SS7 Continuity Testing for Network Access Servers

The following sections are provided:

Feature Summary

This document describes how to set up continuity testing for Signaling System 7 (SS7) on a network access server (NAS).

Continuity testing reduces the call failure rate by detecting failed DS0s (B channels) on the NAS before setting up a call. Calls can be circuit switched data calls or analog modem calls. Because the Cisco Signaling Controller SC2200 does not directly control the bearer channels on an access server, the access server must perform the loopbacks and tone generation or tone detection required for continuity testing.

Continuity testing is required for North American SS7 compliance.

List of Terms

COT—Continuity testing. Used to test individual DS0 channels before establishing a call.

NI2—National ISDN-2 local switch type. This switch type was enhanced to support continuity testing for Public Switched Telephone Network (PSTN) originated calls.

Restrictions

ITU-based networks use only the loopback method for continuity testing. However, ANSI networks may use the tone generation, tone detection, or loopback methods. Only the loopback method is supported for Cisco's first release of COT.

Release 1 of COT supports dial-in calls. Dial-out calls are supported in the second release.

Platforms

The following hardware platforms support this feature:

- Cisco AS5800
- Cisco AS5300
- Cisco AS5200
- Cisco AccessPath

Supported MIBs and RFCs

The GR—246-CORE MIB is supported.

Configuration Tasks

Perform the following tasks to fully configure a D-channel interface then set up continuity testing:

- Configuring D Channels
- Setting Up Continuity Testing

Configuring D Channels

SS7 is processed on the NAS's D channels. You must configure all the D channels to carry the appropriate control and signaling messages for analog modem calls and circuit-switched data calls. In most scenarios, the D channel configuration on each ISDN PRI will be identical.

Each of Cisco's NASs use different interface and slot numbering schemes. For example, the first D channel on a Cisco AS5800 T1 configuration is specified using the **interface serial 1/0/0:23** command. For a Cisco AS5300 and Cisco AS5200, the **interface serial 0:23** command is used.

Note See the software configuration guide that shipped with your access server for more information. The following configuration table shows how to configure a Cisco AS5300.

Configure

Step	Command	Purpose
1	`Router(config)# interface serial number:number`	Specify a D-channel serial interface. Replace the *number* argument with a controller number followed by a colon (**:**) and D-channel number. For example, a Cisco AS5300 T1 configuration can have either **0:23**, **1:23**, **2:23**, or **3:23**. A Cisco AS5300 E1 configuration can have either **0:15**, **1:15**, **2:15**, or **3:15**.
2	`Router(config-if)# dialer-group number`	Define the interesting packets that reset the idle timer and activate ISDN connections. Interesting packets meet the criteria specified by the **dialer-list** command (for example, **dialer-list 1 protocol ip permit**). Replace the dialer group's *number* argument with the same number used by the **dialer-list** command.
3	`Router(config-if)# ip unnumbered ethernet 0`	Assign the D channel an unnumbered address, which conserves IP address space.
4	`Router(config-if)# encapsulation ppp`	Enable PPP encapsulation over HDLC, which is for CHAP and PAP authentication.
5	`Router(config-if)# no ip mroute-cache`	Disable IP mroute cache.
6	`Router(config-if)# isdn incoming-voice modem`	Configure all incoming voice calls to go to the modems.
7	`Router(config-if)# peer default ip address pool name`	Assign a common IP address pool to the interface. Individual remote PCs not connected to a LAN dynamically receive their IP addresses from this pool. Replace the *name* variable with a name for the pool. Local IP pools are configured with the **ip local pool** *name address* global configuration command.
8	`Router(config-if)# ppp authentication chap pap`	Enable CHAP and PAP authentication on the interface.
9	`Router(config-if)# ppp multilink`	Enable PPP multilink.
10	`Router(config-if)# no fair-queue`	Disable fair queuing.

Verify

To verify a D-channel T1 configuration:

- Enter the **show interface 1:23** command. For E1 configurations, enter the **show interface 1:15** command.

```
Router# show interface 1:23
Serial1:23 is up, line protocol is up
  Hardware is DSX1
  Interface is unnumbered.  Using address of FastEthernet0 (15.0.0.60)
  MTU 1500 bytes, BW 64 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set
```

```
  Last input 00:00:00, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     54 packets input, 214 bytes, 0 no buffer
     Received 0 broadcasts, 10 runts, 0 giants, 0 throttles
     10 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     53 packets output, 211 bytes, 0 underruns
     0 output errors, 0 collisions, 10 interface resets
     0 output buffer failures, 0 output buffers swapped out
     1 carrier transitions
  Timeslot(s) Used:24, Transmitter delay is 0 flags
```

Tips

If you are having trouble:

- Make sure the serial interface and protocol are up by entering the **show interface serial** command:

```
Router(config)# show interface serial 0:23
Serial0:23 is up, line protocol is up
  Hardware is DSX1
  Internet address is 61.0.0.2/8
  MTU 1500 bytes, BW 64 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set
  Last input 00:00:02, output 00:00:02, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     6442 packets input, 25855 bytes, 0 no buffer
     Received 0 broadcasts, 8 runts, 0 giants, 0 throttles
     8 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     6439 packets output, 25875 bytes, 0 underruns
     0 output errors, 0 collisions, 8 interface resets
     0 output buffer failures, 0 output buffers swapped out
     1 carrier trnsitions
  Timeslot(s) Used:24, Transmitter delay is 0 flags
```

- Enter the **debug dialer** command to view the error messages. You can also use the **debug dialer events** command or **debug dialer packets** command to view event or packet messages. When you finish viewing the messages, enter the **no debug dialer** command to turn off the messages. See Table 1 for explanations of the messages.

```
Router# debug dialer
PRI0: Dialing cause: PRI0: ip PERMIT
PRI0: No dialer string defined.  Dialing cannot occur..
PRI0: Dialing cause: PRI0: ip PERMIT
```

Table 1 Debug Dialer Messages

Message	Description
`PRI0: No dialer string defined. Dialing cannot occur`	Displayed when a packet is received that should cause a call to be placed. However, there is no dialer string configured, so dialing cannot occur. This message usually indicates a configuration problem. Re-enter the **dialer-group** command in Step 2 in the "Configure" section.
`PRI0: Attempting to dial xxxxxxxxxx`	Indicates that a packet has been received that passes the dial-on-demand access lists. That packet causes dialing of a phone number. The xxxxxxxxxx variable is the number being called.
`PRI0: Unable to dial xxxxxxxxxx`	Displayed if the phone call could not be placed. This can be due to a lack of memory, full output queues, or other problems.
`PRI0: disconnecting call`	Displayed when the Cisco AS5300 attempts to hang up a call.

`PRI0: idle timeout`
`PRI0: re-enable timeout`
`PRI0: wait for carrier timeout`
	One of these three messages is displayed when their corresponding dialer timer expires. They are mostly informational, but are useful when debugging a disconnected call or call failure.

- If dialing cannot occur, check the configuration by entering the **debug isdn q931** command. When you finish viewing the messages, enter the **no debug isdn q931** command to turn off the messages. See Table 2 for explanations of the debug messages.

```
Router# debug isdn q931
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1/0:22, changed state to up
ISDN Event: Call to 9086154535 dsl 3 at 64 Kb/s
TX ->  SETUP dsl = 3 pd = 8  callref = 0x188C
          Bearer Capability i = 0x8890
          Channel ID i = 0xE1808397
          Called Party Number i = 0xA1, '95163287448'
RX <-  RELEASE_COMP dsl = 3 pd = 8  callref = 0x988C
          Cause i = 0x83E020 - Mandatory IE missing
ISDN PRI 3: entering process_rxstate, CALL_CLEARED
ISDN PRI 3: received message 1F
ISDN Event: Hangup call to call id 0xCE2 on dsl 2
```

Table 2 Debug ISDN Messages

Message	Description
`TX ->`	Indicates this message is being transmitted from the local router (user side) to the network side of the ISDN interface.
`RX <-`	Indicates this message is being received by the user side of the ISDN interface from the network side.
`SETUP`	Indicates the SETUP message has been sent to initiate call establishment between peer network layers. The message can be sent from the local router or network.
`pd`	Indicates the protocol discriminator. The protocol discriminator distinguishes messages for call control over the user-network ISDN interface from other ITU-T1[1]-defined messages, including other Q.931 messages. The protocol discriminator is 8 for call control messages such as SETUP.

Table 2 Debug ISDN Messages (Continued)

Message	Description
`callref`	Indicates the call reference number in hexadecimal. The field value indicates the number of calls made from the router (outgoing calls) or the network (incoming calls). Note that the originator of the SETUP message sets the high-order bit of the call reference number to 0. The destination of the connection sets the high-order bit to 1 in subsequent call control messages, such as the CONNECT message. For example, callref = 0x04 in the request becomes callref = 0x84 in the response.
`Bearer Capability`	Indicates the requested bearer service to be provided by the network.
`Cause i`	Indicates the Information Element Identifier. The value depends on the field with which it is associated. Refer to the ITU-T Q.931 specification for details about the possible values associated with each field for which this identifier is relevant.
`Channel ID`	Indicates the Channel Identifier. The value 83 indicates any channel, 89 indicates the B1 channel, and 8A indicates the B2 channel. For more information about the Channel Identifier, refer to ITU-T Recommendation Q.931.
`Called Party Number`	Identifies the called party. This field is only present in outgoing SETUP messages. It can be replaced by the Keypad facility field. This field uses the IA5 character set.
`RELEASE`	Indicates that the sending equipment will release the channel and call reference. The recipient of this message should prepare to release the call reference and channel.
`RELEASE_COMP`	Indicates that the sending equipment has received a RELEASE message and has now released the call reference and channel.

1. ITU-T1 = International Telecommunication Union Telecommunication Standarization Sector.

Setting Up Continuity Testing

Continuity testing is set up by enabling the NI2 switch type and configuring ISDN service COT messages to pass through each D-channel interface involved in SS7 call signaling control.

Configure

Step	Command	Purpose
1	`Router(config)# isdn switch-type primary-ni`	Configure support for the NI2 local ISDN PRI switch type. This switch type is enhanced to support communication between the access server and the external Cisco Signaling Controller SC2200.
2	`Router(config)# interface serial` *number*`:`*number*	Specify a D-channel serial interface. Replace the *number* argument with a controller number followed by a colon (**:**) and D-channel number. For example, a Cisco AS5300 T1 configuration can have either **0:23**, **1:23**, **2:23**, or **3:23**. A Cisco AS5300 E1 configuration can have either **0:15**, **1:15**, **2:15**, or **3:15**.
3	`Router(config-if)# isdn service cot`	Allow ISDN service COT messages to pass through the D channel. This command is disabled by default. This command must also be configured on each D-channel interface that is involved in SS7 call signaling control.

Verify

Use the **debug isdn q931** command to display continuity testing debug messages. The following shows a successful COT sequence debug log after the **debug isdn q931** command is issued and a call comes through the system.

A COT request comes into the NAS, as indicated by the field `COT REQUEST pd`. The NAS performs a loopback test on DS0 channel 1, as indicated by the field `COT_ServiceMsg: set loop on dsl 0, channel 1`. The test operation was a success, as shown by the field `COT Result i = 0x02`.

Note The significant COT messages that you should look for are in bold font.

```
Router# debug isdn q931
00:06:38: ISDN Se0:23: RX <-  RRp sapi = 0  tei = 0 nr = 0
00:06:38: ISDN Se0:23: TX ->  RRf sapi = 0  tei = 0  nr = 0
Router#
00:06:48: ISDN Se0:23: RX <-  RRp sapi = 0  tei = 0 nr = 0
00:06:48: ISDN Se0:23: TX ->  RRf sapi = 0  tei = 0  nr = 0
Router#
00:06:52: ISDN Se0:23: RX <-  INFOc sapi = 0  tei = 0  ns = 0  nr = 0  i =
0x43020003031804E9808381610102620227
00:06:52:     COT REQUEST pd = 67  callref = 0x0003
00:06:52:         Channel ID i = 0xE9808381
00:06:52:         COT Operation i = 0x02
00:06:52:         COT Duration i = 0x2702
00:06:52: ISDN Se0:23: TX ->  RRr sapi = 0  tei = 0  nr = 1
00:06:52: COT_ServiceMsg: set loop on dsl 0, channel 1
00:06:52: COT_Response(call_id 0x8003, operation 2, result 2) sent
00:06:52: ISDN Se0:23: TX ->  INFOc sapi = 0  tei = 0  ns = 0  nr = 1  i =
0x43028003021804E9808381610102630102
00:06:52:     COT RESULT pd = 67  callref = 0x8003
00:06:52:         Channel ID i = 0xE9808381
00:06:52:         COT Operation i = 0x02
00:06:52:         COT Result i = 0x02
00:06:52: ISDN Se0:23: RX <-  RRr sapi = 0  tei = 0  nr = 1
Router#
00:07:02: ISDN Se0:23: RX <-  RRp sapi = 0  tei = 0 nr = 1
00:07:02: ISDN Se0:23: TX ->  RRf sapi = 0  tei = 0  nr = 1
Router#
00:07:12: ISDN Se0:23: RX <-  RRp sapi = 0  tei = 0 nr = 1
00:07:12: ISDN Se0:23: TX ->  RRf sapi = 0  tei = 0  nr = 1
Router#
00:07:14: ISDN Se0:23: RX <-  INFOc sapi = 0  tei = 0  ns = 1  nr = 1  i =
0x43020003031804E9808381610101
00:07:14:     COT REQUEST pd = 67  callref = 0x0003
00:07:14:         Channel ID i = 0xE9808381
00:07:14:         COT Operation i = 0x01
00:07:14: ISDN Se0:23: TX ->  RRr sapi = 0  tei = 0  nr = 2
00:07:14: COT_ServiceMsg: clear loop on dsl 0, channel 1
00:07:14: COT_Response(call_id 0x8003, operation 1, result 1) sent
00:07:14: ISDN Se0:23: TX ->  INFOc sapi = 0  tei = 0  ns = 1  nr = 2  i =
0x43028003021804E9808381610101630101
00:07:14:     COT RESULT pd = 67  callref = 0x8003
00:07:14:         Channel ID i = 0xE9808381
00:07:14:         COT Operation i = 0x01
00:07:14:         COT Result i = 0x02
00:07:14: ISDN Se0:23: RX <-  RRr sapi = 0  tei = 0  nr = 2
Router#
00:07:24: ISDN Se0:23: RX <-  RRp sapi = 0  tei = 0 nr = 2
00:07:24: ISDN Se0:23: TX ->  RRf sapi = 0  tei = 0  nr = 2
Router#
```

```
00:07:34: ISDN Se0:23: RX <-  INFOc sapi = 0  tei = 0  ns = 2  nr = 2  i =
0x43020003031804E9808381610102620227
00:07:34:     COT REQUEST pd = 67  callref = 0x0003
00:07:34:         Channel ID i = 0xE9808381
00:07:34:         COT Operation i = 0x02
00:07:34:         COT Duration i = 0x2702
00:07:34: ISDN Se0:23: TX ->  RRr sapi = 0  tei = 0  nr = 3
00:07:34: COT_ServiceMsg: set loop on dsl 0, channel 1
00:07:34: COT_Response(call_id 0x8003, operation 2, result 2) sent
00:07:34: ISDN Se0:23: TX ->  INFOc sapi = 0  tei = 0  ns = 2  nr = 3  i =
0x43028003021804E9808381610102630102
00:07:34:     COT RESULT pd = 67  callref = 0x8003
00:07:34:         Channel ID i = 0xE9808381
00:07:34:         COT Operation i = 0x02
00:07:34:         COT Result i = 0x02
00:07:34: ISDN Se0:23: RX <-  RRr sapi = 0  tei = 0  nr = 3
Router#
00:07:39: ISDN Se0:23: RX <-  INFOc sapi = 0  tei = 0  ns = 3  nr = 3  i =
0x43020003031804E9808381610101
```

Tips

- To generate service messages for each DS0 (B channel) that is removed from service, use the **isdn service dsl 0 b_channel 1 state 2** command. This command is also configured on the D-channel interface. This command is useful for informing the LS1010 or Digital Cross Connect System (DACS) to not place calls to B channels that are removed from service.
- To view channels that are manually taken out of service or when a PRI line goes up then down, use the **show isdn service** command.

Command Reference

The **isdn service cot** command is added for this feature. All other commands used with this feature are documented in the Cisco IOS Release 11.3 command references.

isdn service cot

To enable ISDN service COT messages to pass through each D-channel interface involved in SS7 call signaling control, enter the **isdn service cot** interface configuration command. Use the **no** form of this command to disable this function.

isdn service cot
no isdn service cot

Syntax Description

This command has no keywords or arguments.

Default

Disabled

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 11.3 AA.

You must also enable the NI2 switch type, which delivers COT messages to the network access server. The NI2 switch type is enabled with the **isdn switch-type primary-ni** command.

Use the **debug isdn q931** command to display the continuity test debug messages.

Related Commands

debug isdn q931
isdn switch-type primary-ni

What to Do Next

For additional software configuration information, see the following publications:

- *SS7 Dial Access Solution System Integration*
- *Cisco AS5300 Universal Access Server Software Configuration Guide*
- *Cisco AS5800 Installation and Configuration Guide*
- *Dial Solutions Configuration Guide* (Cisco IOS Release 11.3)