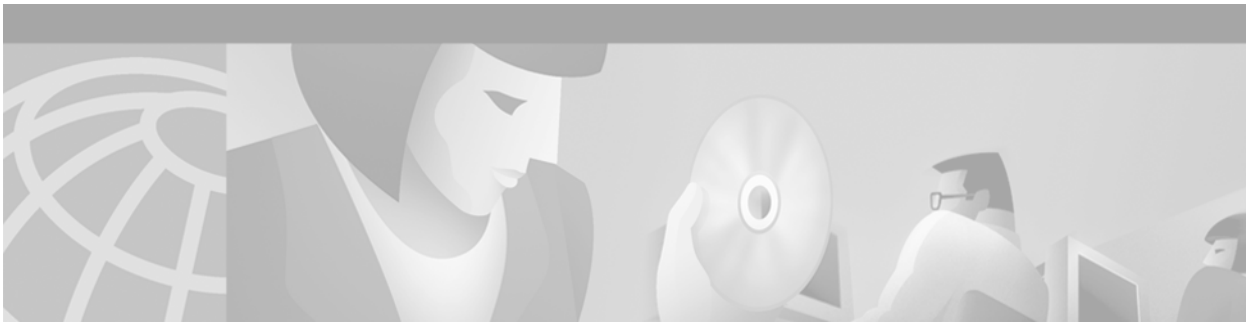


Configuring Support for PBX Signalling Protocols

This chapter describes how to configure support for PBX signalling formats such as Q.SIG and transparent common channel signalling (CCS). Configuring support for these signalling protocols on your router enables the router to interoperate with PBXs running these signalling protocols.

This chapter includes the following sections:

- Configuring Q.SIG PRI Signalling Support
- Configuring Transparent CCS on the Cisco MC3810

For a complete description of the commands used in this chapter, refer to the *Cisco IOS Multiservice Applications Command Reference*. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

Configuring Q.SIG PRI Signalling Support

Configuration Tasks for Q.SIG PRI signalling support are described in the following sections:

- Configuring Voice over IP Q.SIG Network Transparency on the Cisco AS5300
- Configuring Q.SIG PRI Signalling Support on the Cisco MC3810

Although the procedures for configuring Q.SIG signalling support on the Cisco AS5300 and on the Cisco MC3810 are very similar, implementation differences are described in the respective sections.

Benefits of Q.SIG

On both the Cisco AS5300 and the Cisco MC3810, Q.SIG voice signalling provides the following benefits:

- Enables Cisco devices to connect with digital PBXs that use the Q.SIG form of CCS.
- Provides access to multiple remote PBXs with a single connection to a Cisco device.
- Provides transparent support for supplementary PBX services, so that proprietary PBX features are not lost when connecting PBXs to Cisco AS5300 and Cisco MC3810 networks.
- Provides Q.SIG support based on widely used ISDN Q.931 standards. Cisco Q.SIG implementation follows the following European Telecommunications Standards Institute (ETSI) implementation standards:
  - ECMA 143: *Private Telecommunication Network (PTN) Inter-exchange Signalling Protocol Circuit Mode Basic Services*. (This specification covers Q.SIG basic call services.)

  - ECMA 142: *Specification, Functional Model and Information Flows for Control Aspects of Circuit Mode Basic Services in Private Telecommunication Networks*.
  - ECMA 141: *Private Telecommunications Networks Inter-exchange Signalling Data Link Layer Protocol*.
  - ECMA 165: *Generic Functional Protocol for the Support of Supplementary Services*.
- Provides compatibility with H.323 for IP call setup and transport of Q.SIG messaging.
- Provides support for calls that do not require a bearer channel for voice transport.
- Provides support for bandwidth-on-demand, utilizing network resources only when a connection is desired.

Configuring Voice over IP Q.SIG Network Transparency on the Cisco AS5300

Integration of Q.SIG support with VoIP enables Cisco voice switching services to connect PBXs, key systems, and CO switches that communicate by using the Q.SIG protocol.

In Cisco IOS Release 12.1, Q.SIG PRI signalling on the Cisco AS5300 applies only to VoIP.

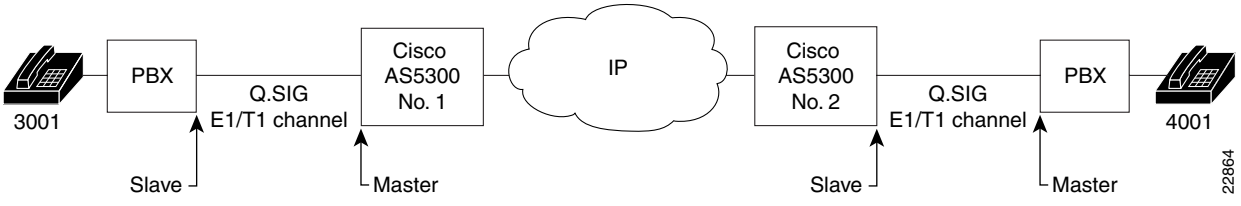
The Q.SIG protocol is a variant of ISDN D-channel voice signalling. It is based on the ISDN Q.921 and Q.931 standards and is becoming a worldwide standard for PBX interconnection. By using Q.SIG signalling, Cisco devices can route incoming voice calls from a private integrated services network exchange (PINX) device across a WAN to a peer Cisco device, which can then transport the signalling and voice packets to a second PINX device.

Note In Cisco IOS Release 12.1, the Cisco AS5300 supports ISDN PRI only when a Q.SIG connection to the PINX is configured on the T1/E1 controller.

Q.SIG allows the user to place Q.SIG calls into and receive Q.SIG calls from Cisco VoIP networks. The Cisco packet network appears to PBXs as a large, distributed transit PBX that can establish calls to any destination served by a Cisco voice node. The switched voice connections are established and torn down in response to Q.SIG control messages that come over an ISDN PRI D channel. The Q.SIG message is passed transparently across the IP network and the message appears to the attached PINX devices as a transit network. The PINX devices are responsible for processing and provisioning the attached services.

Figure 96 shows an example of a Q.SIG signalling configuration. In this example, the Cisco AS5300 acts as either a master to a slave PBX or as a slave to a master PBX.

Figure 96 Cisco AS5300 Q.SIG Signalling Configuration



The following restrictions and limitations apply to the Cisco AS5300 Q.SIG implementation:

- Q.SIG functionality on the AS5300 requires Cisco IOS Release 12.0(7)T or later and VCWare version 4.04.

- Q.SIG data calls are not supported. All calls with bearer capability indicating a nonvoice type (such as video telephony) are rejected.
- The incoming POTS dial peer must have DID configured to prevent generation of a secondary dial tone to ensure end-to-end Q.SIG feature transparency.

Q.SIG Prerequisite Tasks

The following configuration tasks should be completed before you configure Q.SIG for VoIP:

- Configure the ports used on the Cisco AS5300 as voice ports. For information on how to configure ports to be used as voice ports, see "Configuring Voice Ports" section in the "Configuring Voice over IP" chapter.
- Install VCWare version 4.04. For information on how to upgrade or install VCWare, see the "Managing Cisco AS5300 VFCs " section in the "Configuring Voice over IP" chapter.
- Configure VoIP. For information on how to configure VoIP, see the "Configuring Voice over IP" chapter.

Q.SIG Configuration Task List

To configure Q.SIG for Voice over IP, complete the tasks shown in the following sections. Some of these tasks are optional.

- Configuring VoIP Q.SIG
- Configuring Fusion Call Control Signalling (NEC Fusion) on the Cisco AS5300

Configuring VoIP Q.SIG

To configure Q.SIG signalling support on the Cisco AS5300, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# isdn switch-type primary-qsig`	Configures the ISDN switch-type to support Q.SIG signalling. **Note** You can configure the ISDN switch type using either this global command or the same command in interface configuration mode, depending on your configuration. (See Step 5.) If you configure the global **isdn-switch-type** command for Q.SIG support, you need not configure the interface **isdn-switch-type** command for Q.SIG. If the PBX in your configuration is an NEC PBX, and you are using Fusion Call Control Signalling (FCCS). See the "Configuring Fusion Call Control Signalling (NEC Fusion) on the Cisco AS5300" later in this chapter.

	Command	Purpose
Step 2	`Router(config)# controller {T1 | E1} controller number`	Enters controller configuration mode.
Step 3	`Router(config-controller)# pri-group [timeslot range]`	Configures the PRI group for either T1 or E1 to carry voice traffic. For T1, available time slots are from 1 to 23, and for E1, available time slots are from 1 to 31. You can configure the PRI group to include all available time slots, or you can configure a select group of time slots for the PRI group. For example, if only time slots 1 to 10 are in the PRI group, enter the **pri-group timeslot 1-10** command. If the PRI group includes all channels available for T1 (channels 1 to 23), enter the **pri-group timeslot 1-23** command. If the PRI group includes all channels available for E1 (channels 1 to 31), enter the **pri-group timeslot 1-31** command.
Step 4	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 5	`Router(config)# interface serial 1:x`	Enters interface configuration mode for the ISDN PRI interface. For T1, enter **serial 1:23**. For E1, enter **serial 1:15**.
Step 6	`Router(config-if)# isdn switch-type primary-qsig`	If you did not configure the global ISDN switch type for Q.SIG support in Step 1, configures the interface ISDN switch type to support Q.SIG signalling. The conditions that apply to this command in global configuration mode also apply to this command in interface configuration mode. This interface command overrides the global **isdn switch-type** command setting for this interface.
Step 7	`Router(config-if)# isdn protocol-emulate {user | network}`	Configures the ISDN interface to serve as either the primary Q.SIG slave or the primary Q.SIG master. For this command, the **user** keyword specifies slave and the **network** keyword specifies master. If the PINX is the primary Q.SIG master, configure the Cisco AS5300 to serve as the primary Q.SIG slave. If the PINX is the primary Q.SIG slave, configure the Cisco AS5300 to serve as the primary Q.SIG master.
Step 8	`Router(config-if)# isdn overlap-receiving value`	Activates overlap signalling to send to the destination PBX. This command is not mandatory; you can leave the default value.
Step 9	`Router(config-if)# isdn incoming-voice modem`	Routes incoming voice calls to the modem and treats them as analog data.

	Command	Purpose
Step 10	`Router(config-if)# isdn network-failure-cause [value]`	(Optional) Specifies the cause code to pass to the PBX when a call cannot be placed or completed because of internal network failures. Possible values are from 1 to 127. All cause codes except for Normal Call Clearing (16), User Busy (17), No User Responding (18), and No Answer from User (19) will be changed to the specified cause code.
Step 11	`Router(config-if)# isdn bchan-number-order {ascending | descending}`	(Optional) Configures the ISDN PRI interface to make the outgoing call selection in ascending or descending order. The default is descending order, in which the first call from the Cisco AS5300 uses channel 23 (T1) or channel 31 (E1). The second call then uses channel 22 (T1) or channel 30 (E1), and so on in descending order. If you select ascending order and the PRI group starts with 1, the first call uses channel 1, the second call uses channel 2, and so on in ascending order. If the PRI group starts with a different time slot, the ascending order starts with the lowest time slot.
Step 12	`Router(config-if)# exit`	Exits interface configuration mode.

As shown in the preceding section, you have a choice of configuring the **isdn-switch-type** command to support Q.SIG at either the global configuration level or the interface configuration level. For example, if you have a Q.SIG connection on one line and on the PRI port, you can configure the ISDN switch type in one of the following combinations:

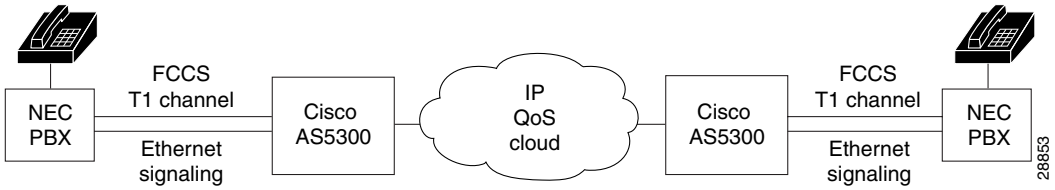
- Set the global **isdn-switch-type** command to support Q.SIG and set the interface **isdn-switch-type** command for **interface serial 0:23** to a PRI setting such as 5ess.
- Set the global **isdn-switch-type** command to support PRI 5ess and set the interface **isdn-switch-type** command for **interface serial 1:23** to support Q.SIG.
- Configure the global **isdn-switch-type** command to another setting (such as switch type VN3), set the interface **isdn-switch-type** command for **interface serial 0:23** to a PRI setting, and set the interface **isdn-switch-type** command for **interface serial 1:23** to support Q.SIG.

Configuring Fusion Call Control Signalling (NEC Fusion) on the Cisco AS5300

If you have an NEC PBX in your network and you are running FCCS, you will need to configure this device appropriately. FCCS, also known as NEC Fusion, allows individual nodes anywhere within a network to operate as if they were part of a single integrated PBX system. The database storage, share, and access routine of NEC Fusion allow real-time access from any node to any other, allowing individual nodes to “learn” about the entire network configuration. This capability allows network-wide feature, functional, operational, and administration transparency.

Figure 97 shows an example of an AS5300 Q.SIG signalling configuration using an NEC PBX.

Figure 97 Q.SIG Signalling Configuration with NEC PBX



To configure NEC Fusion signalling support on the Cisco AS5300, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# controller T1 controller number`	Enters controller configuration mode. NEC Fusion does not support fractional T1/E1; all 24 channels must be available. If they are not available, the configuration request will fail.
Step 2	`Router(config-controller)# pri-group nec-fusion {pbx-ip-address/pbx-ip-host-name} pbx-port number`	Configures the controller to communicate with an NEC PBX using NEC Fusion. The range for the PBX port is 49152 to 65535. If you do not specify a port number, the default value of 55000 will be used. If this value is already in use, the next greater value will be used.
Step 3	`Router(config-controller)# exit`	Exits controller configuration mode.

Verifying VoIP Q.SIG Software on the Cisco AS5300

After you complete the configuration for the AS5300, verify that you configured Q.SIG properly. Enter the **show isdn status** command to view the ISDN layer information. The following output shows that you have correctly designated the global ISDN switch type to be primary-Q.SIG.

```
router# show isdn status

Global ISDN Switchtype = primary-qsig
ISDN Serial1:23 interface
        dsl 0, interface ISDN Switchtype = primary-qsig
         **** Slave side configuration ****
    Layer 1 Status:
        DEACTIVATED
    Layer 2 Status:
        TEI = 0, Ces = 1, SAPI = 0, State = TEI_ASSIGNED
    Layer 3 Status:
        0 Active Layer 3 Call(s)
    Activated dsl 0 CCBs = 0
    The Free Channel Mask: 0x7FFFFF
```

Q.SIG for VoIP Configuration Example

The following configuration example configures interface serial 1:23 for Q.SIG PRI and to act as the Q.SIG slave:

```
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname as5300A
!
ip subnet-zero
!
isdn switch-type primary-qsig
!
controller T1 0
 shutdown
!
controller T1 1
 framing esf
 clock source line primary
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 2
 shutdown
!
controller T1 3
 shutdown
!
!
voice-port 1:D
!
!
dial-peer voice 3001 pots
 destination-pattern 3001
 port 1:D
!
dial-peer voice 4001 pots
 incoming called-number 4001
 direct-inward dial
!
dial-peer voice 4002 voip
 destination-pattern 4001
 session target ipv4:1.14.82.14
!
!
interface Ethernet0
 ip address 1.14.82.13 255.255.0.0
 no ip directed-broadcast
!
interface 1:23
 no ip address
 no ip directed broadcast
 isdn switch-type primary-qsig
 isdn protocol-emulate user
 isdn incoming-voice modem
!
interface FastEthernet0
 no ip address
 no ip directed-broadcast
```

```
 shutdown
!
ip default-gateway 1.14.0.1
ip classless
!
line con 0
 transport input none
line aux 0
line vty 0 4
 login
!
end

=====================================================
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname as5300B
!
ip subnet-zero
!
isdn switch-type primary-qsig
!
!
controller T1 0
 shutdown
!
controller T1 1
 framing esf
 clock source line primary
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 2
 shutdown
!
controller T1 3
 shutdown
!
!
voice-port 1:D
!
!
dial-peer voice 3001 pots
 incoming called-number 3001
 direct-inward-dial
!
dial-peer voice 3002 voip
 destination-pattern 3001
 session target ipv4:1.14.82.13
!
dial-peer voice 4001 pots
 destination-pattern 4001
 port 1:D
!
interface Ethernet0
 ip address 1.14.82.14 255.255.0.0
 no ip directed-broadcast
!
interface Serial1:23
 no ip address
```

```
 no ip directed-broadcast
 isdn switch-type primary-qsig
 isdn protocol-emulate network
 isdn incoming-voice modem
!
interface FastEthernet0
 no ip address
 no ip directed-broadcast
 shutdown
!
ip default-gateway 1.14.0.1
ip classless
!
line con 0
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

Configuring Q.SIG PRI Signalling Support on the Cisco MC3810

The Q.SIG protocol provides signalling for PINX devices. It is based on the ISDN Q.931 standard. Using Q.SIG PRI signalling, the Cisco MC3810 can route incoming voice calls from a PINX device across a WAN to a peer Cisco MC3810, which can then transport the signalling and voice packets to a second PINX device.

In Cisco IOS Release 12.1, Q.SIG PRI signalling on the Cisco MC3810 applies only to VoFR and VoATM.

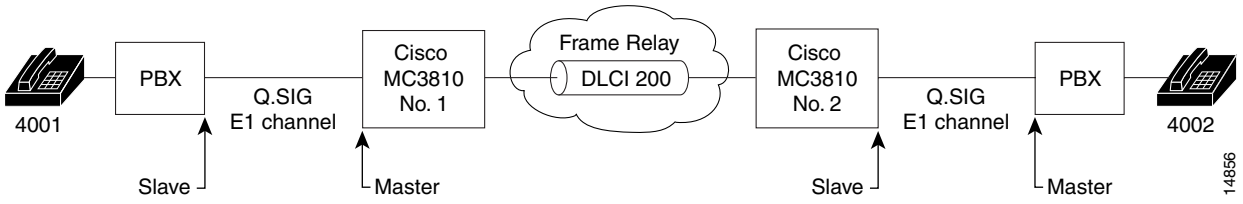
Note The Cisco MC3810 supports ISDN PRI only when a Q.SIG connection to the PINX device is configured on the digital voice module (DVM) T1/E1 controller.

The following restrictions and limitations apply to the Cisco MC3810 Q.SIG PRI implementation:

- Q.SIG data calls are not supported. All calls with bearer capability indicating a nonvoice type (such as for video telephony) are rejected.
- Q.SIG is supported only on T1/E1 controller 1. Each Cisco MC3810 supports only one T1/E1 interface with direct connectivity to a PINX device.
- The Cisco MC3810 supports a maximum of 24 bearer channels.
- When Q.SIG is configured, serial interface 1 cannot support speeds higher than 192 kbps. This restriction assumes that the MFT is installed in slot 3 on the Cisco MC3810. If the MFT is not installed, then serial interface 1 will not operate at all, but Q.SIG will be supported on other interfaces.

Figure 98 shows an example of a Q.SIG signalling configuration. In the example, the Cisco MC3810 either acts as a master to a slave PBX, or as a slave to a master PBX.

Figure 98 Cisco MC3810 Q.SIG Signalling Configuration



Q.SIG Prerequisite Tasks

The following configuration tasks should be completed before you configure Q.SIG on the Cisco MC3810:

- Configure the ports used on the Cisco MC3810 as voice ports. For information on how to configure ports to be used as voice ports, see the "Configuring Voice Ports" section in the "Configuring Voice over ATM" chapter.
- Configure Voice over Frame Relay or Voice over ATM. For information on how to configure Voice over Frame Relay, see the "Configuring Voice over Frame Relay" chapter. For information on how to configure Voice over ATM, see the "Configuring Voice over ATM" chapter.

To configure Q.SIG PRI signalling support on the Cisco MC3810, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# isdn switch-type [primary-qsig-slave | primary-qsig-master]`	Configures the ISDN switch type to serve either as the primary Q.SIG slave or the primary Q.SIG master. If the PINX device is the primary Q.SIG master, configure the Cisco MC3810 to serve as the primary Q.SIG slave. If the PINX device is the primary Q.SIG slave, configure the Cisco MC3810 to serve as the primary Q.SIG master. **Note** You can configure the ISDN switch type using either this global command, or this same command in interface configuration mode, depending on your configuration. (See Step 3.) If you configure the global **isdn-switch-type** command for Q.SIG support, you need not also configure the interface **isdn-switch-type** command for Q.SIG.
Step 2	`Router(config)# interface serial 1:x`	Enters interface configuration mode for the ISDN PRI interface. For T1, enter **serial 1:23**. For E1, enter **serial 1:15**.

	Command	Purpose
Step 3	`Router(config-if)# isdn switch-type [primary-qsig-slave | primary-qsig-master]`	If you did not configure the global ISDN switch type for Q.SIG support in Step 1, configures the interface ISDN switch type to serve either as the primary Q.SIG slave or the primary Q.SIG master. The same conditions that apply to this command in global configuration mode also apply to this command in interface configuration mode. **Note** This interface command overrides the global **isdn switch-type** command setting for this interface.
Step 4	`Router(config-if)# isdn overlap-receiving value`	Activates overlap signalling to send to the destination PBX.
Step 5	`Router(config-if)# isdn network-failure-cause [1-127]`	Specifies the cause code to pass to the PBX when a call cannot be placed or completed because of internal network failures.
Step 6	`Router(config-if)# isdn bchan-number-order {ascending | descending}`	(Optional) Configures the ISDN PRI interface to make the outgoing call selection in ascending or descending order. The default is descending order, in which the first call from the Cisco MC3810 uses channel 23 (T1) or channel 31 (E1). The second call then uses channel 22 (T1) or channel 30 (E1), and so on in descending order. If you select ascending order and the PRI group starts with 1, the first call uses channel 1, the second call uses channel 2, and so on in ascending order. If the PRI group starts with a different time slot, the ascending order starts with the lowest time slot.
Step 7	`Router(config)# controller {T1 | E1} 1`	Enters controller configuration mode. Q.SIG is only supported on controller 1.

	Command	Purpose
Step 8	`Router(config-controller)# pri-group timeslot [1-31]`	Configures the PRI group for either T1 or E1 to carry voice traffic. For T1, available time slots are 1–23, and for E1 available time slots are 1–31. 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 1–10 are in the PRI group, enter the **pri-group timeslot 1-10** command. If the PRI group includes all channels available for T1, enter the **pri-group timeslot 1-24** command. If the PRI group includes all channels available for E1, enter the **pri-group timeslot 1-31** command. **Note** When a PRI group is configured, T1 time slot 24 or E1 time slot 16 is automatically assigned to handle D-channel signalling.

As shown in the procedure, you have a choice of configuring the **isdn-switch-type** command to support Q.SIG at either the global configuration level or at the interface configuration level. For example, if you have a Q.SIG connection on one line and on the BRI port, you can configure the ISDN switch type in one of the following combinations:

- Set the global **isdn-switch-type** command to support Q.SIG, and set the interface **isdn-switch-type** command for **interface bri 0** to a BRI setting such as 5ess.
- Set the global **isdn-switch-type** command to support BRI 5ess, and set the interface **isdn-switch-type** command for **interface serial 1:23** to support Q.SIG.
- Configure the global **isdn-switch-type** command to another setting (such as switch type VN3), and then set the interface **isdn-switch-type** command for **interface bri 0** to a BRI setting, and set the interface **isdn-switch-type** command for **interface serial 1:23** to support Q.SIG.

Note The **codec** command must be configured before any calls can be placed over the connection to the PINX. The default codec type is G729a.

When voice dial peers are configured for use with Q.SIG PRI, voice port 1/1 is used for all bearer channels.

Q.SIG PRI Signalling on the Cisco MC3810 Configuration Example

The following configuration example configures interface serial 1:15 for QSIG PRI, and to act as the QSIG master. The example shows other commands necessary for the configuration.

```
! version 12.1
 no service pad
 service timestamps debug uptime
 service timestamps log uptime
 no service password-encryption
 !
 hostname c3810a
 !
 network-clock base-rate 56k
 ip subnet-zero
 no ip domain-lookup
 ip host rb 10.1.1.1
 !
 isdn switch-type primary-qsig-master
 !
 !
 stun peer-name 10.1.1.1
 stun protocol-group 1 basic
 !
 controller E1 1
  clock source internal
  pri-group timeslots 1-2,16
 !
 !
 !
 interface Ethernet0
  ip address 144.254.156.169 255.255.255.0
  no ip directed-broadcast
  no ip route-cache
  no ip mroute-cache
  no keepalive
 !
 interface Serial0
  ip address 10.1.1.2 255.255.255.0
  no ip directed-broadcast
  encapsulation frame-relay
  no ip route-cache
  no ip mroute-cache
  no arp frame-relay
  bandwidth 256
  no keepalive
  no fair-queue
  serial restart-delay 0
  frame-relay interface-dlci 30 voice-encap 80
  hold-queue 1024 out
 !
 interface Serial1
  no ip address
  no ip directed-broadcast
  encapsulation stun
  no ip route-cache
  no ip mroute-cache
  stun group 1
  stun route all interface Serial0 dlci 30
 !
 interface Serial1:15
  no ip address
  no ip directed-broadcast
```

```
 no logging event link-status
 isdn switch-type primary-qsig-master
 isdn bchan-number-order ascending
 no cdp enable
!
interface Switch0
 no ip address
 no ip directed-broadcast
 encapsulation frame-relay
 no fair-queue
!
interface FR-ATM0
 no ip address
 no ip directed-broadcast
!
interface FR-ATM20
 no ip address
 no ip directed-broadcast
 no ip route-cache
 shutdown
!
router rip
 network 10.0.0.0
 network 144.254.0.0
!
ip classless
!
map-list atm1
!
map-class frame-relay A-relay
 frame-relay traffic-rate 256000 1540000
 no frame-relay adaptive-shaping
!
line con 0
 transport input none
line aux 0
line 2 3
line vty 0 4
 login
!
!
voice-port 1/1
!
voice-port 1/2
!
dial-peer voice 1 pots
 destination-pattern 2...
 port 1/1
!
dial-peer voice 3 pots
 destination-pattern 3
 port 1/3
!
dial-peer voice 5 pots
 destination-pattern 5
 port 1/5
!
dial-peer voice 6 pots
 destination-pattern 6
 port 1/6
!
```

```
dial-peer voice 10 vofr
 destination-pattern 4...
 session target Serial0 30
!
end
```

Configuring Transparent CCS on the Cisco MC3810

The Cisco MC3810 provides support for transparent CCS, which provides point-to-point PINX connection capability to Cisco MC3810 DVM interfaces when the PINX device does not support Q.SIG, or when the PINX device has a proprietary solution.

You can configure transparent CCS in one of two ways: CCS cross-connect (or TDM cross-connect, which implies a fractional trunk), or CCS frame-forwarding. These procedures are described in the following sections:

- Configuring CCS Cross-Connect
- Configuring CCS Frame-Forwarding

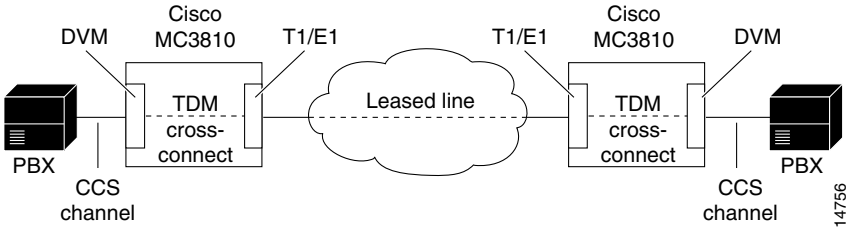
Configuring CCS Cross-Connect

Configuration tasks are described in the following sections:

- Configuring CCS Cross-Connect for T1
- Configuring CCS Cross-Connect for E1
- Configuring T1/E1 Trunk Bearer Channels

Figure 99 shows an example of CCS cross-connect. In this example, the CCS channel from the PBX is cross-connected on the Cisco MC3810 to a time slot on the T1/E1 controller. The channel is then passed through the WAN as a leased line to the second Cisco MC3810, where it is cross-connected to the DVM signalling time slot (time slot 24 for T1, or time slot 16 for E1). The channel is then passed to the second PBX. The CCS signal byte stream is passed through transparently by the Cisco MC3810.

Figure 99 CCS Cross-Connect Configuration



Configuring CCS Cross-Connect for T1

When you configure CCS cross-connect for T1, you need to cross-connect from the first T1 controller to the second T1 controller. To configure CCS cross-connect for T1, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# controller T1 0`	Enters controller configuration mode for controller T1 0.
Step 2	`Router(config-controller)# tdm-group` *tdm-group-no* `timeslot` *timeslot-list*	Configures a TDM channel group for controller T1 0. Do not specify the **type** option in the command.
Step 3	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 4	`Router(config)# controller T1 1`	Enters controller configuration mode for controller T1 1.
Step 5	`Router(config-controller)# mode ccs cross-connect`	Configures CCS cross-connect for controller T1 1.
Step 6	`Router(config-controller)# tdm-group` *tdm-group-no* `timeslot` *timeslot-list*	Configures a TDM channel group for controller T1 1. Do not specify the **type** option in the command.
Step 7	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 8	`Router(config)# cross-connect` *id controller-1 tdm-group-no-1 controller-2 tdm-group-no-2*	Configures cross-connect pass-through between the two controllers.

Configuring CCS Cross-Connect for E1

When you configure CCS cross-connect for E1, you need to configure cross-connect from the first E1 controller to the second E1 controller, and then configure the **mode ccs cross-connect** command to allow the cross-connect to time slot 16. This enables all of the channels to perform similarly to normal CAS mode, but the signalling bit is no longer processed by the Cisco MC3810.

To configure CCS cross-connect for E1, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# controller E1 0`	Enters controller configuration mode for controller E1 0.
Step 2	`Router(config-controller)# tdm-group` *tdm-group-no* `timeslot` *timeslot-list*	Configures a TDM channel group for E1. Do not specify the **type** option in the command.
Step 3	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 4	`Router(config)# controller E1 1`	Enters controller configuration mode for controller E1 1.
Step 5	`Router(config-controller)# mode ccs cross-connect`	Configures controller E1 1 to support CCS cross-connect by enabling channel 16 to no longer carry the signalling bit.

	Command	Purpose
Step 6	`Router(config-controller-cas)# voice-group channel-no timeslots timeslot-list type [ext-sig-master | ext-sig-slave]`	Configures the specified channel to support CCS mode, and specifies whether the T1/E1 trunk will be the external signalling master or slave. A channel configured as **ext-sig-master** automatically generates the off-hook signal and stays in the off-hook state. A channel configured as **ext-sig-slave** automatically generates the answer signal when a call is terminated to that channel. These **type** options are available only when the **mode ccs** command is enabled.
Step 7	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 8	`Router(config)# cross-connect id controller-1 tdm-group-no-1 controller-2 tdm-group-no-2`	Configures cross-connect pass-through between the two controllers.

Configuring T1/E1 Trunk Bearer Channels

If you will use CCS cross-connect for bearer channels of the T1/E1 trunk, you will need to perform some additional configuration. To configure the T1/E1 trunk to support CCS cross-connect for bearer channels, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# controller {T1 | E1} number`	Enters controller configuration mode for the controller.
Step 2	`Router(config-controller)# mode ccs cross-connect`	Specifies the controller to support CCS cross-connect.
Step 3	`Router(config-controller-cas)# voice-group channel-no timeslots timeslot-list type [ext-sig-master | ext-sig-slave]`	Configures the specified channel to support CCS mode, and specifies whether the T1/E1 trunk will be the external signalling master or slave. A channel configured as **ext-sig-master** automatically generates the off-hook signal and stays in the off-hook state. A channel configured as **ext-sig-slave** automatically generates the answer signal when a call is terminated to that channel. These type options are available only when the **mode ccs** command is enabled.
Step 4	`Router(config-controller)# exit`	Exits controller configuration mode.

	Command	Purpose

Step 5	For Cisco MC3810 series analog voice ports:
	`router(config)# voice-port slot/port`
	For Cisco MC3810 series digital voice ports:
	`router(config)# voice-port slot:ds0-group`
		Enters voice-port configuration mode.

Step 6	`Router(config-voiceport)# connection plar string`	Configures the voice-port connection to support PLAR mode. For the string, enter the number of the voice channel that was configured as the **ext-sig-slave** for the **voice-group** command. **Note** After a transparent CCS connection is configured with the **connection plar** command, any change to the configuration will not take place until the connection is shut down with a **shutdown** command and then restarted with a **no shutdown** command. For example, the phone number supplied in the **connection plar** command can be changed while the connection is in **no shutdown** state, but the change will not cause the current connection to be closed and a new connection opened to the new phone number. This will only take effect on the next **no shutdown** command after a **shutdown** command.

The voice channel type configured as the **ext-sig-master** is considered the master side of the permanent virtual circuit (PVC) connection and is responsible for establishing the PVC connection. After the master channel is configured, a fixed timer of 30 seconds starts. The voice signalling driver then generates an off-hook signal on the master voice channel after the timer expires. The call is treated as a regular call, and the master voice channel will not hang up after the connection is made. If the call does not go through, or if the T1/E1 trunk is down, the 30-second timer on the master channel side restarts. A new off-hook signal is then generated at the master channel side after the timer expires.

CCS cross-connect is not supported on analog PVC connections.

Configuring CCS Frame-Forwarding

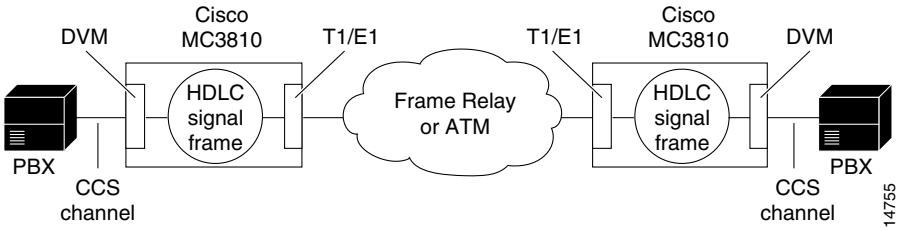
The Cisco MC3810 provides support for CCS frame-forwarding, which allows the Cisco MC3810 DVM to be connected to a Private Telco Network Exchange (PTNX) without needing to interpret CCS signalling information for call processing. CCS frame-forwarding forwards High-Level Data Link Control (HDLC) frames over a preconfigured interface running HDLC, Frame Relay, or ATM encapsulation.

With CCS frame-forwarding, the connection between PTNXs over the network must be point-to-point and preconfigured. With the CCS frame-forwarding implementation, calls from the PTNX devices are not routed, but follow a preconfigured route to the destination.

Note When CCS frame-forwarding is configured, the speed (clock rate) of serial interface 1 on the Cisco MC3810 is limited to a maximum of 192 kbps. This restriction assumes that the MFT is installed in slot 3 on the Cisco MC3810. If the MFT is not installed, then serial interface 1 will not operate at all, but CCS frame-forwarding will be supported on other interfaces.

Figure 100 shows an example of CCS frame-forwarding. In the example, the Cisco MC3810 captures the signalling frame from the PBX. The Cisco MC3810 then transports the signalling frame as a data frame through the Frame Relay or ATM network to the second Cisco MC3810. The second Cisco MC3810 then forwards the signalling frame to the PBX signalling channel.

Figure 100 CCS Frame-Forwarding



Note Although it is not explicitly stated in the procedures, this feature also requires that voice ports and dial peers must also be configured.

To configure CCS frame-forwarding on the Cisco MC3810, use the following commands beginning in global configuration mode:

:

	Command	Purpose
Step 1	`Router(config)# controller {T1 | E1} 1`	Enters controller configuration mode. CCS frame-forwarding is only available on controller T1/E1 1.
Step 2	`Router(config-controller)# mode ccs frame-forwarding`	Specifies the controller to support CCS transparent signalling.
Step 3	`Router(config-controller-cas)# voice-group` *channel-no* **timeslots** *timeslot-list* **type** [**ext-sig-master** | **ext-sig-slave**]	Configures the specified channel to support CCS mode, and specifies whether the T1/E1 trunk will be the external signalling master or slave. A channel configured as **ext-sig-master** automatically generates the off-hook signal and stays in the off-hook state. A channel configured as **ext-sig-slave** automatically generates the answer signal when a call is terminated to that channel. These **type** options are available only when the **mode ccs** command is enabled.

	Command	Purpose

Step 4	For Cisco MC3810 series analog voice ports:
	`router(config)# voice-port slot/port`
	For Cisco MC3810 series digital voice ports:
	`router(config)# voice-port slot:ds0-group`
		Enters voice-port configuration mode.

Step 5	`Router(config-voiceport)# connection plar string`	If the voice port in the voice group is configured as the **ext-sig-master**, configures the voice-port connection to support PLAR mode for bearer channels. For the string, enter the number of the voice channel that was configured as the **ext-sig-master** for the **voice-group** command. If the voice port in the voice group is configured as the **ext-sig-slave**, the dial peer should just terminate the PLAR calls. **Note** After a transparent CCS connection is configured with the **connection plar** command, any change to the configuration will not take place until the connection is shut down with a **shutdown** command and then restarted with a **no shutdown** command. For example, the phone number supplied in the **connection plar** command can be changed while the connection is in **no shutdown** state, but the change will not cause the current connection to be closed and a new connection opened to the new phone number. This will only take effect on the next **no shutdown** command after a **shutdown** command.
Step 6	`Router(config)# interface serial 1:x`	Enters interface mode for serial 1:*x,* where x represents the channel number. For E1, enter 15. For T1, enter 23. This procedure maps the D channel from the DVM to the specified interface.
Step 7	`Router(config-if)# ccs connect {serial |atm} number [dlci dlci| pvc vci | pvc vcd | pvc vpi/vci | pvc string]`	Configures the CCS connection. If the CCS connection is over Frame Relay, specify a serial interface and the DLCI. If the CCS connection is over ATM, specify ATM, interface 0, and the PVC.
Step 8	`Router(config-if)# no cdp enable`	Disables Cisco Discovery Protocol (CDP) on the interface.
Step 9	`Router(config-if)# no keepalive`	Disables keepalive packets on the interface.

CCS Frame-Forwarding Configuration Example

The following configuration example configures CCS frame-forwarding on controller E1. Other commands necessary for the configuration are included.

```
! version 12.0
 no service pad
 service timestamps debug uptime
 service timestamps log uptime
 no service password-encryption
 !
 hostname c3810a
 !
 logging buffered 4096 debugging
 !
 network-clock base-rate 56k
 ip subnet-zero
 no ip domain-lookup
 ip host rb 10.1.1.1
 !
 !
 !
 stun peer-name 10.1.1.1
 stun protocol-group 1 basic
 !
 controller E1 1
  framing NO-CRC4 Australia
  clock source internal
  mode ccs frame-forwarding
  voice-group 1 timeslots 1-2 type ext-sig-master
 !
 !
 !
 interface Ethernet0
  ip address 144.254.156.169 255.255.255.0
  no ip directed-broadcast
  no ip route-cache
  no ip mroute-cache
  no keepalive
 !
 interface Serial0
  ip address 10.1.1.2 255.255.255.0
  no ip directed-broadcast
  encapsulation frame-relay
  no ip route-cache
  no ip mroute-cache
  no arp frame-relay
  bandwidth 256
  no keepalive
  no fair-queue
  serial restart-delay 0
  frame-relay interface-dlci 30 voice-encap 80
  hold-queue 1024 out
 !
 interface Serial1
  no ip address
  no ip directed-broadcast
  encapsulation stun
  no ip route-cache
  no ip mroute-cache
  stun group 1
  stun route all interface Serial0 dlci 30
 !
```

```
interface Serial1:15
 no ip address
 no ip directed-broadcast
 ccs connect Serial0 30
!
interface Switch0
 no ip address
 no ip directed-broadcast
 encapsulation frame-relay
 no fair-queue
!
interface FR-ATM0
 no ip address
 no ip directed-broadcast
!
interface FR-ATM20
 no ip address
 no ip directed-broadcast
 no ip route-cache
 shutdown
!
router rip
 network 10.0.0.0
 network 144.254.0.0
!
ip classless
!
!
map-list atm1
!
map-class frame-relay A-relay
 frame-relay traffic-rate 256000 1540000
 no frame-relay adaptive-shaping
!
!
line con 0
 transport input none
line aux 0
line 2 3
line vty 0 4
 password cisco
 login
!
!
voice-port 1/1
 vad
 connection plar 1
!
voice-port 1/2
 vad
 connection plar 2
!
dial-peer voice 1 vofr
 destination-pattern 1
 session target Serial0 30
!
dial-peer voice 2 vofr
 destination-pattern 2
 session target Serial0 30
!
end
```