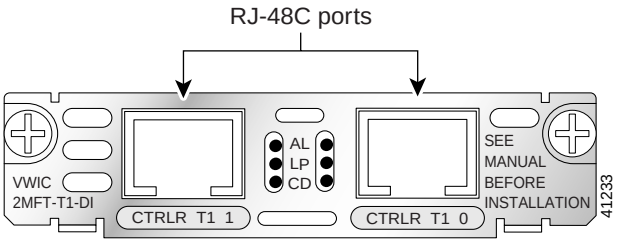


Figure 8 2-Port E1 Multiflex Trunk Interface Card with Drop-and-Insert (VWIC-2MFT-E1-DI)

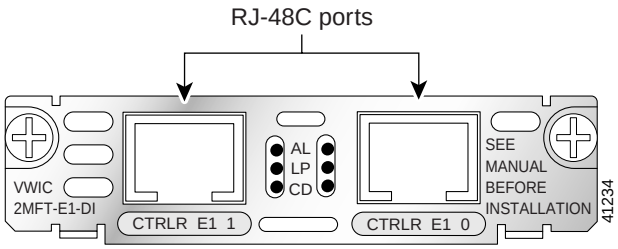
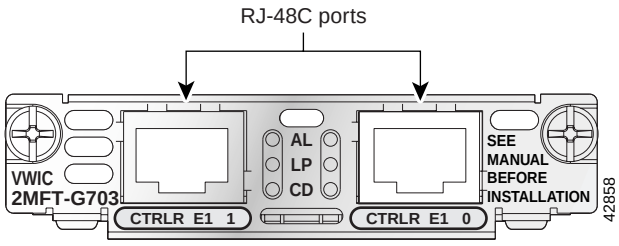


Figure 9 2-Port E1 Multiflex Trunk Interface Card with G.703 Support (VWIC-2MFT-G703)



Connecting the 2-Port Multiflex Trunk Interface Card

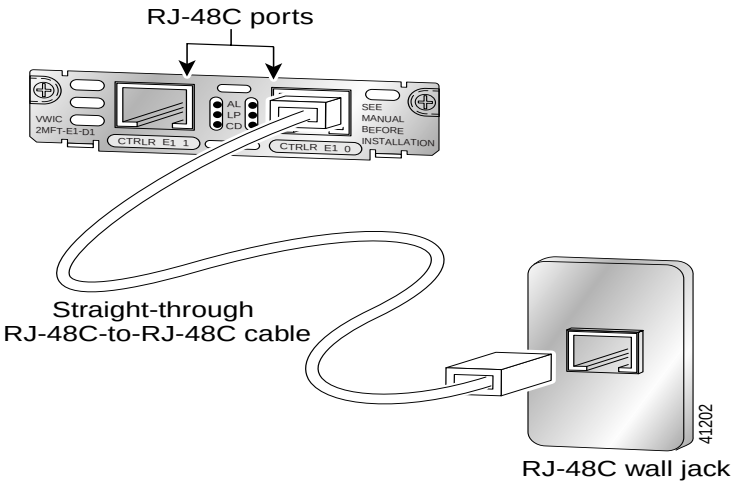
For this connection, use a straight-through RJ-48C-to-RJ-48C cable.

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 that 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 10.

Figure 10 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 port 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 For the following configuration tasks, it is assumed that the clock source has been properly configured for the T1/E1 controller. For detailed information about TDM clock configuration, please refer to the *TDM Clock Configuration for Cisco 1700 Series Routers* online document.

T1/E1 Data Configuration

The procedures in this section tell 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, 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. Repeat the 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)#**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 3	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 4	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**.
Step 5	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 6	Router(config-controller)#**no shutdown**	Activates the controller.
Step 7	Router(config-controller)#**exit**	Exits configuration mode.
Step 8	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.

	Command	Purpose
Step 9	Router(config-if)#**encapsulation** {**atm-dxi** | **frame-relay** | **hdlc** | **lapb** | **ppp** | **smds** | **x25**}	Configures synchronous serial encapsulation. The default encapsulation is hdlc.
Step 10	Router(config-if)#**ip address** *ip-address mask*	Assigns the IP address and subnet mask to the interface.
Step 11	Router(config-if)#**end**	Exits interface configuration mode.

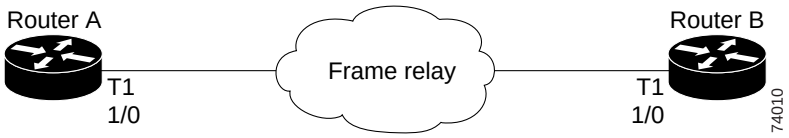
T1/E1 Data Configuration Examples

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

The **channel-group 0** command is configured in such a way 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. Figure 11 shows a diagram of the examples.

Figure 11 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 11.)

```
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 11.)

```
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 11.)

```
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 11.)

```
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.

```
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 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 2 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. Repeat this 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)#**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 3	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**.

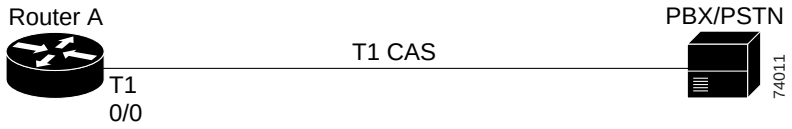
	Command	Purpose
Step 4	Router(config-controller)#**linecode** {**ami** | **b8zs**}	Specifies the line code type designated by your service provider. Alternate mark inversion (AMI) is used on older T1 circuits and references signal transitions with a binary 1, or *mark*. Binary 8 zero substitution (B8ZS), 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**.
Step 5	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 thru 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 6	Router(config-controller)#**no shutdown**	Activates the controller.
Step 7	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. Figure 12 shows a diagram of the example.

Figure 12 Configuration Example for T1 CAS



This section shows the example configuration for Router A, a Cisco 1700 series router. (See Figure 12.)

```
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:

```
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.

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.

The following steps configure your T1/E1 VWIC for drop-and-insert capability. Repeat the 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)#**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 3	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 4	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 T1 line code is **b8zs**.

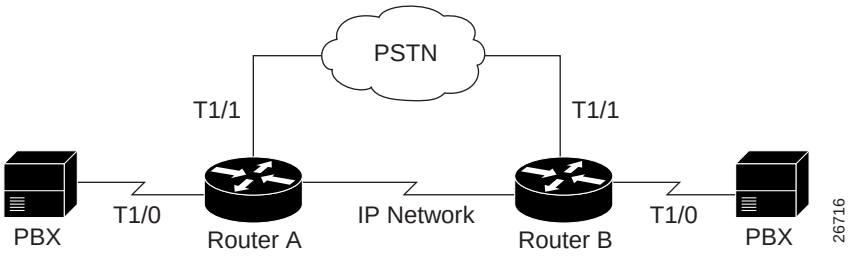
	Command	Purpose
Step 5	Router(config-controller)# **tdm-group** *tdm-group-no* **timeslots** *timeslot-list* [**type** {**e&m** | **fxo** [**ground-start** | **loop-start**] | **fxs** [**ground-start** | **loop-start**]}]	Used only when you need TDM groups for the drop-and-insert (also called *TDM cross-connect*) 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 thru 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 6	Router(config-controller)#**no shutdown**	Activates the controller.
Step 7	Router(config-controller)#**exit**	Exits controller configuration mode.

	Command	Purpose
Step 8	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 5.) **Note** The cross-connection must occur on the same slot, but different ports.
Step 9	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. Figure 13 shows a diagram of the example.

Figure 13 Configuration Example for Drop-and-Insert



The following is the configuration for Router A, a Cisco 1700 series router. (See Figure 13.)

```
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 13.)

```
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:

```
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 drop-and-insert configuration, enter the **show connection all** command.

```
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.

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 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)#**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 *TDM Clock Configuration for Cisco 1700 Series Routers* online document.
Step 3	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 4	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 5	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 6	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.

	Command	Purpose
Step 7	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 8	Router(config-controller)#**no shutdown**	Activates the controller.
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.
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.

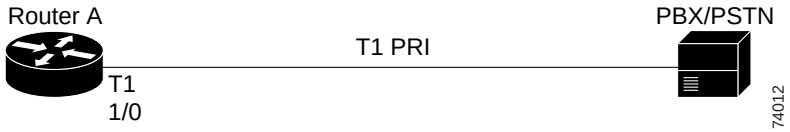
The following caveats apply:

- 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. Figure 14 shows a diagram of the example.

Figure 14 Configuration Example: T1 PRI



The following is the configuration for Router A, a Cisco 1700 series router. (See Figure 14.)

```
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.

```
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. Repeat the procedure for each controller.

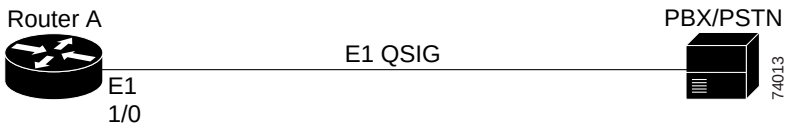
	Command	Purpose
Step 1	Router#**configure terminal**	Enters global configuration mode. Skip this step if you are already in terminal configuration mode.
Step 2	Router(config)#**tdm clock** {**T1** | **E1**} *slot/port* **both** {**export** | **import**}	Configures the TDM clock for T1 or E1 controller 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 *TDM Clock Configuration for Cisco 1700 Series Routers* online document.
Step 3	Router(config)#**isdn switch-type primary-qsig**	Configures the ISDN switch type to support QSIG signaling.
Step 4	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 5	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 6	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 7	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 8	Router(config-controller)#**no shutdown**	Activates the controller.
Step 9	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 10	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 11	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 12	Router(config-if)#**no shutdown**	Activates the interface.
Step 13	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. Figure 15 shows a diagram of the example.

Figure 15 Configuration Example: E1 QSIG



The following is an example configuration for Router A, a Cisco 1700 series router. (See Figure 15.)

```
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 switch type and ISDN status, enter the **show isdn** {**service** | **status**} command. See the "Verifying the PRI Configuration" section 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 this 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)#**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.

	Command	Purpose
Step 3	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 4	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 5	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 6	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 7	Router(config-ctrl-cas)#**no shutdown**	Activates the controller.
Step 8	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.

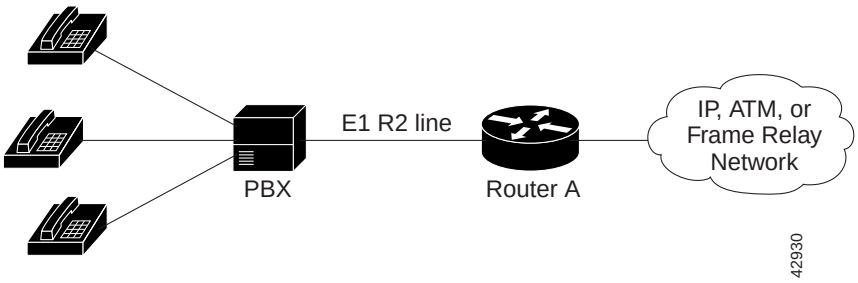
	Command	Purpose
Step 9	Router(config-ctrl-cas)#**ani-digits** Router(config-ctrl-cas)#**answer-signal** Router(config-ctrl-cas)#**caller-digits** Router(config-ctrl-cas)#**category** Router(config-ctrl-cas)#**default** Router(config-ctrl-cas)#**dnis-digits** Router(config-ctrl-cas)#**invert-abcd** Router(config-ctrl-cas)#**ka** 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. Figure 16 shows a diagram of the example.

Figure 16 Configuration Example: E1 R2



The following is an example configuration for Router A, a Cisco 1700 series router. (See Figure 16.)

```
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.

```
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.

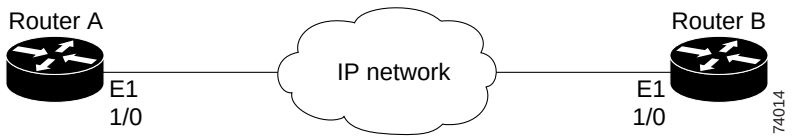
Repeat the following procedure for each E1 controller.

	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)#**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 3	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 4	Router(config-controller)#**no shutdown**	Activates the controller.
Step 5	Router(config-controller)#**exit**	Exits controller configuration mode.
Step 6	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 7	Router(config-if)#**ip address** *ip-address mask*	Assigns the IP address and subnet mask to the interface.
Step 8	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. Figure 17 shows a diagram of the example.

Figure 17 Configuration Example: E1 G.703



The following is the configuration for Router A, a Cisco 1700 series router. (See Figure 17.)

```
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:

```
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 Serial Interface Configuration

To verify 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
```

Obtaining Documentation

The following sections provide sources for obtaining documentation from Cisco Systems.

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You can access the most current Cisco documentation on the World Wide Web at the following sites:

- http://www.cisco.com
- http://www-china.cisco.com
- http://www-europe.cisco.com

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Technical Assistance Center

The Cisco TAC is available to all customers who need technical assistance with a Cisco product, technology, or solution. Two types of support are available through the Cisco TAC: the Cisco TAC Web Site and the Cisco TAC Escalation Center.

Inquiries to Cisco TAC are categorized according to the urgency of the issue:

- Priority level 4 (P4)—You need information or assistance concerning Cisco product capabilities, product installation, or basic product configuration.
- Priority level 3 (P3)—Your network performance is degraded. Network functionality is noticeably impaired, but most business operations continue.
- Priority level 2 (P2)—Your production network is severely degraded, affecting significant aspects of business operations. No workaround is available.
- Priority level 1 (P1)—Your production network is down, and a critical impact to business operations will occur if service is not restored quickly. No workaround is available.

Which Cisco TAC resource you choose is based on the priority of the problem and the conditions of service contracts, when applicable.

Cisco TAC Web Site

The Cisco TAC Web Site allows you to resolve P3 and P4 issues yourself, saving both cost and time. The site provides around-the-clock access to online tools, knowledge bases, and software. To access the Cisco TAC Web Site, go to the following URL:

http://www.cisco.com/tac

All customers, partners, and resellers who have a valid Cisco services contract have complete access to the technical support resources on the Cisco TAC Web Site. The Cisco TAC Web Site requires a Cisco.com login ID and password. If you have a valid service contract but do not have a login ID or password, go to the following URL to register:

http://www.cisco.com/register/

If you cannot resolve your technical issues by using the Cisco TAC Web Site, and you are a Cisco.com registered user, you can open a case online by using the TAC Case Open tool at the following URL:

http://www.cisco.com/tac/caseopen

If you have Internet access, it is recommended that you open P3 and P4 cases through the Cisco TAC Web Site.

Cisco TAC Escalation Center

The Cisco TAC Escalation Center addresses issues that are classified as priority level 1 or priority level 2; these classifications are assigned when severe network degradation significantly impacts business operations. When you contact the TAC Escalation Center with a P1 or P2 problem, a Cisco TAC engineer will automatically open a case.

To obtain a directory of toll-free Cisco TAC telephone numbers for your country, go to the following URL:

http://www.cisco.com/warp/public/687/Directory/DirTAC.shtml

Before calling, please check with your network operations center to determine the level of Cisco support services to which your company is entitled; for example, SMARTnet, SMARTnet Onsite, or Network Supported Accounts (NSA). In addition, please have available your service agreement number and your product serial number.

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