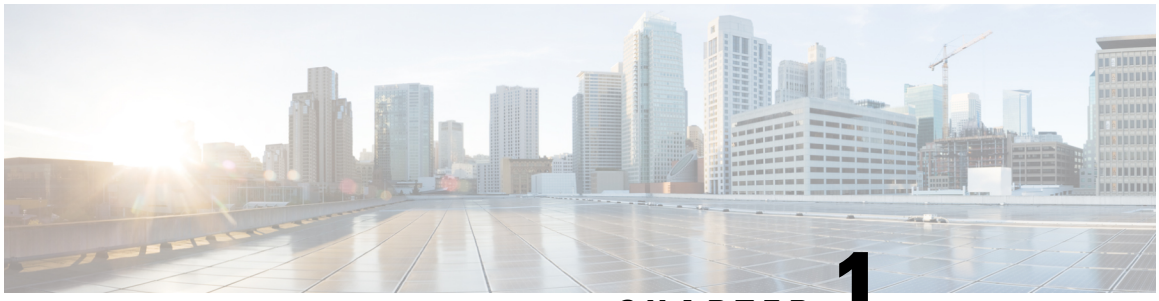
T1 or E1 CEM Interface Module Configuration Guide, Cisco IOS XE 17 (Cisco NCS 4200 Series)

First Published: 2021-03-26

Last Modified: 2022-04-11

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

CONTENTS



CHAPTER 1

Preface

This guide provides an overview and explains how to configure the various features for the T1 or E1 CEM Interface Module.

This document is applicable for the following interface modules:

Table 1: Supported Interface Module

Interface Module	Part Number	Mode
48-port T1/E1 Interface module	• NCS4200-48T1E1-CE	T1/E1
1-port OC48/ STM-16 or 4-port OC-12/OC-3 / STM-1/STM-4 + 12-Port T1/E1 + 4-Port T3/E3 CEM Interface Module	• NCS4200-3GMS	

Circuit Emulation (CEM) is a technology that provides a protocol-independent transport over IP/MPLS networks. It enables proprietary or legacy applications to be carried transparently to the destination, similar to a leased line.

- Document Organization, on page 1
- Related Documentation, on page 2

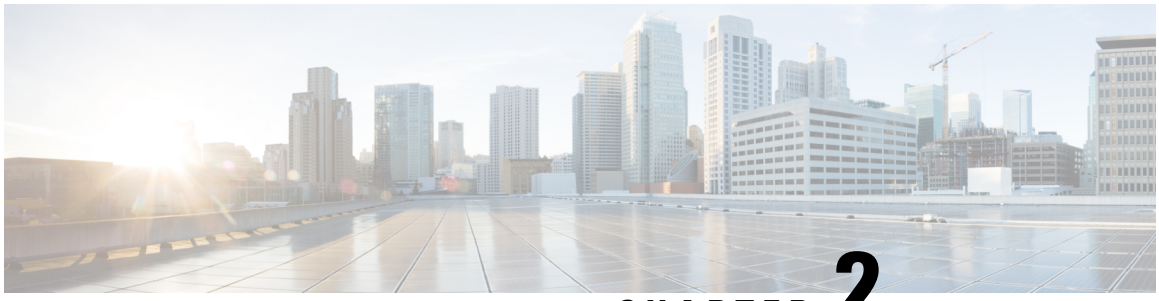
Document Organization

Chapter	Description
Overview of the T1/E1 Interface Module	Provides a high-level overview of the interface module. Also provides additional information such as restrictions, benefits etc..
Configuring the T1/E1 Interface Module	Provides information about how to configure the interface module.
Monitoring the Interface Module	Provides information on monitoring features for the interface module.

Chapter	Description
Troubleshooting the Interface Module	Describes features that you can use to troubleshoot the operation of interface module.
Additional References	Provides information on additonal features, technical details.

Related Documentation

- Alarm Configuring and Monitoring Guide
- CEM Generic Guide
- T3 or E3 CEM Interface Module Configuration Guide



CHAPTER 2

Feature History

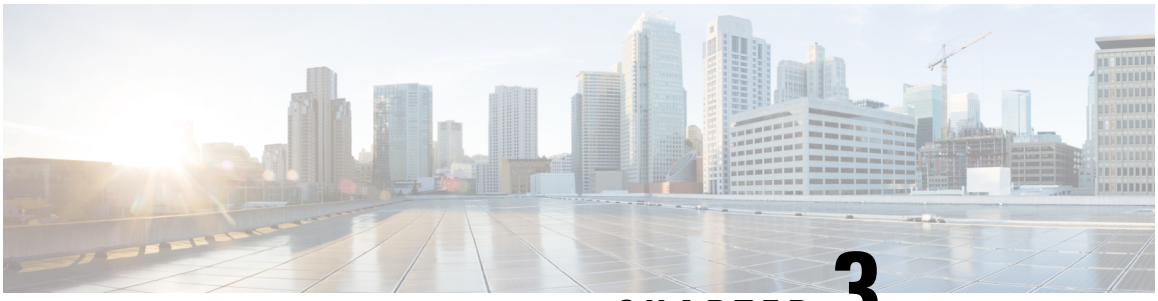
The following table lists the new features supported in the 48-Port T1/E1 CEM Interface Module Configuration Guide in Cisco IOS XE 17 releases., on Cisco NCS 4201 and Cisco NCS 4202 routers.

Feature	Description
Cisco IOS XE Cupertino 17.8.1	
NCS4200-48T1E1-CE support in NCS4202	The router supports the following features for the 48-Port T1/E1 Circuit Emulation (CEM) interface module: • Basic mode, and T1 or E1 controller required configurations • CEM clocking, ACR, and DCR • CEM pseudowires such as Structure-Agnostic TDM over Packet (SATOP) and Circuit Emulation over Packet-Switched Network (CESoPSN) • BERT, loopback, and alarms • Performance monitoring The support for the interface module provides cost-effective delivery of CEM over a packet-based network (MPLS).
Cisco IOS XE Bengaluru 17.5.1	
GR-820-CORE Performance Monitoring	The **`show controller tabular`** command enables you to view the performance monitoring details in tabular form as per GR-820-Core standards.
Cisco IOS XE Bengaluru 17.4.1	
Support for all 0s and 1s BERT Patterns	Support for all 0s and 1s BERT patterns on T1 or E1 interfaces.

The following table lists the new and modified features supported in the 48-Port T1/E1 CEM Interface Module Configuration Guide in Cisco IOS XE 17 releases., on Cisco NCS 4206 and Cisco NCS 4216 routers.

Feature	Description
Cisco IOS XE Bengaluru 17.5.1	

Feature	Description
GR-820-CORE Performance Monitoring	The **show controller tabular** command enables you to view the performance monitoring details in tabular form as per GR-820-Core standards.
Cisco IOS XE Bengaluru 17.4.1	
Support for all 0s and 1s BERT Patterns	Support for all 0s and 1s BERT patterns on T1 or E1 interfaces.



CHAPTER 3

Overview of the T1 or E1 Interface Module

Table 2: Feature History

Feature Name	Release Information	Description
NCS4200-48T1E1-CE support in NCS4202	Cisco IOS XE Cupertino 17.8.1	The router supports the following features for the 48-Port T1/E1 Circuit Emulation (CEM) interface module: • Basic mode, and T1 or E1 controller required configurations • CEM clocking, ACR, and DCR • CEM pseudowires such as Structure-Agnostic TDM over Packet (SATOP) and Circuit Emulation over Packet-Switched Network (CESoPSN) • BERT, loopback, and alarms • Performance monitoring The support for the interface module provides cost-effective delivery of CEM over a packet-based network (MPLS).

The T1 or E1 interface module delivers T1 or E1 connectivity on the router with the RSP3 module. The module can be software configured as either T1 mode or E1 mode per interface module The module provides physical connectivity using a single high-density connector and requires a breakout cable and patch panel for individual port connections.

The T1 or E1 interface module supports the following modes:

- T1

- E1

Note Mixing T1 and E1 ports on the same interface module is not supported.

CEM configurations are supported on different modes on the interface module. The troubleshooting, monitoring, and redundancy features are supported on the module. The module can be clocked from a line or from an internal clock source. The table describes the configurations and features for the modes that are supported on the T1 or E1 interface module.

Table 3: Configurations on T1 or E1 Interface Module

	T1	E1
Required Configurations		
Mode	Yes	Yes
Internal/Line Clock Source	Yes	Yes
ACR/DCR Clock	Yes	Yes
CEM Configurations		
Structure-Agnostic TDM over Packet (SATOP) (Framed/Unframed)	Yes	Yes
Circuit Emulation over Packet-Switched Network (CESoPSN)	Yes	Yes
Troubleshooting Features		
Bit Error Rate Testing (BERT)	Yes	Yes
Loopback	Yes	Yes
Monitoring Features		
Performance Monitoring	Yes	Yes

- Restrictions for Configuring T1 or E1 Interfaces, on page 6
- Circuit Emulation, on page 7
- Overview of CEM Pseudowire, on page 7
- Framed Structure-Agnostic TDM over Packet (SAToP), on page 7
- Circuit Emulation Service over Packet-Switched Network, on page 9

Restrictions for Configuring T1 or E1 Interfaces

- You can configure CEM to support serial interface configuration.
- The card can be configured either in the T1 or E1 mode. A combination of T1 and E1 ports is not supported.

Circuit Emulation

Circuit Emulation (CEM) is a technology that provides a protocol-independent transport over IP/MPLS networks. It enables proprietary or legacy applications to be carried transparently to the destination, similar to a leased line.

CEM provides a bridge between a Time-Division Multiplexing (TDM) network and Multiprotocol Label Switching (MPLS) network. The router encapsulates the TDM data in the MPLS packets and sends the data over a CEM pseudowire to the remote Provider Edge (PE) router. As a result, CEM functions as a physical communication link across the packet network.

The router supports the pseudowire type that utilizes CEM transport: Structure-Agnostic TDM over Packet (SAToP) and Circuit Emulation Service over Packet-Switched Network (CESoPSN).

L2VPN over IP/MPLS is supported on the interface modules.

Note We recommend that you configure the controller in the administratively up mode. Configuration under the administratively down mode is not recommended and it might cause configuration errors.

Overview of CEM Pseudowire

Pseudowires manage encapsulation, timing, order, and other operations in order to make it transparent to users. The pseudowire tunnel acts as an unshared link or circuit of the emulated service. CEM is a way to carry TDM circuits over packet switched network. CEM embeds the TDM circuits into packets, encapsulates them into an appropriate header, and then sends that through Packet Switched Network. The receiver side of CEM restores the TDM circuits from packets.

Configuring Pseudowire

Cisco Pseudowire Emulation Edge-to-Edge (PWE3) allows you to transport traffic by using traditional services such as T1/E1 over a packet-based backhaul technology such as MPLS or IP. A pseudowire (PW) consists of a connection between two provider edge (PE) chassis that connects two attachment circuits (ACs), such as T1/E1 or T3 /E3 links.

Framed Structure-Agnostic TDM over Packet (SAToP)

Framed Structure-Agnostic TDM over Packet (SAToP) is required to detect an incoming AIS alarm in the DS1 SAToP mode. An AIS alarm indicates a problem with the line that is upstream from the DS1 network element connected to the interface. Framed SAToP further helps in the detection of a packet drop.

In case of unframed mode of SAToP, data received from the Customer Edge (CE) device is transported ove the pseudowire. If the Provider Edge (PE) device receives a Loss of Frame (LOF) signal or Remote Alarm Indication (RAI) signal from a CE, the PE can only transmit the signal that is detected by the CE device. With the introduction of Framed SAToP, when the PE device receives the LOF or RAI signal, the PE device can detect the alarm for SAToP. Thus, the alarm can be detected earlier in the network. This helps in enhanced performance.

Note Framing type should be maintained same in all routers end to end.

Difference between Framed and Unframed SAToP:

1. For unframed SAToP, the incoming signal is transmitted to the far end. This signal is not analyzed by the PE device. Hence, no alarm is reported.
2. For framed SAToP, the incoming signal is analyzed but is not terminated. If a LOF or RAI signal is detected, the remote PE detects the signals and transmits towards the remote CE.

Difference between Framed SAToP and CESoP:

Table 4: Behaviour Difference between Unframed SAToP, Framed SAToP, and CESoP on LOF Alarm

Modes	Alarm Detected at PE	Controller Status at PE	Alarm Detected at CE (Remote)	Framing Bits Generationat PE (Remote)	Framing Bits Terminated at PE (Remote)
Unframed SAToP	None	Up	LOF	No	No
Framed SAToP	LOF	Down (Data path remians up)	AIS[1][2]	Yes	No
CESOP	LOF	Down (Data path remians up)	AIS	Yes	Yes

[1] AIS—Cisco IOS XE Amsterdam 17.3.1 to later releases
[2] LOF—Support until Cisco IOS XE Amsterdam 17.2.1

Table 5: Behaviour Difference between Unframed SAToP, Framed SAToP, and CESoP on RDI Alarm

Modes	Alarm Detected at PE	Controller Status at PE	Alarm Detected at CE (Remote)	Framing Bits Generation at PE (Remote)	Framing Bits Terminated at PE (Remote)
Unframed SAToP	None	Up	RDI	No	No
Framed SAToP	RDI	Down (data path remains up)	RDI	No	No
CESOP	RDI	Down (data path remains up)	RDI	M-bit is set into control word	Yes

Table 6: Behaviour Difference between Unframed SAToP, Framed SAToP, and CESoP on AIS alarm

Modes	Alarm Detected at PE	Controller Status at PE	Alarm Detected at CE (Remote)	Framing Bits Generation at PE (Remote)	Framing Bits Terminated at PE (Remote)
Unframed SAToP	AIS	Down (data path remains up)	AIS	No	No
Framed SAToP	AIS	Down (data path remains up)	AIS	No	No
CESOP	AIS	Down (data path remains up)	AIS	L-bit is set into control word	Yes

Remote Loopback from CE to PE Detection:

Framed SAToP does not detect any loopback.

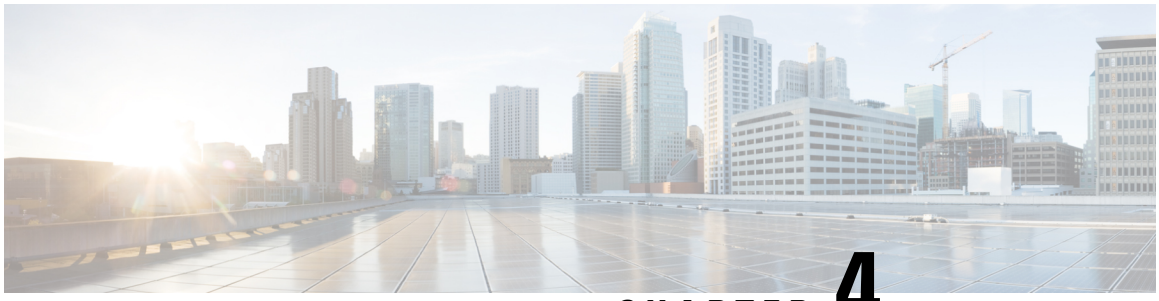
	Loopback Detected at PE	Controller Status at PE (Remote)	Controller Status at CE (Remote)
Unframed SAToP	No	Not in Loopback	Loopback
Framed SAToP	No	Not in Loopback	Loopback
CESOP	Yes	Loopback	Not in loopback

Circuit Emulation Service over Packet-Switched Network

CESoPSN is a method for encapsulating structured (NxDS0) TDM signals as pseudowires over packet switching networks.

Restrictions for CESoPSN on T1 Interface

- The maximum number of CEM interface supported is 192.
- DS0 loopback is not supported on the T1 interface.
- Alarm forwarding is not supported on the T1 interface.
- Card protection is not supported on the T1 interface.



CHAPTER 4

Configuring T1 or E1 Interfaces

This chapter provides the information about how to configure a T1 or E1 interface.

Setting the Card Type

To set the card type for the T1/E1 interfaces, complete these steps:

```
enable
configure terminal
card type t1  0 1
exit
```

Configuring the Controller

To configure T1 interface, use the following commands:

```
enable
configure terminal
controller t1 0/1/0
clock source internal
framing esf
cablelength short 110
linecode b8zs
no shut
exit
```

Note For T1 interface, the default frame mode is Extended Super Frame (ESF).

To configure E1 interface, use the following commands:

```
enable
configure terminal
controller e1 0/1/0
clock source internal
framing crc4
linecode hdb3
no shut
exit
```

Note For E1 interface, the default frame mode is Cyclic Redundancy Check 4 (CRC4).

Staring with Cisco IOS XE Cupertino 17.7.1, the cable length short values are modified for the following interface modules:

- NCS4200-48T1E1-CE
-

Table 7: Cable Length Short Values

Cable Length Short (in ft)	Range (in ft)
110	0–133
220	134–266
330	267–399
440	400-533
550	534–655

For the following interface modules, the cable length short values remain the same:

Table 8: IM Port Support - Cable Length Short

Port Supported	IM
T1 Port	NCS4200-8E1T1-CE

Table 9: Cable Length Short Values - IMs

Cable Length Short (in ft)	Range (in ft)
110	0–110
220	111–220
330	221–330
440	331–440
550	441–550

Verifying the Controller Configuration

Use the **show controllers** command to verify the controller configuration:

```
Router# show controller e1 0/2/0
E1 0/2/0 is up.
Applique type is ASR903-48T1E1-CE

  Cablelength is short 110
  No alarms detected.
  alarm-trigger is not set
  Soaking time: 3, Clearance time: 10
  AIS State:Clear  LOS State:Clear  LOF State:Clear
  Framing is ESF, FDL is ansi, Line Code is B8ZS, Clock Source is Line.
  BER thresholds:  SF = 10e-3  SD = 10e-6
  Data in current interval (230 seconds elapsed):
   Near End
     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 Unavailable Secs
     0 Path Failures, 0 SEF/AIS Secs
   Far End
     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 Unavailable Secs
     0 Path Failures
  Data in Interval 1:
   Near End
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 14 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 15 Unavailable Secs
     1 Path Failures, 0 SEF/AIS Secs
   Far End Data
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 4 Fr Loss Secs, 2 Line Err Secs, 0 Degraded Mins
     4 Errored Secs, 0 Bursty Err Secs, 4 Severely Err Secs, 0 Unavailable Secs
     0 Path Failures
  Total Data (last 1 15 minute intervals):
   Near End
     0 Line Code Violations, 0 Path Code Violations,
     0 Slip Secs, 0 Fr Loss Secs, 14 Line Err Secs, 0 Degraded Mins,
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 15 Unavailable Secs
     1 Path Failures, 0 SEF/AIS Secs
   Far End
     0 Line Code Violations, 0 Path Code Violations,
     0 Slip Secs, 4 Fr Loss Secs, 2 Line Err Secs, 0 Degraded Mins,
     4 Errored Secs, 0 Bursty Err Secs, 4 Severely Err Secs, 0 Unavailable Secs
     0 Path Failures
```

Use the **show platform** command to verify the router information:

Configuring Structure-Agnostic TDM over Packet - T1/E1 Interfaces

To configure Structure-Agnostic TDM over Packet (SAToP), use the following commands:

```
enable
```

```
configure terminal
controller t1 0/1/0
cem-group 0 unframed
exit
```

Note To configure SAToP, the framing mode for the port is set to unframed.

Verifying CEM Configuration for SAToP

Use the following command to verify the CEM configuration for T1/E1 interfaces:

```
Router#  show cem circuit interface CEM 0/1/0

CEM0/1/0, ID: 0, Line: UP, Admin: UP, Ckt: ACTIVE
Controller state: up, T1 state: up
Idle Pattern: 0xFF, Idle CAS: 0x8
Dejitter: 5 (In use: 0)
Payload Size: 192
Framing: Unframed
CEM Defects Set
None

Signalling: No CAS
RTP: No RTP

Ingress Pkts:    475471              Dropped:             0
Egress Pkts:     475471              Dropped:             0

CEM Counter Details
Input Errors:    0                   Output Errors:       0
Pkts Missing:    0                   Pkts Reordered:      0
Misorder Drops:  0                   JitterBuf Underrun:  0
Error Sec:       0                   Severly Errored Sec: 0
Unavailable Sec: 0                   Failure Counts:      0
Pkts Malformed:  0                   JitterBuf Overrun:   0
```

Configuring Framed SAToP

Note Framing type should be maintained same in all routers end to end.

To configure framed SAToP:

```
enable
configure terminal
controller t1 0/1/0
framing esf
cem-group 0 framed
exit
```

Verifying Framed SAToP Configuration

Use the following command to verify the CEM configuration for T1/E1 interfaces:

```
Router#  show cem circuit interface cem 0/1/0

CEM0/1/0, ID: 0, Line: UP, Admin: UP, Ckt: ACTIVE
Mode :T1, CEM Mode: T1-SAToP
Controller state: up, T1 state: up
Idle Pattern: 0xFF, Idle CAS: 0x8
Dejitter: 5 (In use: 0)
Payload Size: 192
Framing: Framed SAToP
CEM Defects Set
None

Signalling: No CAS
RTP: No RTP

Ingress Pkts: 7836 Dropped: 0
Egress Pkts: 7836 Dropped: 0

CEM Counter Details
Input Errors: 0 Output Errors: 0
Pkts Missing: 0 Pkts Reordered: 0
Misorder Drops: 0 JitterBuf Underrun: 0
Error Sec: 0 Severly Errored Sec: 0
Unavailable Sec: 0 Failure Counts: 0
Pkts Malformed: 0 JitterBuf Overrun: 0
Generated Lbits: 0 Received Lbits: 0
Generated Rbits: 0 Received Rbits: 0
```

Verifying CEM Statistics for Framed SAToP

Use the following commands to verify the pseudowire configuration for SAToP:

- **show cem circuit**—Displays information about the circuit state, administrative state, the CEM ID of the circuit, and the interface on which it is configured. If cross connect is configured under the circuit, the command output also includes information about the attachment circuit status.

```
Router# show cem circuit

  <0-4294967295>    CEM ID
  detail     Detailed information of cem ckt(s)
  interface  CEM Interface
  summary    Display summary of CEM ckts
  |          Output modifiers
Router# show cem circuit

CEM Int. ID Ctrlr Admin Circuit AC
----------------------------------------------------------------
CEM0/1/0 1   UP    UP    Active UP
CEM0/1/1 2   UP    UP    Active UP
CEM0/1/2 3   UP    UP    Active UP
CEM0/1/3 4   UP    UP    Active UP
CEM0/1/4 5   UP    UP    Active UP
```

- **show cem circuit** *cem-id* — Displays the detailed information about that particular circuit.

```
Router# show cem circuit 0
CEM0/1/2, ID: 0, Line: UP, Admin: UP, Ckt: ACTIVE
```

```
Mode :T1, CEM Mode: T1-SAToP
Controller state: up, T1 state: up
Idle Pattern: 0xFF, Idle CAS: 0x8
Dejitter: 5 (In use: 0)
Payload Size: 192
Framing: Framed SAToP
CEM Defects Set
None

Signalling: No CAS
RTP: No RTP

Ingress Pkts: 167027103 Dropped: 0
Egress Pkts: 167027102 Dropped: 0

CEM Counter Details
Input Errors: 0 Output Errors: 0
Pkts Missing: 0 Pkts Reordered: 0
Misorder Drops: 0 JitterBuf Underrun: 0
Error Sec: 0 Severly Errored Sec: 0
Unavailable Sec: 0 Failure Counts: 0
Pkts Malformed: 0 JitterBuf Overrun: 0
Generated Lbits: 0 Received Lbits: 0
Generated Rbits: 0 Received Rbits: 0
```

- **show cem circuit summary** — Displays the number of circuits which are up or down per interface basis.

```
Router# show cem circuit summary

CEM Int. Total Active Inactive
---------------------------------------
CEM0/1/0   1     1      0
CEM0/1/1   1     1      0
CEM0/1/2   1     1      0
CEM0/1/3   1     1      0
CEM0/1/4   1     1      0
```

Verifying CEM Statistics for SAToP

Use the following commands to verify the pseudowire configuration for SAToP:

- **show cem circuit**—Displays information about the circuit state, administrative state, the CEM ID of the circuit, and the interface on which it is configured. If cross connect is configured under the circuit, the command output also includes information about the attachment circuit status.

```
Router# show cem circuit

  <0-32000>    CEM ID
  detail     Detailed information of cem ckt(s)
  interface  CEM Interface
  summary    Display summary of CEM ckts
  |          Output modifiers
Router# show cem circuit

CEM Int.       ID   Line      Admin     Circuit         AC
---------------------------------------------------------------
CEM0/1/0       1    UP        UP        ACTIVE          --/--
CEM0/1/0       2    UP        UP        ACTIVE          --/--
CEM0/1/0       3    UP        UP        ACTIVE          --/--
```

```
CEM0/1/0       4    UP         UP         ACTIVE          --/--
CEM0/1/0       5    UP         UP         ACTIVE          --/--
```

- **show cem circuit** *cem-id* — Displays the detailed information about that particular circuit.

```
Router# show cem circuit 0

CEM0/1/2, ID: 0, Line: UP, Admin: UP, Ckt: ACTIVE
Controller state: up, T1 state: up
Idle Pattern: 0xFF, Idle CAS: 0x8
Dejitter: 5 (In use: 0)
Payload Size: 192
Framing: Unframed
CEM Defects Set
None

Signalling: No CAS
RTP: No RTP

Ingress Pkts:    11060               Dropped:             0
Egress Pkts:     11061               Dropped:             0

CEM Counter Details
Input Errors:    0                   Output Errors:       0
Pkts Missing:    0                   Pkts Reordered:      0
Misorder Drops:  0                   JitterBuf Underrun:  0
Error Sec:       0                   Severly Errored Sec: 0
Unavailable Sec: 0                   Failure Counts:      0
Pkts Malformed:  0                   JitterBuf Overrun:   0
```

- **show cem circuit summary** — Displays the number of circuits which are up or down per interface basis.

```
Router# show cem circuit summary

CEM Int.       Total Active  Inactive
---------------------------------------
CEM0/1/0       1     1       0
```

Configuring CEM Group for SAToP for T1 Interfaces

To configure a CEM group for SAToP.

```
enable
configure terminal
controller t1 0/1/0
cem-group 0 unframed
end
```

Note You need metroaggrservice license to configure CEM group on the Interface Module.

By deafult, metroaggressive license is enabled for NCS 4200 Series Routers.

Configuring CEM Group for CESoPSN on T1 Interface

The following section describes how to configure a CEM group for CESoPSN.

To configure xconnect over MPLS, use the following commands:

```
enable
configure terminal
controller t1 0/1/32
cem-group 0  timeslots 1-10
```

Configure cross-connect:

```
enable
configure terminal
interface cem 0/1/32
cem 0
xconnect 2.2.2.2 10 encapsulation mpls
```

Perform a similar configuration on the other end of the pseudowire.

```
show running-config | sec 0/1/16
controller t1 0/1/16
 framing esf
 linecode b8zs
 cablelength short 110
  cem-group 0 timeslots 1-10
interface CEM0/1/16
 no ip address
 cem 0
  xconnect 2.2.2.2 10 encapsulation mpls
```

Check for cross-connect configuration using the following command:

```
Router#show xconnect all  | i 0/1/32
UP pri   ac CE0/1/32:0(CESoPSN Basic)    UP mpls 2.2.2.2:10       UP

Router#sh controllers  t1 0/1/32
T1 0/1/32 is up
  Applique type is NCS4200-48T1E1-CE
  Cablelength is short 110
  No alarms detected.
  alarm-trigger is not set
  Soaking time: 3, Clearance time: 10
  AIS State:Clear  LOS State:Clear  LOF State:Clear
  Framing is ESF, Line Code is B8ZS, Clock Source is Line.
```

Verifying CEM for CESoPSN on T1 Interface

Use the following commands to verify the pseudowire configuration for CESoPSN:

- show cem circuit—Displays information about the circuit state, administrative state, the CEM ID of the circuit, and the interface on which it is configured. If cross connect is configured under the circuit, the command output also includes information about the attachment circuit status.

- show mpls l2 vc—Displays information about the MPLS VC.
- show mpls l2 vc detail—Displays detailed information about the MPLS VC.

```
PE1#show mpls l2 vc 10

Local intf     Local circuit              Dest address    VC ID      Status
-------------  -------------------------- --------------- ---------- ----------
CE0/1/32       CESoPSN Basic 0            2.2.2.2         10         UP

PE1#sh mpls l2 vc 10 detail
Local interface: CE0/1/32 up, line protocol up, CESoPSN Basic 0 up
  Destination address: 2.2.2.2, VC ID: 10, VC status: up
    Output interface: Te0/0/0, imposed label stack {650}
    Preferred path: not configured
    Default path: active
    Next hop: 123.123.123.2
  Create time: 00:21:25, last status change time: 00:21:25
    Last label FSM state change time: 00:21:25
  Signaling protocol: LDP, peer 2.2.2.2:0 up
    Targeted Hello: 1.1.1.1(LDP Id) -> 2.2.2.2, LDP is UP
    Graceful restart: configured and not enabled
    Non stop routing: not configured and not enabled
    Status TLV support (local/remote)   : enabled/supported
      LDP route watch                   : enabled
      Label/status state machine        : established, LruRru
      Last local dataplane   status rcvd: No fault
      Last BFD dataplane     status rcvd: Not sent
      Last BFD peer monitor  status rcvd: No fault
      Last local AC  circuit status rcvd: No fault
      Last local AC  circuit status sent: No fault
      Last local PW i/f circ status rcvd: No fault
      Last local LDP TLV     status sent: No fault
      Last remote LDP TLV    status rcvd: No fault
      Last remote LDP ADJ    status rcvd: No fault
    MPLS VC labels: local 577, remote 650
    Group ID: local 238, remote 276
    MTU: local 0, remote 0
    Remote interface description:
  Sequencing: receive disabled, send disabled
  Control Word: On (configured: autosense)
  SSO Descriptor: 2.2.2.2/10, local label: 577
  Dataplane:
    SSM segment/switch IDs: 6893171/4140658 (used), PWID: 674
  VC statistics:
    transit packet totals: receive 0, send 0
    transit byte totals:   receive 0, send 0
    transit packet drops:  receive 0, seq error 0, send 0
```

Configuring DS1 Local Connet

The following section describes how to configure first segment for DS1 local connection:

```
enable
configure terminal
controller T1 0/1/0
framing unframed
clock source internal
linecode b8zs
```

```
cablelength short 110
cem-group 0 unframed
description TO_CE1_0/1/0
```

The following section describes how to configure second segment for DS1 local connection:

```
enable
configure terminal
controller T1 0/1/3
framing unframed
clock source recovered 0
linecode b8zs
cablelength short 110
cem-group 0 unframed
description TO_CE1_0/1/1
```

The following section describes how to create a DS1 local connection:

```
enable
configure terminal
connect ds1_connect CEM0/1/0 0 CEM0/1/3 0
```

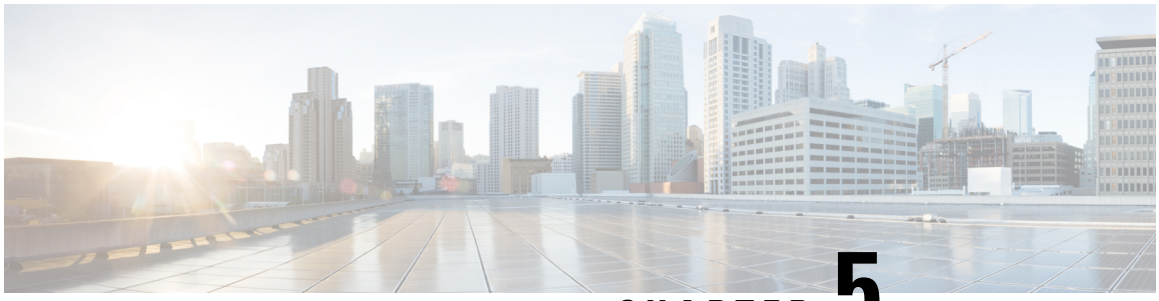
Verifying DS1 Local Connect

Use the following commands to verify the DS1 local connection:

- show connection name—Displays information about the connection state and segment state.

```
Router#show connection name ds1_connect

Connection: 673 - ds1_connect
 Current State: UP
 Segment 1: CEM0/1/0 SATOP T1 0 up
 Segment 2: CEM0/1/3 SATOP T1 0 up
```



CHAPTER 5

Monitoring the T1 or E1 Interface Module

This chapter provides information on monitoring the T1 or E1 interface module. Some of monitoring tools available are:

- Perfomance Monitoring
- Performance Monitoring, on page 21

Performance Monitoring

The performance monitoring result displays the statistics or error count generated on the TDM lines for DS1.

To view the performance monitoring details, use the **show controller** command:

```
Router# show controllers t1 0/1/1

T1 0/1/1 is down.
  Applique type is ASR900-48T1E1-CE
  Cablelength is short 110
  No alarms detected.
  alarm-trigger is not set
  Soaking time: 3, Clearance time: 10
  AIS State:Clear  LOS State:Clear  LOF State:Clear
  Framing is ESF, FDL is ansi, Line Code is B8ZS, Clock Source is Line.
  BER thresholds:  SF = 10e-3  SD = 10e-6
  Data in current interval (230 seconds elapsed):
   Near End
     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 Unavailable Secs
     0 Path Failures, 0 SEF/AIS Secs
   Far End
     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 Unavailable Secs
     0 Path Failures
  Data in Interval 1:
   Near End
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 14 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 15 Unavailable Secs
     1 Path Failures, 0 SEF/AIS Secs
   Far End Data
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 4 Fr Loss Secs, 2 Line Err Secs, 0 Degraded Mins
```

```
    4 Errored Secs, 0 Bursty Err Secs, 4 Severely Err Secs, 0 Unavailable Secs
    0 Path Failures
  Total Data (last 1 15 minute intervals):
   Near End
    0 Line Code Violations, 0 Path Code Violations,
    0 Slip Secs, 0 Fr Loss Secs, 14 Line Err Secs, 0 Degraded Mins,
    0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 15 Unavailable Secs
    1 Path Failures, 0 SEF/AIS Secs
   Far End
    0 Line Code Violations, 0 Path Code Violations,
    0 Slip Secs, 4 Fr Loss Secs, 2 Line Err Secs, 0 Degraded Mins,
    4 Errored Secs, 0 Bursty Err Secs, 4 Severely Err Secs, 0 Unavailable Secs
    0 Path Failures
Router# show controllers e1 0/1/1

E1 0/1/1 is down.
  Applique type is ASR900-48T1E1-CE
  Cablelength is short 110
  No alarms detected.
  alarm-trigger is not set
  Soaking time: 3, Clearance time: 10
  AIS State:Clear  LOS State:Clear  LOF State:Clear
  Framing is ESF, FDL is ansi, Line Code is B8ZS, Clock Source is Line.
  BER thresholds:  SF = 10e-3  SD = 10e-6
  Data in current interval (230 seconds elapsed):
   Near End
    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 Unavailable Secs
    0 Path Failures, 0 SEF/AIS Secs
   Far End
    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 Unavailable Secs
    0 Path Failures
  Data in Interval 1:
   Near End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 0 Fr Loss Secs, 14 Line Err Secs, 0 Degraded Mins
    0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 15 Unavailable Secs
    1 Path Failures, 0 SEF/AIS Secs
   Far End Data
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 4 Fr Loss Secs, 2 Line Err Secs, 0 Degraded Mins
    4 Errored Secs, 0 Bursty Err Secs, 4 Severely Err Secs, 0 Unavailable Secs
    0 Path Failures
  Total Data (last 1 15 minute intervals):
   Near End
    0 Line Code Violations, 0 Path Code Violations,
    0 Slip Secs, 0 Fr Loss Secs, 14 Line Err Secs, 0 Degraded Mins,
    0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 15 Unavailable Secs
    1 Path Failures, 0 SEF/AIS Secs
   Far End
    0 Line Code Violations, 0 Path Code Violations,
    0 Slip Secs, 4 Fr Loss Secs, 2 Line Err Secs, 0 Degraded Mins,
    4 Errored Secs, 0 Bursty Err Secs, 4 Severely Err Secs, 0 Unavailable Secs
    0 Path Failures
```

The performance monitoring result displays the statistics TDM lines for DS1.

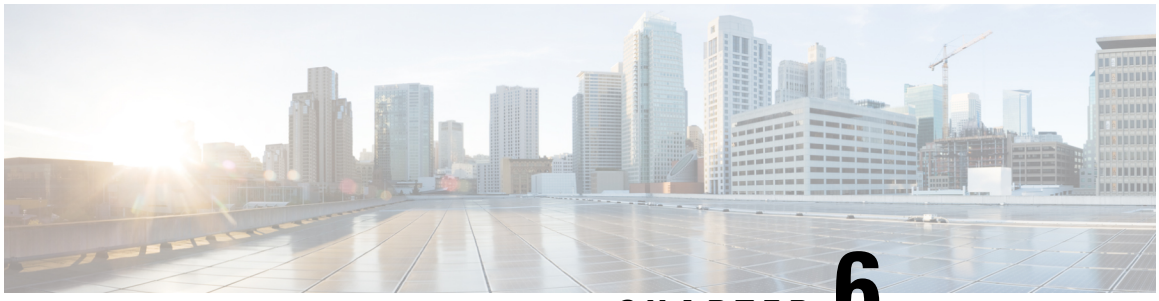
Table 10: Feature History Table

Feature Name	Release Information	Description
GR-820-CORE Performance Monitoring	Cisco IOS XE Bengaluru 17.5.1	The **show controller tabular** command enables you to view the performance monitoring details in tabular form as per GR-820-Core standards.

To view the performance monitoring details on T1 controller, use the **show controller t1 tabular** command:

```
Router#show controllers t1 0/1/0 tabular

T1 0/1/0 is up
  Applique type is ASR900-48T1E1-CE
  Cablelength is short 110
  No alarms detected.
  alarm-trigger is not set
  Soaking time: 3, Clearance time: 10
  Framing is ESF, Line Code is B8ZS, Clock Source is Line.
  BER thresholds:  SF = 10e-3  SD = 10e-6
  Near End Data
  INTERVAL     CV-L   ES-L   CV-P   ES-P  SES-P  CSS-P  SAS-P  UAS-P   FC-P
  09:49-10:01     0      0      0      0      0      0      0      0      0
  Far End Data
  INTERVAL     ES-LFE  ES-PFE  SES-PFE  SEFS-PFE  CSS-PFE  UAS-PFE  FC-PFE
  09:49-10:01       0       0        0         0        0        0       0
```



CHAPTER 6

Troubleshooting the T1 or E1 Interface Module

You can use the following methods to troubleshoot the T1 or E1 interface modules:

- Bit Error Rate Testing (BERT)
- Loopback

Overview of BERT

Bit Error Rate Testing (BERT) is used to test the integrity of the physical line.

The interface contains on board BERT circuitry. With this circuitry, the interface software can send and detect a programmable pattern that is compliant with CCITT/ITU O.151, O.152, O.153 pseudo-random, and repetitive test patterns. BERTs allow you to test cables and signal problems in the field.

The bit error rate (BER) is determined by comparing the erroneous bits received with the total number of bits received. You can display and analyze the total number of error bits transmitted and the total number of bits received on the link. You can retrieve error statistics anytime during the BERT.

Both the total number of bits and the error bits received are available for analysis. You can select the testing period from 1 minute to 24 hours and you can also retrieve the error statistics anytime during the BERT test.

Running a BERT Test

When running a BERT test, the system expects to receive the same pattern that it transmits. To help ensure this, two common options are available:

- Use a loopback somewhere in the link or network
- Configure remote testing equipment to transmit the same BERT test pattern at the same time.

The BERT runtime engine can be kept running until the interval completes or can be stopped by unconfiguring it anytime.

Types of BERT

BERT is supported in two directions:

- Line - supports BERT in TDM direction

- System - supports BERT in PSN direction

BERT engines uses different BERT patterns for transmission for each mode. The supported BERT patterns on each card is described.

BERT Restrictions

- BERT is not supported on the following modes:
  - T3—Framing M-13, non-channelized
  - E3—Framing G832, channelized
- When the BERT is initiated with pattern 0s and 1s from the local end and the loopback local is applied from the far end, then the BERT syncing does not happen. Since the BERT process is asserted as LOS alarms for all 0s and AIS alarms for all 1s BERT patterns. Whereas the BERT syncing behaves properly when the BERT is initiated from both the local and the far end.

  For all 1s on T3 or E3, the BERT behaviour is not asserted as AIS and the BERT syncing happens as usual.
- In the unframed mode, BERT sync is not stable and may generate alarms until Cisco IOS XE Fuji 16.9.4.

Note Framing type should be similar in all routers end to end.

BERT Restrictions for Cisco IOS XE Bengaluru 17.4.1 release

- When the BERT is initiated from the local end and the loopback local is applied from the far end, then BERT syncing does not happen. Since the BERT process is asserted as LOS alarms for all 0s and AIS alarms for all 1s BERT patterns. Whereas the BERT syncing behaves properly when the BERT is initiated from both the local and the far end.

BERT for SAToP

BERT is supported for both unframed and framed modes.

Configuring BERT for SAToP

Before You Begin

Before you run BERT test, you must configure card type and controller.

To run a BERT on T1/E1 interface, perform the following tasks in global configuration mode.

```
enable
configure terminal
controller t1 0/1/1
bert pattern 2^11 interval 5 direction line/system
exit
```

Note To terminate a BERT test during the specified test period, use the **no bert** command.

Verifying BERT Configuration for SAToP

Use the following command to verify the BERT configuration for T1/E1 interfaces:

```
Router# show controllers t1 0/1/1

T1 0/1/1 is up.
  Applique type is ASR903-48T1E1-CE
  Cablelength is short 110
   DSX1 BERT pattern     : 2^11
   DSX1 BERT direction   : Line
   DSX1 BERT sync        : no sync
   DSX1 BERT sync count  : 0
   DSX1 BERT interval    : 5
   DSX1 BERT time remain : 2
   DSX1 BERT total errs  : 0
   DSX1 BERT total k bits: 0
   DSX1 BERT errors (last): 0
   DSX1 BERT k bits (last): 0
   Last clearing of BERT counters never
  No alarms detected.
  alarm-trigger is not set
  Soaking time: 3, Clearance time: 10
  AIS State:Clear  LOS State:Clear  LOF State:Clear
  Framing is ESF, FDL is ansi, Line Code is B8ZS, Clock Source is Line.
  BER thresholds:  SF = 10e-3  SD = 10e-6
  Data in current interval (230 seconds elapsed):
   Near End
     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 Unavailable Secs
     0 Path Failures, 0 SEF/AIS Secs
   Far End
     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 Unavailable Secs
     0 Path Failures
  Data in Interval 1:
   Near End
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 14 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 15 Unavailable Secs
     1 Path Failures, 0 SEF/AIS Secs
   Far End Data
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 4 Fr Loss Secs, 2 Line Err Secs, 0 Degraded Mins
     4 Errored Secs, 0 Bursty Err Secs, 4 Severely Err Secs, 0 Unavailable Secs
     0 Path Failures
  Total Data (last 1 15 minute intervals):
   Near End
     0 Line Code Violations, 0 Path Code Violations,
     0 Slip Secs, 0 Fr Loss Secs, 14 Line Err Secs, 0 Degraded Mins,
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 15 Unavailable Secs
     1 Path Failures, 0 SEF/AIS Secs
   Far End
     0 Line Code Violations, 0 Path Code Violations,
     0 Slip Secs, 4 Fr Loss Secs, 2 Line Err Secs, 0 Degraded Mins,
```

```
    4 Errored Secs, 0 Bursty Err Secs, 4 Severely Err Secs, 0 Unavailable Secs
    0 Path Failures
```

You can view the results of a BERT test at the following times:

- After you terminate the test using the **no bert** command
- After the test runs completely
- Anytime during the test (in real time)

BERT for CESoPSN

BERT is supported at the TDM side and pseudowire side. BERT can be used either at NxDS0 or DS1 but not together.

BERT is supported on following controllers:

- T1—NxDS0, DS1
- T3—NxDS0, DS1 (channelised), clear channel DS3.
- OCX—NxDS0, DS1 (channelised),DS3(channelised), clear channel DS3,STS1,STS-nc,VT-1.5,VT1.5 T1

Configuring BERT for CESoPSN

Before You Begin

Before you run BERT test, you must configure card type and controller.

To run a BERT on T1/E1 interface for CESoPSN, perform the following tasks in global configuration mode.

```
enable
configure terminal
controller t1 0/1/1
bert pattern 2^11 interval 5 direction line/system timeslots value speed
exit
```

Note To terminate a BERT test during the specified test period, use the **no bert** command.

Verifying BERT Configuration for CESoPSN

Use the following command to verify the BERT configuration for CESoPSN on T1 interfaces:

```
Router# show controllers t1 0/1/32
T1 0/1/32 is up
  Applique type is NCS4200-48T1E1-CE
  Cablelength is short 110
   DS0 Bert enabled on the following timeslots : 1-2
   Speed : 64 kpbs
   DSX1 BERT test result: (running)
   DSX1 BERT pattern     : 2^15
```

```
  DSX1 BERT direction   : Line
  DSX1 BERT sync        : sync
  DSX1 BERT sync count  : 1
  DSX1 BERT interval    : 1
  DSX1 BERT time remain : 00:00:55
  DSX1 BERT total errs  : 0
  DSX1 BERT total k bits: 512
  DSX1 BERT errors (last): 0
  DSX1 BERT k bits (last): 512
  Last clearing of BERT counters never
No alarms detected.
 alarm-trigger is not set
 Soaking time: 3, Clearance time: 10
 AIS State:Clear  LOS State:Clear  LOF State:Clear
 Framing is ESF, FDL is ansi, Line Code is B8ZS, Clock Source is Line.
 BER thresholds:  SF = 10e-3  SD = 10e-6
 Data in current interval (230 seconds elapsed):
  Near End
    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 Unavailable Secs
    0 Path Failures, 0 SEF/AIS Secs
  Far End
    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 Unavailable Secs
    0 Path Failures
 Data in Interval 1:
  Near End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 0 Fr Loss Secs, 14 Line Err Secs, 0 Degraded Mins
    0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 15 Unavailable Secs
    1 Path Failures, 0 SEF/AIS Secs
  Far End Data
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 4 Fr Loss Secs, 2 Line Err Secs, 0 Degraded Mins
    4 Errored Secs, 0 Bursty Err Secs, 4 Severely Err Secs, 0 Unavailable Secs
    0 Path Failures
 Total Data (last 1 15 minute intervals):
  Near End
    0 Line Code Violations, 0 Path Code Violations,
    0 Slip Secs, 0 Fr Loss Secs, 14 Line Err Secs, 0 Degraded Mins,
    0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 15 Unavailable Secs
    1 Path Failures, 0 SEF/AIS Secs
  Far End
    0 Line Code Violations, 0 Path Code Violations,
    0 Slip Secs, 4 Fr Loss Secs, 2 Line Err Secs, 0 Degraded Mins,
    4 Errored Secs, 0 Bursty Err Secs, 4 Severely Err Secs, 0 Unavailable Secs
    0 Path Failures
```

You can view the results of a BERT test at the following times:

- After you terminate the test using the **no bert** command
- After the test runs completely
- Anytime during the test (in real time)

Loopback on T1 or E1 Interfaces

You can use the following loopback on the T1 or E1 interfaces. Loopback is supported on both unframed and framed modes.

Restrictions

- Framing type should be maintained same in all routers end to end .
- AIS alarm is not transmitted to the connected peer port with **loopback local line** configuration until Cisco IOS XE 16.9.4 Fuji Release.

Loopback	Description
loopback local line	Loops the outgoing transmit signal back to the receive signal. This is done using the diagnostic loopback feature in the interface module's framer. Set the **clock source** command to internal for this loopback mode.
loopback network line	Loops the incoming signal back in the interface module using the line loopback mode of the framer. The framer does not reclock or reframe the incoming data. All incoming data is received by the interface module driver. Loopback network line is supported on E1 interface.

Note Starting Cisco IOS Release 16.8.1, the following loopback commands are not supported.

- loopback diag
- loopback local
- loopback local payload

Configuring Loopback

Before You Begin

Before you configure loopback, you must configure the controller and the CEM.

To set a loopback local on the T1 interface, perform the following tasks in global configuration mode:

```
enable
configure terminal
controller t1 0/1/1
loopback local line
exit
```

To set a loopback diag on the T1 interface, perform the following tasks in global configuration mode:

```
enable
configure terminal
controller t1 0/1/1
loopbackdiag
exit
```

To set a loopback local on the E1 interface, perform the following tasks in global configuration mode:

```
enable
configure terminal
controller e1 0/1/1
loopback local
exit
```

To set a loopback network on the E1 interface, perform the following tasks in global configuration mode:

```
enable
configure terminal
controller e1 0/1/1
loopback network line
exit
```

Note To remove a loopback, use the **no loopback** command.

Note Network payload configuration is not supported on the port configured with SAToP. To configure loopback network payload when SAToP is configured, you need to remove the CEM configuration and then configure the loopback.

Loopback Remote on T1 Interfaces

The remote loopback configuration attempts to put the far-end T1 into a loopback.

The remote loopback setting loops back the far-end at line or payload, using IBOC (in-band bit-orientated CDE) or the ESF loopback codes to communicate the request to the far-end.

For releases later than Cisco IOS XE Fuji 16.8.x, we recommend that you use ESF loopback codes with ESF framing and IBOC loopback codes with SF framing.

Restrictions for Loopback Remote

- E1 loopback remote is not supported until Cisco IOS XE 16.9.4 Fuji Release. Starting from Cisco IOS XE Fuji 16.9.5 release, E1 loopback remote is supported.
- Loopback remote is not supported when cem-group is configured under T1 until Cisco IOS XE 16.9.4 Fuji Release.
- IBOC loopcode configuration is not supported when CESoP or SATOP (framed or unframed) is configured.
- ESF loopcode configuration is not supported when SAToP is configured.

Configuring Loopback Remote on a T1 Interface Module

To set T1 loopback remote iboc fac1/fac2/csu for DS1, perform the following tasks in global configuration mode:

```
enable
configure terminal
controller t1 0/1/1
loopback remote iboc {fac1 | fac2 | csu}
exit
```

To set T1 loopback remote esf line csu/payload on the DS1 interface, perform the following tasks in global configuration mode:

```
enable
configure terminal
controller t1 0/1/1
loopback remote esf {line csu | payload}
exit
```

Note **loopback remote esf line niu** is not supported.

Verifying the Loopback Remote Configuration

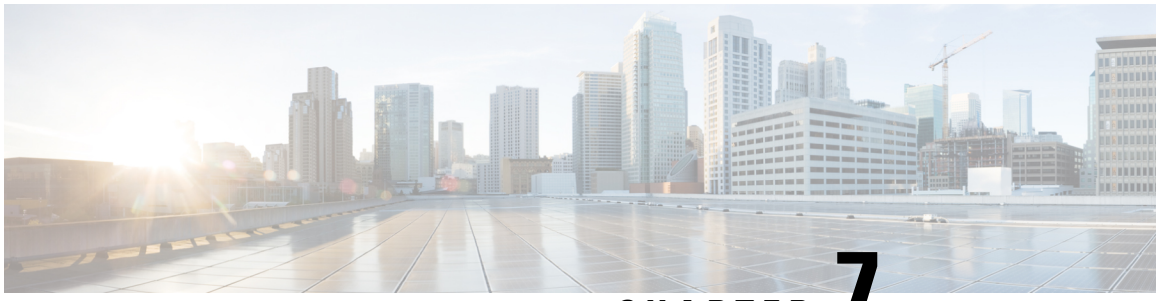
Use the following command to check the loopback remote configuration:

```
router# show running-config | sec 0/1/1
controller T1 0/1/10
 threshold sd-ber 6
 threshold sf-ber 3
 framing sf
 linecode b8zs
 cablelength short 110
 loopback remote iboc fac1
```

Use the following command to verify the loopback remote configuration:

```
router# show controller t1 0/1/1
T1 0/1/1 is up (NIU FAC1 Line Loopback with IBOC)
  Currently in Inband Remotely Line Looped
  Applique type is ASR900-48T1E1-CE
  Cablelength is short 110
  Receiver has no alarms.
  alarm-trigger is not set
Soaking time: 3, Clearance time: 10
  AIS State:Clear  LOS State:Clear  LOF State:Clear
  Framing is ESF, FDL is ansi, Line Code is B8ZS, Clock Source is Line.
  BER thresholds:  SF = 10e-3  SD = 10e-6
  Data in current interval (230 seconds elapsed):
   Near End
     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 Unavailable Secs
     0 Path Failures, 0 SEF/AIS Secs
   Far End
     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 Unavailable Secs
```

```
   0 Path Failures
Data in Interval 1:
 Near End
   0 Line Code Violations, 0 Path Code Violations
   0 Slip Secs, 0 Fr Loss Secs, 14 Line Err Secs, 0 Degraded Mins
   0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 15 Unavailable Secs
   1 Path Failures, 0 SEF/AIS Secs
 Far End Data
   0 Line Code Violations, 0 Path Code Violations
   0 Slip Secs, 4 Fr Loss Secs, 2 Line Err Secs, 0 Degraded Mins
   4 Errored Secs, 0 Bursty Err Secs, 4 Severely Err Secs, 0 Unavailable Secs
   0 Path Failures
Total Data (last 1 15 minute intervals):
 Near End
   0 Line Code Violations, 0 Path Code Violations,
   0 Slip Secs, 0 Fr Loss Secs, 14 Line Err Secs, 0 Degraded Mins,
   0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 15 Unavailable Secs
   1 Path Failures, 0 SEF/AIS Secs
 Far End
   0 Line Code Violations, 0 Path Code Violations,
   0 Slip Secs, 4 Fr Loss Secs, 2 Line Err Secs, 0 Degraded Mins,
   4 Errored Secs, 0 Bursty Err Secs, 4 Severely Err Secs, 0 Unavailable Secs
   0 Path Failures
```



CHAPTER 7

Card Protection for T1 or E1

The card protection feature is supported on the following interface module:

Table 11: Supported Interface Module

Interface Module	Part Number
48-port T1/E1 Interface module	• NCS4200-48T1E1-CE

In this feature, the interface module bay is protected by another interface module of the same type.

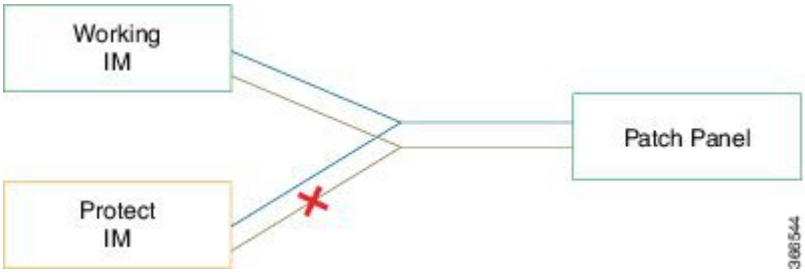
Card Protection

The Card Protection feature is required to protect traffic flow either when an interface module is out of service, when the software fails or a hardware component has issues. Because card protection is supported only on redundant interface modules, traffic is switched to the protect interface module when the active interface module does not respond, and vice-versa.

Note This feature does not require any change in the patch panel of the interface modules.

In card protection, a Y Cable is used to multiplex the signal from the patch panel to both the ports of active and protect interface modules. Both ports receive the signal, but only the active interface module transmits the signal from its port.

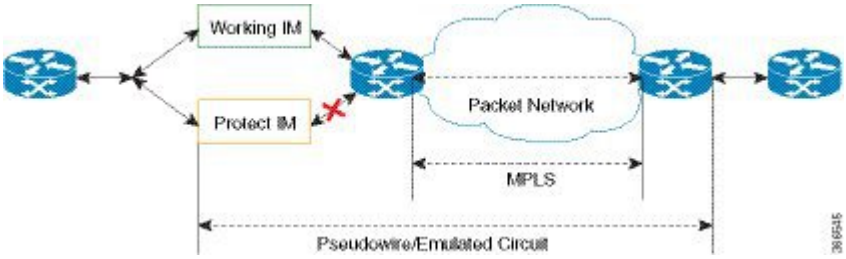
Figure 1: Y Cable



To support the Card Protection feature, the configuration on the active and protect interface module must be same. To achieve this, a virtual interface module is created with the same interface module type as the active interface module. A virtual controller is also created, which broadcasts the configuration to both the interface modules. The configuration on the physical controllers is then blocked and you can make configuration changes only on the virtual controller. The user configuration can only be performed on the virtual controller.

The virtual controller supports CEM level configuration and all other configurations. These configurations are blocked on physical controllers.

Figure 2: Card Protection Topology



Note DS3 (T3) channelized into T1 and E3 channelized into E1s are supported in card protection. For more information on configuration, see the *Configuring the Controller of Channelized T3/T1 Interfaces* section.

Y Cable

In card protection, a Y cable is used to multiplex the signal from the patch panel to both the ports of active and standby interface modules. Both the active and protect ports receive the signal, but only the active port transmits the signal from its port. Protect port transmitter is disabled.

Card Protection Switchover

The following table shows the card protection switchover trigger and time to complete the switchover between the working and protect interface module.

Trigger	Time
Interface Module Reload with CLI OIR	Less than 50 millisecond

Trigger	Time
Non-responsive Interface Module Process (interface module reloads on its own, the reload is initiated due to software error)	100 millisecond to 200 millisecond
Interface Module shuts down due to high temperature	Less than 50 millisecond
Interface Module shuts down using CLI	Less than 50 millisecond
Interface Module stops using CLI	Less than 50 millisecond
Card Physical Jackout	100 millisecond to 200 millisecond
Serializer/Deserializer (SerDes) Failures	250 millisecond to 1 second
Alarm Based Switchover	Based on Hold Over Time or Soak Time
Card Protection Commands	20 millisecond to 30 millisecond
Non-responsive Interface Module Process (interface module reloads on its own, the reload is initiated due to software error)	200 millisecond to 1 second
Card Physical Jackout	200 millisecond to 1 second

Alarm Based Switchover

Alarm based switchover is only applicable for Loss Of Signal (LOS) alarm. Switchover happens only when the number of ports with LOS alarm in working interface module is greater than that on the protect interface module.

Each card protection group maintains a weight for each working and protect interface module. This weight is updated when the LOS alarms are asserted or cleared. The switchover happens only if the weight of working interface module and protect interface module stays same for a certain amount of time called soak time.

When there is any issue with the Patch Panel, both working interface module and protect interface module have the same number of LOS alarms (weights are same). Hence, switchover does not happen.

Restrictions

- Card physical jack out convergence time for card protection switchover is more than 50 milliseconds.
- The time taken to restart the interface module due to any software error is more than 50 milliseconds.
- Alarm toggle on active or backup card causes at least one card protection switch.
- When BERT is started from the virtual controllers, the syslog displays the physical controllers instead of the virtual controller port.

Supported Features on Interface Module

The supported features are:

- Switching Mode
  - Non-revertive mode
  - Revertive mode
- Alarm Based Switchover
- SerDes Based Switchover
- Adaptive Clock Recovery (ACR) on virtual CEM
- Differential Clock Recovery (DCR) on virtual CEM
- Maintenance Commands
  - Lockout
  - Force
  - Manual

Note All controller configurations are performed on the virtual controller.

You can create card protection with one slot (either primary or backup) and the remaining slots can be added later.

How to Configure Card Protection for T1 or E1

Configuring T1/E1 Card Protection

Configuring Card Protection Group:

```
enable
configure terminal
card type t1 0 2
card type t1 0 1
card-protection [1-16]
primary slot 0 bay 1
backup slot 0 bay 2
end
```

Note The card protection number 1 to 16 refers to CPGN.

Configuring Virtual Card and Virtual Controller:

When card protection group is configured, it creates virtual card for card protection object, denoted by 8/x/port. Slot 8 is a fixed slot number for all card protection created virtual card. Bay number 'x' for virtual card is x =CPGN -1 = 15. Virtual controllers can be configured from 8/15/0 to 8/15/47.

Physical Card Configuration:

- No configuration is required for traffic.

Virtual Card Configuration:

- Configures CEM on virtual controller (8/x/port).
- Configures xconnect and local connect on CEM interface.

```
enable
configure terminal
controller t1 8/15/0
cem 0 unframed
interface cem 8/15/0
cem 0
xconnect 11.1.1.1 212 encasulation mpls
end
```

```
enable
configure terminal
controller t1 8/15/11
cem 0 unframed
interface cem 8/15/11
cem 0
connect testLC cem 8/15/0 0 cem 8/15/11 0
end
```

Note To un-configure a CEM group under a virtual controller, first perform shutdown of the virtual controller and then un-configure the CEM group.

Configuring Revertive Mode

To configure revertive mode:

```
enable
configure terminal
card-protection 4
primary slot 0 bay 0
backup slot 0 bay 5
end
card-protection 4
revertive time [30-720]
end
```

Note The revertive time ranges from 30 to 720 seconds.

Verification of T1/E1 Card Protection Configuration

Use **show card-protection** command to verify card protection group configuration.

```
#show card-protection 2 detail
Working(0/1:A900-IMA48T-C NCS4200-48T1E1-CE):
    Number of LOS Alarms:7
    ok,Active
    1:1,  Revertive

    Protect(0/2:A900-IMA48T-C NCS4200-48T1E1-CE):
    Number of LOS Alarms:7
    ok,Inactive
    1:1,  Revertive

Revert Timer : (Not Started)
Last switchover reason :None
```

Use **show xconnect all** command to verify xconnect configuration.

```
#show xconnect all | I CE8/15/
UP   pri   ac CE8/15/0:0(SATOP T1)        UP mpls 11.1.1.1:212              UP
#

#show xconnect all | i CE8/15/
72       testLC         CE8/15/11 SAT1 0        CE8/15/12 SAT1 0              UP
#
```

Configuring Maintenance Commands

To configure maintenance commands:

```
enable
configure terminal
card-protection 4
primary slot 0 bay 0
backup slot 0 bay 5
end
card-protection 4
card-protection [manual {backup|primary} | force {backup|primary} | lockout]
end
```

Note Maintenance commands are not synced in the standby environment. After Redundancy Force Switchover (SSO), maintenance commands must be executed again on the new active environment.

Priority Table

The following table shows the priority of the actions:

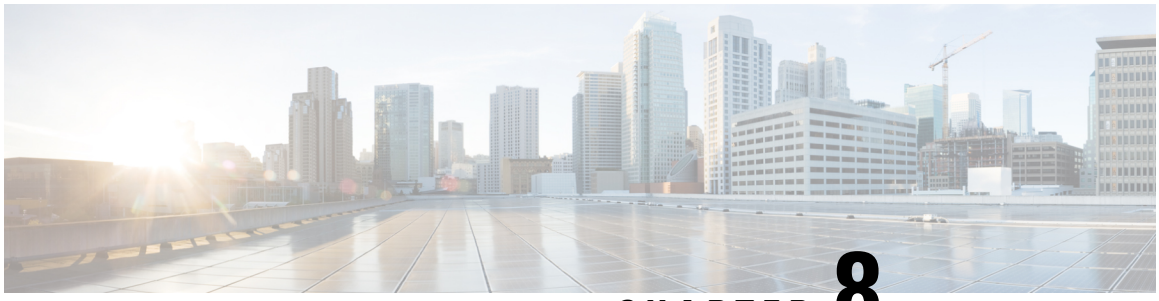
Priority	Configurations
1	Lockout
2	Force
3	Alarm or Card Failure

Priority	Configurations
4	Manual Switch
5	Revert

Associated Commands

The following table shows the commands for the IM configuration:

Command	Link
Card Protection Creation Commands: **card-protection** *CPGN* **card-protection** {*primary* | *backup*} **card-protection** *revertive time* **Card Protection Maintenance Commands**: **card-protection** *CPGN* [**manual** {*primary* | *backup*} | **force** {*primary* | *backup*} | **lockout**]	https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp1208639895
show card-protection CPGN detail	https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s2.html#wp1628614402



CHAPTER 8

Additional References

This appendix describes additional CEM features that are used on the router. This appendix describes the following topics:

Linecode Configuration and Supported Patterns

The following pattern for linecode configuration is supported for T1 or E1.

Table 12: Linecode Configuration and Pattern Supported on T1 or E1 Controllers

Part Number	Linecode Configuration	T1 or E1	Random Pattern
XRT83VSH316 LIU	B8ZS/AMI	T1	QRSS
	HDB3/AMI	E1	PRBS15

Configuration Using AMI Linecodes at Both Ends (UUT (AMI) and TESTER (AMI))

When both sides are configured as AMI, the linecodes match and the T1 or E1 controller is always UP with a smooth traffic flow.

Configuration Using Different Linecodes at Both Ends (UUT (AMI) and TESTER (B8ZS or HDB3))

- The line codes do not match when one side is configured with AMI and other side is configured with non-AMI codes such as B8ZS or HDB3. Based on the pattern that is inserted, there is change in the behavior.
- For 511 QRSS pattern, although the line codes do not match, the controller is UP. The controllers go DOWN for other patterns.
- Each pattern is unique and contains a combination of ones and zeros. Only the pattern 511 QRSS is supported. If patterns other than 511 QRSS are used, then LOS is generated, and controller goes to the DOWN state.

The following table details the configuration using same and different linecodes at both ends and the pattern that is supported on T1 (UUT mode) controller:

Table 13: Configuration Using Linecodes for T1 Controllers

Pattern Mode (ANSI)	Pattern with UUT (AMI) and TESTER (B8zS)	UUT(AMI) and TESTER (AMI)
511 QRSS	Controller is UP. Linecodes do not match.	T1 controller is UP on UUT. Linecodes match.
QRSS	UUT controller is DOWN.	T1 controller is UP on UUT. Linecodes match.
2047 QRSS	UUT controller is DOWN.	T1 controller is UP on UUT. Linecodes match.

The following table details configuration using same and different linecodes at both ends and the pattern that is supported on E1 (UUT mode) controller:

Table 14: Configuration Using Linecodes for E1 Controllers

Pattern Mode (ANSI)	Pattern with UUT (AMI) and TESTER (B8zS)	UUT(AMI) and TESTER (AMI)
2^15- 1	Controller is DOWN.	E1 controller is UP on UUT. Linecodes match.
2^15- 1 INV	Controller is DOWN.	E1 controller is UP on UUT. Linecodes match.