



# 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, on page 1](#)
- [Loopback on T1 or E1 Interfaces, on page 9](#)
- [User-defined Remote Loopback on T1 Interfaces, on page 12](#)

## 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.




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

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- System BERT is not supported for any pattern in framed SATOP for releases earlier to Cisco IOS XE 17.13.1.
 

Starting with Cisco IOS XE 17.13.1, system BERT is supported for any pattern in the framed SAToP on T1/E1 interface module.
- System BERT is not configurable, without cem-group configuration.
- Path modes, unframed modes, and concatenation modes are not supported.
- The default BERT pattern supported is PRBS. The QRSS pattern is supported only on T1 or E1 level and the STS-1E path level for pattern 2^20-O151.

### 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 t10/1/1
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 -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)

## Framed SAToP System BERT

*Table 1: Feature History*

Feature Name	Release Information	Description
Framed SAToP System BERT	Cisco IOS XE 17.13.1	You can configure SATOP system BERT with framing under CEM circuits on T1 or E1 interfaces and verify if the BERT is stable and transmitted end-to-end.

System BERT is used between PEs on the core side. This feature is supported only on the 48-port T1/E1 Interface module. You can run a maximum of 16 BERTs at a time.

### Restrictions for Framed SAToP System BERT

- Framing change is not allowed while bert is running

### Configuring Framed SAToP System BERT

You can configure the framed SAToP system BERT in the following scenarios:

- **Scenario 1: PE1—core—PE2**  
CEM system BERT is configured on both PE1 and PE2.
- **Scenario 2: PE1—core—PE2**  
CEM system BERT is configured on PE1 and loopback local is configured on PE2.

**Scenario 1: PE1—CORE—PE2**

1. Configure system BERT on PE1.
2. Configure system BERT on PE2.
3. Configure cross-connect on core.

**Configure System BERT on PE1**

```
PE1#config terminal
PE1(config)#controller T1 0/4/35
PE1(config-controller)#bert pattern 3-in-24 interval 40 direction system
PE1(config)#end
```

**Configure System BERT on PE2**

```
PE1#config terminal
PE1(config)#controller T1 0/3/17
PE1(config-controller)#bert pattern 3-in-24 interval 40 direction system
PE1(config)#end
```

**Configure Cross Connect on Core**

Ensure that the cross connection is UP before configuring BERT.

**Scenario 2: PE1—core—PE2**

1. Configure system BERT on T1 at the PE1 side.
2. Apply loopback local on PE2.
3. Configure cross-connect on core.

```
PE1#show run | s 0/4/35
controller T1 0/4/35
  threshold sd-ber 6
  threshold sf-ber 3
  framing esf
  linecode b8zs
  cablelength short 110
  no snmp trap link-status
  cem-group 0 framed
interface CEM0/4/35
  no ip address
  cem 0
```

**Configure System BERT on PE1**

```
PE1#config terminal
PE1(config)#controller T1 0/4/35
PE1(config-controller)#bert pattern 3-in-24 interval 40 direction system
PE1(config)#end
```

**Apply Loopback Local on PE2**

```
PE2(config-controller)#controller T1 0/4/0
PE2(config-controller)#loopback local
PE2(config-controller)#end
```

### Configure Cross Connect on Core

Ensure that the cross connection is UP before configuring BERT.

## Verifying Framed SAToP System BERT

Use the following **show** commands to verify the framed SAToP system BERT configuration:

### Scenario 1: PE1—CORE—PE2

#### Verify the configuration on PE1

```
PE1#show xconnect all
Legend:  XC ST=Xconnect State  S1=Segment1 State  S2=Segment2 State
         UP=Up                DN=Down                AD=Admin Down    IA=Inactive
         SB=Standby           HS=Hot Standby       RV=Recovering    NH=No Hardware

XC ST Segment 1                               S1 Segment 2                               S2
-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
UP pri mpls 2.2.2.2:500                        UP   ac CE0/4/35:0 (SATOP T1)  UP
```

```
PE1#show controller T1 0/4/35 | sec BERT
DSX1 BERT test result: (running)
DSX1 BERT pattern      : 3-in-24
DSX1 BERT direction   : System
DSX1 BERT sync       : sync
DSX1 BERT sync count  : 1
DSX1 BERT interval    : 100
DSX1 BERT time remain : 01:39:52
DSX1 BERT total errs  : 0
DSX1 BERT total k bits: 10759
DSX1 BERT errors (last): 0
DSX1 BERT k bits (last): 10759
Last clearing of BERT counters never
```

#### Verify the configuration on PE2

```
PE1#show xconnect all
Legend:  XC ST=Xconnect State  S1=Segment1 State  S2=Segment2 State
         UP=Up                DN=Down                AD=Admin Down    IA=Inactive
         SB=Standby           HS=Hot Standby       RV=Recovering    NH=No Hardware

XC ST Segment 1                               S1 Segment 2                               S2
-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
UP pri mpls 3.3.3.3:500                        UP   ac CE0/3/17:0 (SATOP T1)  UP
```

```
PE1#show controller T1 0/3/17 | sec BERT
DSX1 BERT test result: (running)
DSX1 BERT pattern      : 3-in-24
DSX1 BERT direction   : System
DSX1 BERT sync       : sync
DSX1 BERT sync count  : 1
DSX1 BERT interval    : 100
DSX1 BERT time remain : 01:39:52
DSX1 BERT total errs  : 0
DSX1 BERT total k bits: 10759
DSX1 BERT errors (last): 0
DSX1 BERT k bits (last): 10759
Last clearing of BERT counters never
```

### Scenario 2: PE1—CORE—PE2



## 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
<b>loopback local line</b>	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 <b>clock source</b> command to internal for this loopback mode.
<b>loopback network line</b>	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
loopback diag
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
```




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

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**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.

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## 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
  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
    
```

## User-defined Remote Loopback on T1 Interfaces

Table 2: Feature History

Feature Name	Release Information	Description
User-defined Remote Loopback on T1 Interfaces	Cisco IOS XE 17.13.1	You can customize the loopback codes on T1 in a 16-bit format in contrast to the standard 6-bit loop code on the 48-port T1 interface module.

For this release, you can configure the custom code only in the transmit direction (Tx) with ESF framing. The user-defined loop codes are supported only on the T1 controllers of 48-port T1/E1 Interface module .

The list of supported loop codes are:

- 0xFF48, 0xFF24, 0xD3D3, 0x3F02, 0x9393, 0xD5D5, 0xD5D6, and 0x6767
- 0xDBDB, 0xC741, 0xC754, 0xC743, 0xC742, 0xFF1E, 0xC541, and 0x12FF
- 0x5F5F, 0x56D7, 0x56D8, 0x56DF, 0x56FB, 0xD5D6, 0xD5D5, and 0x5688
- 0x5687, 0xC564, 0x9393, 0x24FF, 0xC741, 0xC742, 0xC743, and 0xC744
- 0xC745, 0xC746, 0xC747, 0xC748, 0xC749, 0xC74A, 0xC74B, and 0xC74C
- 0xC74D, 0xC74E, 0xC74F, 0xC750, 0xC751, 0xC752, 0xC753, and 0xC754

## Configuring User-defined Remote Loopback on T1 Interfaces

You can configure a T1 remote loopback with ESF framing and 16-bit custom code on PE router.

```
PE1#config terminal
PE1(config)#controller T1 0/4/47
PE1(config-controller)#loopback remote esf line custom_code 0x9393
PE1(config-controller)#end
```

You can verify the remote loopback configuration using the following **show** command:

```
PE1#show run | sec 0/4/47
controller T1 0/4/47
threshold sd-ber 6
threshold sf-ber 3
framing esf
linecode b8zs
cablelength short 110
loopback remote esf line custom_code 0x9393
no snmp trap link-status
```

## Verifying User-defined Remote Loopback on T1 Interfaces

Use the following **show** commands to verify the user-defined remote loopback:

```
PE1#show controller T1 0/4/47
T1 0/4/47 is up (Far End Line Loopback with ESF BOC Custom Code)
Currently in FDL Custom Code Remotely Line Looped
Applique type is A900-IMA48D-C
Cablelength is short 110
Receiver has no alarms.
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
Data in current interval (870 seconds elapsed):
Near End
```

```
PE1#show facility-alarm status | i 0/4/47
T1 0/4/47 May 10 2023 14:13:54 MINOR LOOPBACK_REMOTE_FDL_CUSTOM_COD
Loopback Remote Line FDL Custom Code Alarm [22]
```

