



## **1 port OC-48/STM-16 or 4 port OC-12/OC-3 / STM-1/STM-4 + 12 port T1/E1 + 4 port T3/E3 CEM Interface Module Configuration Guide, Cisco IOS XE 16 (ASR 920 Series Routers)**

**First Published:** 2020-07-31

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## CHAPTER 1

# Configuring Support of 1 port OC-48/STM-16 or 4 port OC-12/OC-3 / STM-1/STM-4 + 12 port T1/E1 + 4 port T3/E3 CEM Interface Module

The 1 port OC-48/STM-16 or 4 port OC-12/OC-3 / STM-1/STM-4 + 12 port T1/E1 + 4 port T3/E3 CEM Interface Module has 12XDS1, 4XDS3, electrical interfaces, and 4XSFP ports that can provide multiple functions such as 1XOC-48/12/3 and 3XOC-12/3. The maximum speed supported on OCx ports is OC-48. The interface module supports a maximum of 3G CEM traffic.



**Note** In addition to support on RSP2 module, the IM is supported on RSP3 from the Cisco IOS XE 16.9.x release.



**Note** OCx Port License should be enabled for the configuration.

- [Restrictions of Feature Support on 4 Port OC48/OC12/OC3 + 12 Port T1/E1 + 4 Port T3/E3 CEM Interface Module, on page 1](#)
- [Port Licensing, on page 2](#)
- [Uninstalling a License, on page 4](#)
- [Enabling T1 Controller, on page 5](#)
- [Enabling T3 Controller, on page 5](#)
- [Enabling SONET Controller, on page 5](#)
- [Associated Commands, on page 6](#)
- [Additional References , on page 6](#)

## Restrictions of Feature Support on 4 Port OC48/OC12/OC3 + 12 Port T1/E1 + 4 Port T3/E3 CEM Interface Module

- Mixed mode support, for example, DS1 and E1 or DS3 and E3 or SONET and SDH simultaneously on different ports is not available.

- E1/E3, Unidirectional Path Switching Ring (UPSR), and Data Communication Channel (DCC) are not supported.
- Multiservice functionality: MLPPP, FR, and MLFR are not supported.
- EoS and EoPDH are not supported.
- The **configure replace** command is *not* supported.
- A combination of T1/T3/SONET with E1/E3/SDH modes are not supported.
- When IM is used with RSP3 module, then it is not allowed in slots 0 and 1 on chassis.
- Synchronization Status Message (SSM) is not supported on T3 ports.

## Port Licensing

The Cisco Software License Activation feature is a set of processes and components to activate Cisco IOS-XE software feature sets by obtaining and validating fee-based Cisco software licenses. You should enable the license *only* for OCx ports. License is not required for the ports 0-15 (DSx ports).

You should associate a required license to a port. Many licenses can be configured for a port. Only one license can be associated with a port as only one rate can be configured at a time. Other licenses are not required unless rate is changed frequently.

No license is enabled on the port by default. Same port license (OC-3 or OC-12) can be used for Legacy OC-3 IM. A port can be enabled with any one of the following license types:

- OC-3
- OC-12
- OC-48

On each IM, OCx port can be configured on ports 16-19. For example, a maximum of four OC-3 ports can be configured on ports 16-19. A maximum of four OC-12 ports can be configured on ports 16-19. A maximum of one OC-48 port can be configured on ports 16-19.

## Information About Port Licensing

### Scenario of IM Removal

- All licenses enabled on the IM ports are removed.
- The free licenses can be associated with the same or different IM ports.

### Scenario of IM Re-insertion

- When IM is inserted back in the same slot, the IM ports require the licenses based on the configurations.
- The available free licenses are used and old configurations are retained.
- When free licenses are not available, the controller port moves to "shut" state and the following error message is displayed:



```

configure terminal
controller mediatype 0/1/19
mode sonet
rate oc3
controller sonet 0/1/19
rate oc3
  license is not enabled for this rate
% Unable to configure this rate.
end

```

- To remove the "shut" state, perform any one of the following actions:
  - Remove all the configurations present at rate level and beyond.
  - Enable the license on the port that has the same rate as that of the configured controller. For example, enable OC3 license for any OC3 configuration to remove the "shut" state.

Thus, port configurations remain intact and controller port re-configuration is not required.

## Installing a License

To install or upgrade a license by using the **license install** command, you must have already received the license file from the Cisco Product License Registration portal at <http://www.cisco.com/go/license> (or you already backed up the license by using the **license save** command).

To install the license:

```

enable
show license udi
Convert the PAK to a license by entering the PAK and the UDI into the Cisco Product License
Registration portal: http://www.cisco.com/go/license
license install stored-location-url
show license detail
end

```

## Enabling a License

Use the **platform enable controller MediaType <slot/bay/port> <port rate>** to enable a particular license type on the controller port. Providing a particular license type is mandatory to enable the license on the IM.




---

**Note** This command is not applicable for DSx ports (0-15).

---




---

**Note** You should configure controller mediatype and controller SONET before enabling the license on the port. License enabling is allowed when the license with the same rate is configured on the port. The configuration fails if the license with a different rate is configured on the port.

---

To enable port licensing:

```

enable
configure terminal
platform enable controller MediaType 0/4/16 oc3
controller MediaType 0/4/16

```

```

mode sonet
exit
controller sonet 0/4/16
rate oc3
exit

```

## Verifying License Configuration

Use the **show license detail** command to verify the license configuration:

```

Router#show license detail
Index: 15 Feature: oc3 Version: 1.0
  License Type: Permanent
  License State: Active, In Use
  License Count: 1/1/0 (Active/In-use/Violation)
  License Priority: Medium
  Store Index: 4
  Store Name: Primary License Storage
#

```

## Disabling a License

Use the **no platform enable controller MediaType <slot/bay/port> <port rate>** to disable a particular license type on the controller port.




---

**Note** Disabling a license is not successful if a rate is configured on the controller that requires the license. Hence, you should first remove the controller configuration before disabling the license.

---

To disable port licensing:

```

enable
configure terminal
controller sonet 0/4/16
sts-1 1
no vtg 1 t1 1 cem-group 23 unframed
no mode vt-15
controller MediaType 0/4/16
no mode sonet
exit
no platform enable controller MediaType 0/4/16 oc3

```

## Uninstalling a License

To uninstall a license:

```

enable
configure terminal
no platform enable controller MediaType slot/bay/port OC3
end
license clear feature-name

```

## Enabling T1 Controller



**Note** T1/T3 or E1/E3 does not require any license.

To enable T1 controller:

```
enable
configure terminal
controller mediatype 0/4/0
mode t1
end
```

## Configuring the Controller

To configure T1 interface, use the following commands:

```
enable
configure terminal
controller mediatype 0/4/0
mode t1
exit
controller t1 0/4/0
clock source internal
framing esf
cablelength short 110
linecode b8zs
no shutdown
exit
```

## Enabling T3 Controller

To enable T3 controller:

```
enable
configure terminal
controller mediatype 0/4/12
mode t3
end
```

## Enabling SONET Controller

To enable SONET controller:

```
enable
configure terminal
controller mediatype 0/0/16
mode sonet
end
```

## Associated Commands

The following table shows the commands for the IM configuration:

Command	Link
<b>platform enable controller Mediatype</b> <slot/bay/port> <port rate>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp3145726977">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp3145726977</a>

## Additional References

### Related Documents

Related Topic	Document Title
Cisco IOS commands	<a href="#">Cisco IOS Master Commands List, All Releases</a>
Compact-SFP	<a href="#">Cisco SFP Modules for Gigabit Ethernet Applications Data Sheet</a>

### Standards and RFCs

Standard/RFC	Title
—	<i>There are no standards and RFCs for this feature.</i>

### MIBs

MIB	MIBs Link
—	<i>There are no MIBs for this feature.</i> <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

**Technical Assistance**

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<p><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></p>

**Additional References**



## CHAPTER 2

# Configuring CEM

---

This module describes how to configure Circuit Emulation (CEM).

- [Overview of Circuit Emulation, on page 9](#)
- [Configuring CEM, on page 10](#)
- [Pseudowire Scale Support, on page 14](#)
- [Overview of DS3 CEP, on page 15](#)
- [Associated Commands, on page 20](#)
- [Additional References for Configuring CEM, on page 21](#)

## Overview of 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 chassis encapsulates the TDM data in the MPLS packets and sends the data over a CEM pseudowire to the remote Provider Edge (PE) chassis. As a result, CEM functions as a physical communication link across the packet network.

The chassis supports the pseudowire type that utilizes CEM transport: Structure-Agnostic TDM over Packet (SAToP).

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

The RSP switchover with physical SSO is above 50 ms as follows:

- R0 to R1 is 5 seconds
- R1 to R0 is 10 seconds

## Structure-Agnostic TDM over Packet

Structure-Agnostic TDM over Packet (SAToP) encapsulates Time Division Multiplexing (TDM) bit-streams as pseudowires over public switched networks. It disregards any structure that may be imposed on streams, in particular the structure imposed by the standard TDM framing.

The protocol used for emulation of these services does not depend on the method in which attachment circuits are delivered to the Provider Edge (PE) chassis. For example, a T1 attachment circuit is treated the same way for all delivery methods, including copper, multiplex in a T3 circuit, a virtual tributary of a SONET circuit, or unstructured Circuit Emulation Service (CES).

In SAToP mode, the interface is considered as a continuous framed bit stream. The packetization of the stream is done according to IETF RFC 4553. All signaling is carried out transparently as a part of a bit stream.

## CEM PW Scale

Effective from the 16.12.1 release,

- 21504 CEM Pseudowire (PWs) without protection (with SONET)
- 10752 CEM PWs with protection

will be supported on the Cisco router.

Currently the Cisco A900-IMA1Z8S-CX support a maximum of 5376 CEM PWs.

4 Interface Modules can be used on the ASR 903 and NCS 4206 routers to achieve the 21K CEM PWs.

This can be achieved by:

- Configuring CEM circuits on all the 192 STS on the 9th port of the Cisco A900-IMA3G-IMSG which supports OC192.
- Configuring CEM circuits on all the 4 OC48 ports of the Cisco A900-IMA3G-IMSG which supports OC192.




---

**Note** The 21K CEM PW's can be achieved on the ASR 907/921 and NCS 4216 by using the combination of the Cisco A900-IMA1Z8S-CX and A900-IMA3G-IMSG IMs in multiple slot combinations.

---

### Restrictions for PW Scale Increase

- When you configure the 21505th T1 PW command, your configuration may fail even though no error message is prompted

## Configuring CEM

This section provides information about how to configure CEM. CEM provides a bridge between a Time Division Multiplexing (TDM) network and a packet network, MPLS. The chassis encapsulates the TDM data in the MPLS packets and sends the data over a CEM pseudowire to the remote Provider Edge (PE) chassis.

The following sections describe how to configure CEM.

### Configuring CEM Restriction

Not all combinations of payload size and dejitter buffer size are supported. If you apply an incompatible payload size or dejitter buffer size configuration, the chassis rejects it and reverts to the previous configuration.






---

**Note** CEM interface does *not* support `idle-cas` parameter.

---

## Configuring CEM Classes

A CEM class allows you to create a single configuration template for multiple CEM pseudowires. Follow these steps to configure a CEM class:



- Note**
- The CEM parameters can be configured either by using CEM class or on CEM interface directly.
  - The CEM parameters at the local and remote ends of a CEM circuit must match; otherwise, the pseudowire between the local and remote PE chassis does not come up.
- 

```
enable
configure terminal
class cem mycemclass
payload-size 512
dejitter-buffer 12
exit
interface cem 0/4/0
cem 0
cem class mycemclass
xconnect 10.10.10.10 200 encapsulation mpls
exit
```

## Configuring CEM Parameters

The following sections describe the parameters you can configure for CEM circuits.

### Configuring Payload Size (Optional)

To specify the number of bytes encapsulated into a single IP packet, use the `payload-size` command. The size argument specifies the number of bytes in the payload of each packet. The range is from 32 to 1312 bytes.

Default payload sizes for an unstructured CEM channel are as follows:

- T1 = 192 bytes

Default payload sizes for a structured CEM channel depend on the number of time slots that constitute the channel. Payload size (L in bytes), number of time slots (N), and packetization delay (D in milliseconds) have the following relationship:  $L = 8 * N * D$ . The default payload size is selected in such a way that the packetization delay is always 1 millisecond.

The payload size must be an integer of the multiple of the number of time slots for structured CEM channels.

### Setting the Dejitter Buffer Size

To specify the size of the dejitter-buffer used to compensate for the network filter, use the `dejitter-buffer` command. The configured dejitter-buffer size is converted from milliseconds to packets and rounded up to

the next integral number of packets. Use the size argument to specify the size of the buffer, in milliseconds. The range is from 1 to 32; the default is 5.

## Shutting Down a CEM Channel

To shut down a CEM channel, use the **shutdown** command in CEM configuration mode. The **shutdown** command is supported only under CEM mode and not under the CEM class.

## Configuring DS1 CT3 SAToP Mode on OCx Ports

To configure DS1 CT3 SAToP mode on OCx ports, use the following commands:

```
enable
configure terminal
controller MediaType 0/4/16
mode sonet
controller sonet 0/4/16
rate oc12
sts-1 1
mode ct3
t1 1 cem-group 100 unframed
t1 1 framing unframed
interface cem 0/4/16
cem 100
xconnect 2.2.2.2 10 encapsulation mpls
end
```

## Configuring VT DS1 SAToP Mode

To configure VT DS1 SAToP mode, use the following commands:

```
enable
configure terminal
controller MediaType 0/4/16
mode sonet
controller sonet 0/4/16
rate oc12
sts-1 1
mode vt-15
vtg 1 t1 1 framing unframed
vtg 1 t1 1 cem-group 0 unframed
end
```

## Configuring STS-Nc CEP

To configure STS-Nc CEP, use the following commands:

```
enable
configure terminal
controller MediaType 0/4/16
mode sonet
controller sonet 0/4/16
rate oc12
sts-1 1 - 3 mode sts-3c
cem-group 100 cep
interface cem 0/4/16
cem 100
xconnect 2.2.2.2 10 encapsulation mpls
end
```

## Configuring CEP

To configure CEP, use the following commands:

```
enable
configure terminal
controller MediaType 0/4/16
mode sonet
controller sonet 0/4/16
sts-1 1
mode unframed
cem-group 100 cep
end
```

## Configuring VT-15 CEP

To configure VT-15 CEP, use the following commands:

```
enable
configure terminal
controller MediaType 0/4/16
mode sonet
controller sonet 0/4/16
rate oc12
sts-1 1
mode vt-15
vtg 1 vt 1 cem-group 100 cep
end
```

## Configuring DS3 SAToP

To configure DS3 SAToP, the STS-1 needs to be configured in mode T3::

```
enable
configure terminal
controller MediaType 0/4/16
mode sonet
controller sonet 0/4/16
rate oc12
sts-1 1
mode t3
cem-group 100 unframed
interface cem 0/4/16
cem 100
xconnect 2.2.2.2 10 encapsulation mpls
end
```

## Configuring Unidirectional APS

To configure unidirectional ACR (SONET Framing), use the following commands:

```
enable
configure terminal
controller sonet 0/4/16
clock source internal
aps group acr 1
aps working 1
aps unidirectional
exit
controller sonet 0/4/16
aps group acr 1
aps protect 1 10.7.7.7
```

```
aps revert 3
aps adm
end
```




---

**Note** To restore the system to its default condition, use the **no** form of the command.

---

### Configuring Bi-directional ACR (SONET Framing)

To configure bi-directional ACR (SONET Framing), use the following commands:

```
enable
configure terminal
controller sonet 0/4/16
clock source internal
aps group acr 1
aps working 1
exit
controller sonet 0/4/16
aps group acr 1
aps protect 1 10.7.7.7
end
```




---

**Note** To restore the system to its default condition, use the **no** form of the command.

---

### Configuring CEM APS

To configure CEM APS:

```
enable
configure terminal
controller MediaType 0/4/16
mode sonet
controller sonet 0/4/16
controller sonet-acr acr_no
sts-1 1
vtg 1 t1 1 cem-group 100 unframed
end
```

## Pseudowire Scale Support

*Table 1: Feature History*

Feature Name	Release	Description
Pseudowire Scale Support	Cisco IOS XE Amsterdam 17.3.1	A maximum of <b>26,880</b> CEM Pseudowires are supported on the Cisco RSP3 chassis using combination of the 1-Port OC-192 or 8-Port Low Rate CEM interface module.

Feature Name	Release	Description
Pseudowire Scale Support	Cisco IOS XE Gibraltar 16.12.1	A maximum of <b>21,504</b> Pseudowires are supported on the Cisco RSP3 chassis using combination of the 1-Port OC-192 or 8-Port Low Rate CEM interface module.

Effective **Cisco IOS XE 17.3.1** the Cisco router supports,

- 26,880 CEM Pseudowires (PWs) without protection (with SONET)
- 13,440 CEM PWs with protection

Effective Cisco **IOS XE 16.12.1** the Cisco router supports,

- 21,504 CEM Pseudowire (PWs) without protection (with SONET)
- 10,752 CEM PWs with protection

will be supported on the Cisco router.



#### Note

These 26,880 and 21,504 CEM PWs can be achieved on the router by using the combination of the 1-port OC-192 Interface module or 8-port Low Rate Interface Module and 1-port OC148/ STM-16 or 4-port OC-12/OC-3 / STM-1/STM-4 + 12-Port T1/E1 + 4-Port T3/E3 CEM Interface Module IMs with the 48-port T3/E3 CEM Interface Module and 48-port T1/E1 CEM Interface Module (ASR 900 48-port T1/E1 Interface Module) in multiple slot combinations.

#### Restrictions for PW Scale

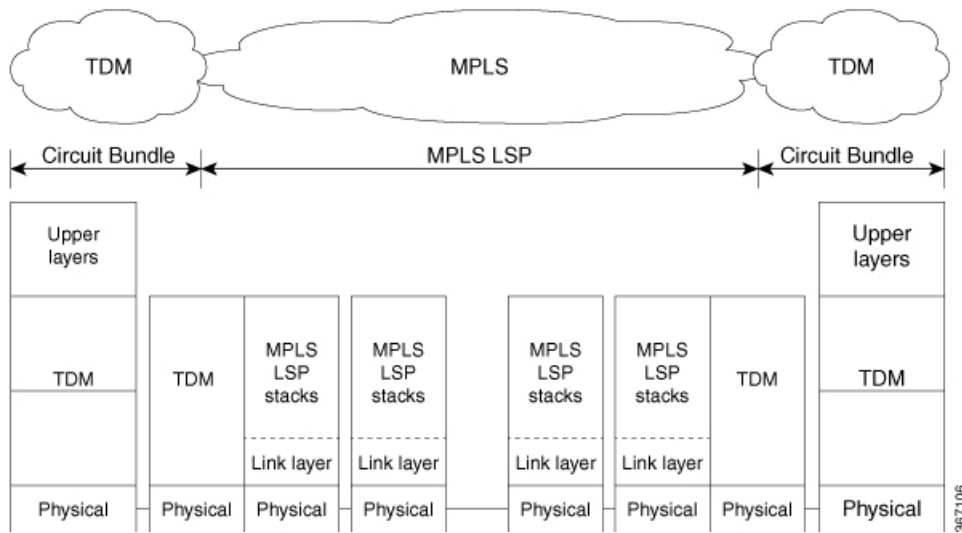
- CEM PW scale is supported in **only** in the SONET mode.
- When configured for scale beyond the maximum CEM PW scale, a syslog is generated as *Cannot allocate CEM group*, maximum CEM group exceeded, but the configurations will not be rejected.
- While performing ISSU with the specified CEM PW scales, sufficient interface-module-delay must be provided for each IM. This provision enables all PWs to program after the IM OIR. The minimum 'time for delay' in case of 1-port OC-192 Interface module or 8-port Low Rate Interface Module (ASR 900 Combo 8 port SFP GE and 1 port 10GE IM with CEM, 10G) is 1800 seconds.
- After SSO and successful bulk sync, run the **show platform software tdm-combo cem ha-stray-entries** command. If the output of this command displays no entries, then the next SSO can be performed. You must wait until **show platform software tdm-combo cem ha-stray-entries** has no entries.

To configure CEM PWs see the [Carrier Ethernet Configuration Guide \(Cisco ASR 900 Series\)](#).

## Overview of DS3 CEP

Effective Cisco IOS XE Fuji 16.8.1, DS3 CEP feature is introduced to achieve CEP configuration on DS3 ports of the interface module. Here, T3 or E3 is mapped to STS-1 or VC4 that is emulated on a packet network.

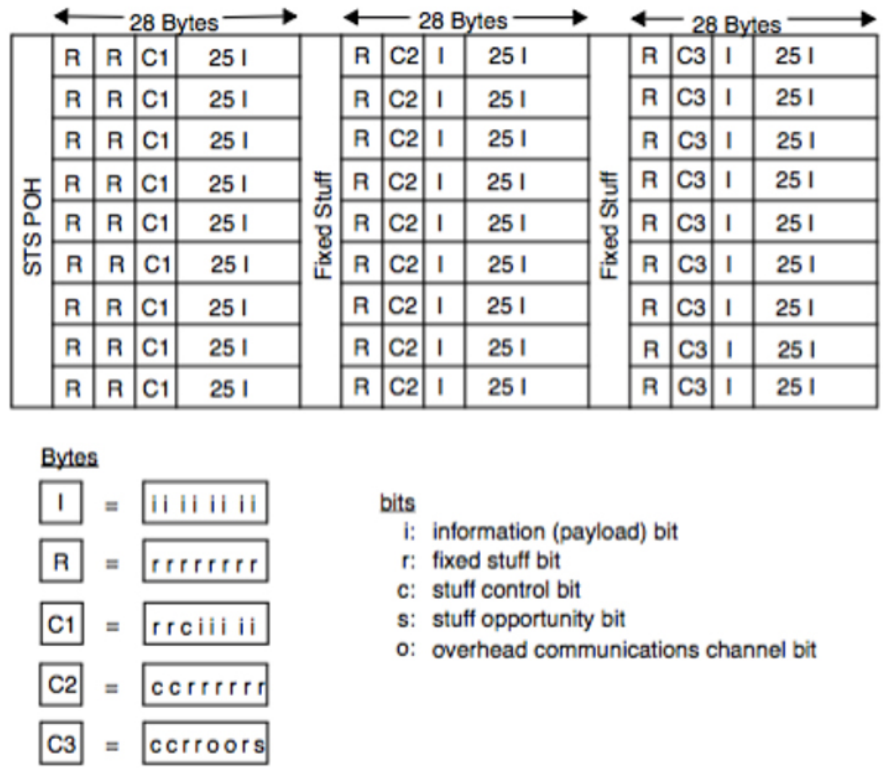
Figure 1: Network Reference Model and Protocol Layers for TDM-MPLS User Plane Interworking



## Asynchronous Mapping for DS3 CEP

An asynchronous mapping for a DS3 in the payload capacity of an STS-1 signal is defined for clear-channel transport of DS3 signals that meet the DS3 requirements in GR-499-CORE. The asynchronous DS3 mapping consists of nine subframes each of 125  $\mu$ s. Each subframe contains 621 information (I) bits, a set of five stuff control (C) bits, one stuff opportunity (S) bit, and two overhead communication channel (O) bits. The remaining bits of the STS-1 payload capacity are fixed stuff (R) bits. The O-bits are reserved for future overhead communication purposes. The values of the R and O bits are undefined. In each subframe, the set of five C-bits are used to control the S-bit. CCCCC = 00000 is used to indicate that the S-bit is an information bit, while CCCCC = 11111 is used to indicate that the S-bit is a stuff bit. The value of the S-bit (if it is stuff bit) is undefined.

Figure 2: Asynchronous Mapping for DS3 CEP



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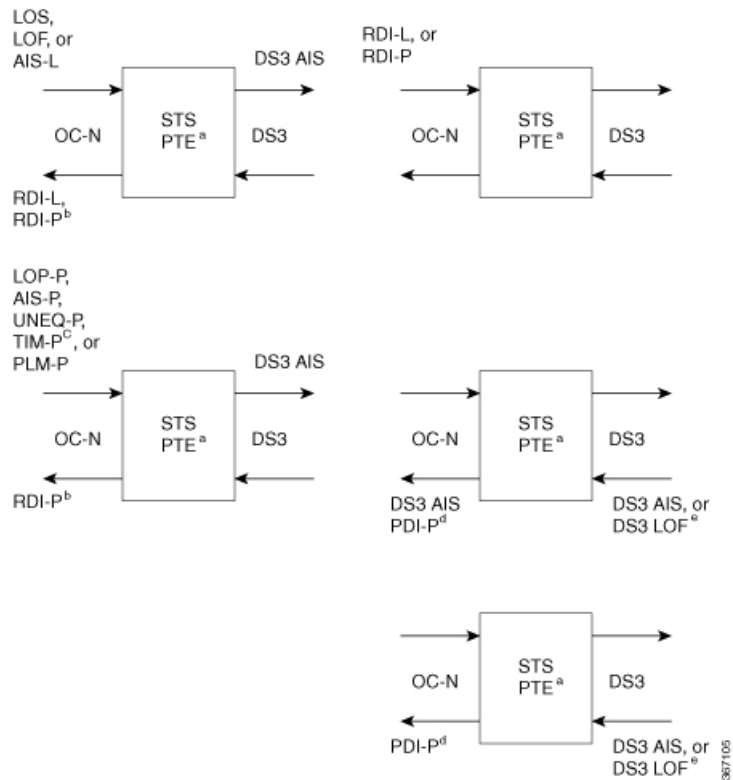
## Restrictions

- BERT for both line and system directions is *not* supported.
- Card Protection is *not* supported.
- E3 CEP is not supported on optical or SDH controller.

## Alarms

If an alarm is detected in the DS3 end, the C2 bytes are used to inform the remote Provider Edge (PE). For this, the alarm mapping table has to be followed as shown in the figure below.

Figure 3: Alarm Mapping Table



## Configuring DS3 CEP

### Pre-requisites:

The default mode is channelized mode. Use **no channelized** command to change to non-channelized mode.

To configure DS3 CEP for mode T3:

```
enable
controller MediaType 0/4/15
mode t3
controller t3 0/4/15
no channelized
cem-group 0 cep
```

To configure DS3 CEP for mode E3:

```
enable
controller MediaType 0/4/15
mode e3
controller e3 0/4/15
no channelized
cem-group 0 cep
```

### Configuration of Overhead C2 and J1 Bytes:

You can configure overhead C2 and J1 bytes after you configure DS3 CEP.

```
enable
controller MediaType 0/4/15
```



```

mode e3
controller e3 0/4/15
threshold sd-ber 6
threshold sf-ber 3
no channelized
framing g751
cablelength short
cem group 0 cep
overhead j1 tx length 16
overhead j1 expected length 16

```

For loopback configuration, see *Loopback on T3/E3 Interfaces* section.

## Verification of DS3 CEP Configuration

Use `show controller t3 0/4/15 path` to verify DS3 CEP configuration:

```

router#show controller t3 0/4/15 path

T3 0/1/20 PATH 1.

Asynchronous Mapping for DS3 into STS-1

TX : TDM to PSN direction
RX : PSN to TDM direction

Clock Source is internal

      AIS = 0          RDI = 0          REI = 349          BIP(B3) = 22
      LOP = 0          PSE = 0          NSE = 0           NEWPTR = 0
      LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: None

TCA threshold:  B3 = 10e-6
Rx: C2 = FF
Tx: C2 = 01

Tx J1 Length : 64
Tx J1 Trace

 72 74 72 32 20 30 2F 31 2F 32 30 2E 31 00 00 00      rtr2 0/1/20.1...
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....

Expected J1 Length : 64
Expected J1 Trace

 72 74 72 32 20 30 2F 31 2F 32 30 2E 31 00 00 00      rtr2 0/1/20.1...
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 64
Rx J1 Trace

 72 73 70 32 20 30 2F 35 2F 31 32 2E 31 00 00 00      rsp2 0/5/12.1...
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....

```

```
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
```

```
router#
```



**Note** The verification output does not provide the details for alarms.

## Associated Commands

The following commands are used to configure CEM:

Commands	URL
<b>cem</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2184138077">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2184138077</a>
<b>cem group</b> <i>cem-group-number</i> <b>unframed</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600</a>
<b>cem-group</b> <i>cem-group-number</i> <b>cep</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600</a>
<b>class</b> <b>cem</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp7199841750">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp7199841750</a>
<b>controller</b> <b>t1</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1472647421">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1472647421</a>
<b>mode</b> <b>ct3</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp5913349630">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp5913349630</a>
<b>mode</b> <b>t3</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp5688885940">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp5688885940</a>
<b>mode</b> <b>vt-15</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp1137973905">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp1137973905</a>
<b>payload-size</b> <b>dejitter-buffer</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp3946673156">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp3946673156</a>
<b>rate</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp4442889730">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp4442889730</a>

Commands	URL
<b>show cem circuit</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s2.html#wp1086825073">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s2.html#wp1086825073</a>
<b>sts-1</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s6.html#wp2423232697">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s6.html#wp2423232697</a>
<b>t1 t1-line-number cem-group</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2399838226">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2399838226</a>
<b>t1 t1-line-number framing</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2623191253">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2623191253</a>
<b>t1 t1-line-number clock source</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp3480850667">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp3480850667</a>
<b>vtg vtg-number vt vt-line-number cem-group cem-group-number cep</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp3494199143">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp3494199143</a>
<b>xconnect</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp8578094790">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp8578094790</a>
<b>show controllers t3</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp1987423547">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp1987423547</a>

## Additional References for Configuring CEM

### Related Documents

Related Topic	Document Title
Cisco IOS commands	<i>Cisco IOS Master Commands List, All Releases</i>

### Standards

Standards	Title
—	There are no standards for this feature.

**MIBs**

MIB	MIBs Link
—	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

**RFCs**

RFCs	Title
—	There are no RFCs for this feature.

**Technical Assistance**

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>



## CHAPTER 3

# Configuring T1 Interfaces

This chapter provides information about configuring the T1 interfaces:



**Note** T1 is supported only on Cisco ASR 900 RSP3 Module.

- [Information About T1 Interfaces, on page 23](#)
- [Performance Monitoring, on page 24](#)
- [Configuring Structure-Agnostic TDM over Packet - T1 Interfaces, on page 25](#)
- [Overview of Framed Structure-Agnostic TDM over Packet \(SAToP\), on page 26](#)
- [Troubleshooting T1 Controllers, on page 29](#)
- [Associated Commands, on page 34](#)

## Information About T1 Interfaces

The following sections provide information about T1 interfaces.

### Overview of T1 Interfaces

The 12-port T1 interface module on CEM line card supports generic single or dual-port T1 trunk interfaces for voice, data, and integrated voice or data applications.

### Configuring the Controller

To configure T1 interface, use the following commands:

```
enable
configure terminal
controller mediatype 0/4/0
mode t1
exit
controller t1 0/4/0
clock source internal
framing esf
cablelength short 110
linecode b8zs
```

```
no shutdown
exit
```

## Verifying Controller Configuration

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

```
#show controller t1 0/4/0
T1 0/4/0 is up
  Applique type is A900-IMA3G-IMSG
  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
```

## Performance Monitoring

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

To view the performance monitoring error details, use the **show controller t1** command:

```
PE2#show controller t1 0/4/0
T1 0/4/0 is up
  Applique type is A900-IMA3G-IMSG
  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

```

## Configuring Structure-Agnostic TDM over Packet-T1 Interfaces

To configure Structure-Agnostic TDM over Packet (SAToP):

```

enable
configure terminal
controller t1 0/4/0
cem-group 0 unframed
exit
interface cem 0/4/0
cem 0
xconnect 2.2.2.2 10000 encapsulation mpls
exit

```

## Verifying CEM Configuration for SAToP

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

```
#show cem ci interface cem 0/4/0
```

```

CEM 0/4/0, 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: 6 (In use: 0)
Payload Size: 192
Framing: Unframed
CEM Defects Set
None

Signalling: No CAS
RTP: No RTP

Ingress Pkts:      6463477          Dropped:          0
Egress Pkts:       5132190          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

```

## Overview of 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 over 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** BERT is *not* supported in system direction for framed SAToP.

---




---

**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 2: 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 Generation at PE (Remote)	Framing Bits Terminated at PE (Remote)
Unframed SAToP	None	Up	LOF	No	No
Framed SAToP	LOF	Down (Data path remains up)	LOF <sup>12</sup>	Yes	No
CESOP	LOF	Down (Data path remains up)	AIS	Yes	Yes

<sup>1</sup> AIS—Support until Cisco IOS XE 16.9.3 Fuji release

<sup>2</sup> LOF—Starting from Cisco IOS XE Fuji 16.9.4 or later releases

**Table 3: 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 4: 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

## Configuring Framed SAToP



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

To configure Framed Structure-Agnostic TDM over Packet (SAToP):

```
enable
configure terminal
controller t1 0/4/0
framing esf
cem-group 0 framed
exit
interface cem 0/4/0
cem 0
xconnect 2.2.2.2 10000 encapsulation mpls
exit
```

## Verifying CEM Configuration for Framed SAToP

Use **show cem ci interface** to verify CEM configuration for Framed SAToP:

```
#show cem ci interface cem 0/4/0

CEM 0/4/0, 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: 6 (In use: 0)
Payload Size: 192
Framing: Framed SAToP
CEM Defects Set
None

Signalling: No CAS
RTP: No RTP

Ingress Pkts:    6463477          Dropped:          0
Egress Pkts:    6463477          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
```

## Troubleshooting T1 Controllers

You can use the following methods to troubleshoot the T1 controllers:

### Running Bit Error Rate Testing

Bit error rate testing (BERT) is supported on T1 interfaces.

The interface module contains onboard BERT circuitry. With this, the interface module 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. BERT allows you to test cables and signal problems in the field.

When running a BERT test, your system expects to receive the same pattern that it is transmitting. 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 following keywords list different BERT keywords and their descriptions.

**Table 5: BERT Pattern Descriptions**

Keyword	Description
<b>2^11</b>	Pseudo-random test pattern that is 2,048 bits in length.
<b>2^15</b>	Pseudo-random O.151 test pattern that is 32,768 bits in length.
<b>2^20-O153</b>	Pseudo-random O.153 test pattern that is 1,048,575 bits in length.
<b>2^20-QRSS</b>	Pseudo-random QRSS O.151 test pattern that is 1,048,575 bits in length.
<b>2^23</b>	Pseudo-random 0.151 test pattern that is 8,388,607 bits in length.

The total number of error bits received, and the total number of 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.

BERT is supported in two directions:

- Line - supports BERT in TDM direction
- System - supports BERT in PSN direction



**Note** Before starting system side BERT, you must configure CEM. When the BERT is configured towards system direction, it internally loopbacks the TDM side. BERT in system direction is *not* supported for framed SAToP.

## Configuring BERT

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

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

```
enable
configure terminal
controller t1 0/4/0
bert pattern 2^11 interval 5 direction [line | system]
exit
```

### Verifying BERT Configuration for SAToP

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

```
Router# show controllers t1 0/4/0
T1 0/4/0 is up.
Applique type is A900-IMA3G-IMSG
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 unframed, Line Code is B8ZS, Clock Source is Internal.
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

```

## Loopback on T1 Interfaces

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

Loopback	Description
<b>loopback diag</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. The interface transmits AIS in this mode. Set the <b>clock source</b> command to internal for this loopback mode.
<b>loopback local</b>	Loops the incoming receive signal back out to the transmitter. You can specify whether to use the line or payload.
<b>loopback local line</b>	The incoming signal is looped back in the interface using the framer's line loopback mode. The framer does not reclock or reframe the incoming data. All incoming data is received by the interface driver.
<b>loopback local payload</b>	Loops the incoming signal back in the interface using the payload loopback mode of the framer. The framer reclocks and reframes the incoming data before sending it back out to the network.  <b>Note</b> Loopback Local Payload support is available only when framing is ESF.
<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.

### Configuring Loopback

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 0/4/0
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 0/4/0
loopbackdiag
exit
```




---

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

---




---

**Note** Network payload configuration is not supported on 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 (inband bit-orientated CDE) or the ESF loopback codes to communicate the request to the far-end.

### Restrictions for Loopback Remote

E1 loopback remote is not supported.

### 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 0/0/1
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 0/0/1
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 0/0/1
controller T1 0/2/10
  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 0/0/1
T1 0/0/1 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
```

## Associated Commands

The commands used to configure the Interfaces.

Commands	URL
<b>cem-group</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600</a>
<b>payload-size dejitter-buffer</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp3946673156">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp3946673156</a>
<b>class cem</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2169323859">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2169323859</a>
<b>controller t1/e1</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1472647421">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1472647421</a>
<b>xconnect</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp8578094790">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp8578094790</a>
<b>linecode</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-11.html#wp2312535965">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-11.html#wp2312535965</a>
<b>framing</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-f1.html#wp2853515177">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-f1.html#wp2853515177</a>
<b>clock source</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp6081785140">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp6081785140</a>
<b>cable length</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2492964151">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2492964151</a>
<b>bert pattern</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp3620978929">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp3620978929</a>
<b>channelized</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp7026926390">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp7026926390</a>



Commands	URL
<b>loopback</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-11.html#wp1033903426">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-11.html#wp1033903426</a>
<b>show controller t1</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp2149471094">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp2149471094</a>





## CHAPTER 4

# Configuring T3 Interfaces

T3 interface supports 4 ports. The channels on the T3 interface can be configured as either clear channel mode or channelized mode.



**Note** T3 is supported only on Cisco ASR 900 RSP3 Module.

- [Information About T3 Interfaces, on page 37](#)
- [Enabling T3 Controller, on page 37](#)
- [Configuring Framed SAToP - Channelized T3/T1 Interfaces, on page 44](#)
- [Performance Monitoring , on page 44](#)
- [Troubleshooting T3 Controllers, on page 51](#)
- [Associated Commands, on page 59](#)

## Information About T3 Interfaces

The following sections provide information about T3 interfaces.

### Overview of T3 Interfaces

The T3 interface supports two modes, clear channel mode and channelized mode.

### Benefits of T3 Interfaces

The following are the benefits of T3 interfaces:

- Higher bandwidth
- Flexibility by channelization

## Enabling T3 Controller

To enable T3 controller:

```
enable
configure terminal
controller mediatype 0/4/12
mode t3
end
```

## Configuring the Controller of Clear Channel T3 Interfaces

When the clear channel T3 interface is used for the first time, the running configuration does not show the T3 controller. You can use the **show platform** command to check whether the chassis recognizes the T3 port and initializes the card correctly. After the port is configured for the slot, the respective controller appears in the running configuration and you can configure the clear channel T3 interface.

Perform this task to configure clear channel controller as T3.

```
enable
configure terminal
controller t3 0/4/12
no channelized
clock source line
no shut
exit
```




---

**Note** By default, the T3 controller is in C-Bit framing mode. To configure CEM, the framing mode must be set to unframed.

---

## Verifying Controller Configuration of Clear Channel T3 Interfaces

Use the **show controllers** command to verify the controller configuration of clear channel T3 interface:

```
# show controllers t3 0/4/12
T3 0/4/12 is up.
Hardware is A900-IMA3G-IMSG
Applique type is Clear Channel T3
No alarms detected.
Framing is Unframed, Line Code is B3ZS, Cablelength is 224
Clock Source is internal
Equipment customer loopback
Data in current interval (240 seconds elapsed):
  Near End
    0 Line Code Violations, 0 P-bit Coding Violations
    0 C-bit Coding Violations, 0 P-bit Err Secs
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
    0 Unavailable Secs, 0 Line Errored Secs
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
    0 Severely Errored Line Secs, 0 Path Failures
    0 AIS Defect Secs, 0 LOS Defect Secs
  Far End
    0 Errored Secs, 0 Severely Errored Secs
    0 C-bit Unavailable Secs, 0 Path Failures
    0 Code Violations, 0 Service Affecting Secs
Data in Interval 1:
  Near End
    0 Line Code Violations, 0 P-bit Coding Violations
    0 C-bit Coding Violations, 0 P-bit Err Secs
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
    20 Unavailable Secs, 20 Line Errored Secs
```

```

    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
    20 Severely Errored Line Secs, 1 Path Failures
    0 AIS Defect Secs, 20 LOS Defect Secs
Far End
    0 Errored Secs, 0 Severely Errored Secs
    0 C-bit Unavailable Secs, 0 Path Failures
    0 Code Violations, 0 Service Affecting Secs
Total Data (last 1 15 minute intervals):
Near End
    0 Line Code Violations, 0 P-bit Coding Violations,
    0 C-bit Coding Violations, 0 P-bit Err Secs,
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
    20 Unavailable Secs, 20 Line Errored Secs,
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
    20 Severely Errored Line Secs, 1 path failures
    0 AIS Defect Secs, 20 LOS Defect Secs
Far End
    0 Errored Secs, 0 Severely Errored Secs
    0 C-bit Unavailable Secs, 0 Path Failures
    0 Code Violations, 0 Service Affecting Secs
T1 1 is up
timeslots:
FDL per AT&T 54016 spec.
No alarms detected.
Framing is ESF, Clock Source is Internal
Data in current interval (250 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 Stuffed 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    3 Errored Secs, 0 Bursty Err Secs, 3 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations,0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
    0 Unavailable Secs, 0 Path Failures

```

## Configuring the Controller of Channelized T3/T1 Interfaces

When the channelized T3/T1 interface is used for the first time, the running configuration does not show the T3 controller. You can use the `show platform` command to check if the chassis recognizes the T3 port and initializes the card properly. After the port is configured for the slot, the respective controller appears in the running configuration and you can configure the channelized T3/T1 interface.

Perform this task to configure channelized controller as T3/T1.

```
enable
configure terminal
controller t3 0/4/12
channelized
clock source line
no shut
exit
```




---

**Note** The channelized mode is the default mode for T3 interface.

---

## Verifying the Controller Configuration of Channelized T3/T1 Interfaces

Use the `show controllers` command to verify the controller configuration of channelized T3/T1 interfaces:

```
# show controllers t3 0/4/12
T3 0/4/12 is down.
Hardware is A900-IMA3G-IMSG
Applique type is Channelized T3/T1
Receiver has loss of signal.
MDL transmission is disabled
FEAC code received: No code is being received
Framing is C-BIT Parity, Line Code is B3ZS, Cablelength Short less than 225ft
BER thresholds: SF = 10e-10 SD = 10e-10
Clock Source is line
Equipment customer loopback
Data in current interval (240 seconds elapsed):
  Near End
    0 Line Code Violations, 0 P-bit Coding Violations
    0 C-bit Coding Violations, 0 P-bit Err Secs
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
    0 Unavailable Secs, 0 Line Errored Secs
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
    0 Severely Errored Line Secs, 0 Path Failures
    0 AIS Defect Secs, 0 LOS Defect Secs
  Far End
    0 Errored Secs, 0 Severely Errored Secs
    0 C-bit Unavailable Secs, 0 Path Failures
    0 Code Violations, 0 Service Affecting Secs
Data in Interval 1:
  Near End
    0 Line Code Violations, 0 P-bit Coding Violations
    0 C-bit Coding Violations, 0 P-bit Err Secs
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
    20 Unavailable Secs, 20 Line Errored Secs
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
    20 Severely Errored Line Secs, 1 Path Failures
    0 AIS Defect Secs, 20 LOS Defect Secs
  Far End
    0 Errored Secs, 0 Severely Errored Secs
    0 C-bit Unavailable Secs, 0 Path Failures
```

```

    0 Code Violations, 0 Service Affecting Secs
Total Data (last 1 15 minute intervals):
Near End
    0 Line Code Violations, 0 P-bit Coding Violations,
    0 C-bit Coding Violations, 0 P-bit Err Secs,
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
    20 Unavailable Secs, 20 Line Errored Secs,
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
    20 Severely Errored Line Secs, 1 path failures
    0 AIS Defect Secs, 20 LOS Defect Secs
Far End
    0 Errored Secs, 0 Severely Errored Secs
    0 C-bit Unavailable Secs, 0 Path Failures
    0 Code Violations, 0 Service Affecting Sec

T1 1 is down
timeslots:
FDL per AT&T 54016 spec.
No alarms detected.
Framing is ESF, Clock Source is Internal
Data in current interval (250 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 Stuffed 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    3 Errored Secs, 0 Bursty Err Secs, 3 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations,0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
    0 Unavailable Secs, 0 Path Failures

```

## Configuring SAToP - Clear Channel T3 Interfaces

Before Structure-Agnostic TDM over Packet (SAToP) is configured, the controller of clear channel T3 interface must be configured.

```

enable
configure terminal
controller t3 0/4/12
no channelized
cem-group 0 unframed
interface CEM 0/4/12
cem 0
xconnect 10.10.2.2 204 encapsulation mpls
exit

```

## Verifying CEM Configuration of Clear Channel T3 Interfaces for SAToP

Use the **show run interface** command to verify the configuration of xconnect:

```

# show run interface cem 0/4/12
Current configuration : 96 bytes
!
interface CEM 0/4/12
no ip address
cem 0
xconnect 10.10.2.2 204 encapsulation mpls
!
end

```

Use the **show cem circuit interface cem** command to verify the CEM interface configuration of clear channel T3 interface for SAToP:

```

# show cem circuit interface cem 0/4/12
CEM 0/4/12, ID: 0, Line: UP, Admin: UP, Ckt: ACTIVE
Controller state: down, T3 state: up
Configuring SAToP - Clear Channel T3 Interfaces
Idle Pattern: 0xFF, Idle CAS: 0x8
Dejitter: 5 (In use: 0)
Payload Size: 1024
Framing: Unframed
CEM Defects Set
None
Signalling: No CAS
RTP: No RTP
Ingress Pkts: 1321577 Dropped: 0
Egress Pkts: 1321577 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 SAToP - Channelized T3/T1 Interfaces

Before SAToP is configured, the controller of channelized T3/T1 interface must be configured.

```

enable
configure terminal
controller t3 0/4/12
channelized
t1 1 cem-group 0 unframed
interface CEM 0/4/12
no shut
cem 0

```



```
xconnect 10.10.2.2 204 encapsulation mpls
exit
```

## Verifying the CEM Configuration of Channelized T3 or T1 Interfaces

Use the **show run controller** command to verify the CEM configuration of channelized T3 or T1 interface:

```
# show run controller t3 0/4/12
Current configuration : 109 bytes
!
Controller T3 0/4/12
framing c-bit
cablelength short
t1 1 cem-group 0 unframed
end
```

Use the **show cem circuit interface cem** command to verify the CEM configuration of channelized T3 or T1 interface:

```
# show cem circuit interface cem 0/4/12
CEM0/4/12, ID: 1, 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: 105043259 Dropped: 0
Egress Pkts: 105043387 Dropped: 0
CEM Counter Details
Input Errors: 0 Output Errors: 0
Pkts Missing: 0 Pkts Reordered: 0
Misorder Drops: 0 JitterBuf Underrun: 32
Error Sec: 0 Severly Errored Sec: 0
Unavailable Sec: 0 Failure Counts: 0
Pkts Malformed: 0 JitterBuf Overrun: 0
---
CEM0/4/12, ID: 28, 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: 136303 Dropped: 0
Egress Pkts: 0 Dropped: 0
CEM Counter Details
Input Errors: 0 Output Errors: 0
Pkts Missing: 135682 Pkts Reordered: 0
Misorder Drops: 0 JitterBuf Underrun: 137649
Error Sec: 0 Severly Errored Sec: 0
Unavailable Sec: 0 Failure Counts: 135
Pkts Malformed: 0 JitterBuf Overrun: 0
```

# Configuring Framed SAToP - Channelized T3/T1 Interfaces



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

To configure the controller of channelized T3/T1 interface for framed SAToP:

```
enable
configure terminal
controller t3 0/4/12
channelized mode
framing c-bit
t1 1 cem-group 0 framed
interface CEM 0/4/12
cem 0
xconnect 10.10.2.2 204 encapsulation mpls
exit
```

## Verifying the CEM Configuration of Channelized T3/T1 Interfaces for Framed SAToP

Use the **show run controller** command to verify the CEM configuration of channelized T3/T1 interface for Framed SAToP:

```
# show run controller t3 0/4/12
Current configuration : 109 bytes
!
Controller T3 0/4/12
framing c-bit
cablelength short
t1 1 cem-group 0 framed
end
```

Use the **show cem circuit interface cem** command to verify the CEM configuration of channelized T3/T1 interface for Framed SAToP:

```
# show cem circuit interface cem 0/4/12
CEM0/0/0, ID: 1, Line: UP, Admin: UP, Ckt: ACTIVE
Mode :Channelized-T1, T1: 1, CEM Mode: T1-SAToP
Controller state: down, T1 state: up
Idle Pattern: 0xFF, Idle CAS: 0x8
Dejitter: 5 (In use: 0)
Payload Size: 192
Framing: Framed SAToP
CEM Defects Set
None
```

## Performance Monitoring

You can view the statistics or error count generated on the TDM lines for T3 interfaces.

```
enable
configure terminal
```

```

controller MediaType 0/4/12
mode t3
controller t3 0/4/12
framing c-bit
cablelength
long 224-450 ft
short 0-224 ft
controller MediaType 0/4/12
mode t3
controller T3 0/4/12
framing c-bit
cablelength short

```

To view the performance monitoring result, use the **show controller t3** command:

```

Router# show controller t3 0/4/12

T3 0/4/12 is up.
Hardware is A900-IMA3G-IMSG
Applique type is Channelized T3/T1
  No alarms detected.
  MDL transmission is disabled
  FEAC code received: No code is being received
  Framing is C-BIT Parity, Line Code is B3ZS, Cablelength Short less than 225ft
  BER thresholds: SF = 10e-10 SD = 10e-10
  Clock Source is internal
  Equipment customer loopback
  Data in current interval (240 seconds elapsed):
    Near End
      0 Line Code Violations, 0 P-bit Coding Violations
      0 C-bit Coding Violations, 0 P-bit Err Secs
      0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
      0 Unavailable Secs, 0 Line Errored Secs
      0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
      0 Severely Errored Line Secs, 0 Path Failures
      0 AIS Defect Secs, 0 LOS Defect Secs
    Far End
      0 Errored Secs, 0 Severely Errored Secs
      0 C-bit Unavailable Secs, 0 Path Failures
      0 Code Violations, 0 Service Affecting Secs
  Data in Interval 1:
    Near End
      0 Line Code Violations, 0 P-bit Coding Violations
      0 C-bit Coding Violations, 0 P-bit Err Secs
      0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
      20 Unavailable Secs, 20 Line Errored Secs
      0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
      20 Severely Errored Line Secs, 1 Path Failures
      0 AIS Defect Secs, 20 LOS Defect Secs
    Far End
      0 Errored Secs, 0 Severely Errored Secs
      0 C-bit Unavailable Secs, 0 Path Failures
      0 Code Violations, 0 Service Affecting Secs
  Total Data (last 1 15 minute intervals):
    Near End
      0 Line Code Violations, 0 P-bit Coding Violations,
      0 C-bit Coding Violations, 0 P-bit Err Secs,
      0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
      20 Unavailable Secs, 20 Line Errored Secs,
      0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
      20 Severely Errored Line Secs, 1 path failures
      0 AIS Defect Secs, 20 LOS Defect Secs
    Far End
      0 Errored Secs, 0 Severely Errored Secs

```

```

    0 C-bit Unavailable Secs, 0 Path Failures
    0 Code Violations, 0 Service Affecting Secs

T1 1 is up
timeslots:
FDL per AT&T 54016 spec.
No alarms detected.
Framing is ESF, Clock Source is Internal
Data in current interval (250 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 Stuffed 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
  Far End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    3 Errored Secs, 0 Bursty Err Secs, 3 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
  Far End
    0 Line Code Violations,0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
    0 Unavailable Secs, 0 Path Failures

```

### Use Case 1

If your configuration is as follows:

- T1 is up
- No alarms
- Framing is unframed
- Clock Source is Internal

, then the following performance monitoring result is displayed:

```

Router# show controller t3 0/4/12
T3 0/4/12 is up.
Hardware is A900-IMA3G-IMSG
Applique type is Channelized T3/T1

```

```

No alarms detected.
MDL transmission is disabled
FEAC code received: No code is being received
Framing is unframedt
Clock Source is internal
Equipment customer loopback
Data in current interval (240 seconds elapsed):
Near End
  0 Line Code Violations, 0 P-bit Coding Violations
  0 C-bit Coding Violations, 0 P-bit Err Secs
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
  0 Unavailable Secs, 0 Line Errored Secs
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  0 Severely Errored Line Secs, 0 Path Failures
  0 AIS Defect Secs, 0 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs
Data in Interval 1:
Near End
  0 Line Code Violations, 0 P-bit Coding Violations
  0 C-bit Coding Violations, 0 P-bit Err Secs
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
  20 Unavailable Secs, 20 Line Errored Secs
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  20 Severely Errored Line Secs, 1 Path Failures
  0 AIS Defect Secs, 20 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs
Total Data (last 1 15 minute intervals):
Near End
  0 Line Code Violations, 0 P-bit Coding Violations,
  0 C-bit Coding Violations, 0 P-bit Err Secs,
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
  20 Unavailable Secs, 20 Line Errored Secs,
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  20 Severely Errored Line Secs, 1 path failures
  0 AIS Defect Secs, 20 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs
T1 1 is up
timeslots:
FDL per AT&T 54016 spec.
No alarms detected.
Framing is unframed, Clock Source is Internal
Data in current interval (250 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 Stuffed 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    3 Errored Secs, 0 Bursty Err Secs, 3 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations,0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
    0 Unavailable Secs, 0 Path Failures

```

## Use Case 2

If your configuration is as follows:

- T1 28 is up
- No alarm received
- Framing is unframed
- Clock Source is Internal

, then the following performance monitoring result is displayed:

```

Router# show controller t3 0/4/12
T3 0/4/12 is up.
Hardware is A900-IMA3G-IMSG
Applique type is Channelized T3/T1
No alarms detected.
MDL transmission is disabled
FEAC code received: No code is being received
Framing is unframedt
Clock Source is internal
Equipment customer loopback
Data in current interval (240 seconds elapsed):
Near End
    0 Line Code Violations, 0 P-bit Coding Violations
    0 C-bit Coding Violations, 0 P-bit Err Secs
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
    0 Unavailable Secs, 0 Line Errored Secs
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
    0 Severely Errored Line Secs, 0 Path Failures
    0 AIS Defect Secs, 0 LOS Defect Secs
Far End
    0 Errored Secs, 0 Severely Errored Secs
    0 C-bit Unavailable Secs, 0 Path Failures
    0 Code Violations, 0 Service Affecting Secs
Data in Interval 1:
Near End
    0 Line Code Violations, 0 P-bit Coding Violations
    0 C-bit Coding Violations, 0 P-bit Err Secs

```

```

    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
    20 Unavailable Secs, 20 Line Errored Secs
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
    20 Severely Errored Line Secs, 1 Path Failures
    0 AIS Defect Secs, 20 LOS Defect Secs
  Far End
    0 Errored Secs, 0 Severely Errored Secs
    0 C-bit Unavailable Secs, 0 Path Failures
    0 Code Violations, 0 Service Affecting Secs
Total Data (last 1 15 minute intervals):
  Near End
    0 Line Code Violations, 0 P-bit Coding Violations,
    0 C-bit Coding Violations, 0 P-bit Err Secs,
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
    20 Unavailable Secs, 20 Line Errored Secs,
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
    20 Severely Errored Line Secs, 1 path failures
    0 AIS Defect Secs, 20 LOS Defect Secs
  Far End
    0 Errored Secs, 0 Severely Errored Secs
    0 C-bit Unavailable Secs, 0 Path Failures
    0 Code Violations, 0 Service Affecting Secs
T1 28 is up
timeslots:
FDL per AT&T 54016 spec.
No alarms detected.
Framing is unframed, Clock Source is Internal
Data in current interval (250 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 Stuffed 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
  Far End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    3 Errored Secs, 0 Bursty Err Secs, 3 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
  Far End
    0 Line Code Violations,0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
    0 Unavailable Secs, 0 Path Failures

```

The complete output for the T3 **show controller** command is:

```
# show controllers t3 0/4/12
T3 0/4/12 is down.
Hardware is A900-IMA3G-IMSG
Applique type is Channelized T3/T1
No alarms detected.
MDL transmission is disabled
FEAC code received: No code is being received
Framing is C-BIT Parity, Line Code is B3ZS, Cablelength Short less than 225ft
BER thresholds: SF = 10e-10 SD = 10e-10
Clock Source is internal
Equipment customer loopback
Data in current interval (240 seconds elapsed):
Near End
  0 Line Code Violations, 0 P-bit Coding Violations
  0 C-bit Coding Violations, 0 P-bit Err Secs
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
  0 Unavailable Secs, 0 Line Errored Secs
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  0 Severely Errored Line Secs, 0 Path Failures
  0 AIS Defect Secs, 0 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs
Data in Interval 1:
Near End
  0 Line Code Violations, 0 P-bit Coding Violations
  0 C-bit Coding Violations, 0 P-bit Err Secs
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
  20 Unavailable Secs, 20 Line Errored Secs
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  20 Severely Errored Line Secs, 1 Path Failures
  0 AIS Defect Secs, 20 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs
Total Data (last 1 15 minute intervals):
Near End
  0 Line Code Violations, 0 P-bit Coding Violations,
  0 C-bit Coding Violations, 0 P-bit Err Secs,
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
  20 Unavailable Secs, 20 Line Errored Secs,
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  20 Severely Errored Line Secs, 1 path failures
  0 AIS Defect Secs, 20 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs

T1 28 is up
timeslots:
FDL per AT&T 54016 spec.
No alarms detected.
Framing is unframed, Clock Source is Internal
Data in current interval (250 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 Stuffed 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    3 Errored Secs, 0 Bursty Err Secs, 3 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations,0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
    0 Unavailable Secs, 0 Path Failures

```

## Troubleshooting T3 Controllers

You can use the following methods to troubleshoot the T3 controllers on the chassis:

### Running Bit Error Rate Testing

Bit error rate testing (BERT) is supported on T3 interfaces. You can run 16 BERTs at a time. The test can be either of the T1 or the T3 interface.

The interface contains on board BERT circuitry. With this, 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.

When running a BERT test, your system must receive the same pattern that it is transmitting. So, ensure the two common options are available:

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

Table 1 lists different BERT keywords and their descriptions.

Table 6: BERT Pattern Descriptions

Keyword	Description
0s	Not supported
1s	Not supported
2^11	Pseudo-random test pattern that is 2,048 bits in length.
2^15	Pseudo-random O.151 test pattern that is 32,768 bits in length.
2^20-O153	Pseudo-random O.153 test pattern that is 1,048,575 bits in length.
2^20-QRSS	Pseudo-random QRSS O.151 test pattern that is 1,048,575 bits in length.
2^23	Pseudo-random 0.151 test pattern that is 8,388,607 bits in length.

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.

BERT is supported in two directions:

- Line - supports BERT in TDM direction
- System - supports BERT in PSN direction



**Note** When the BERT is configured towards the system direction, it internally loopbacks the TDM side.



**Note** 0s and 1s keywords are not supported for T1, T3, and OCx controllers.

## Configuring BERT for Clear and Channelized T3 Interfaces

Before you configure BERT for clear channel T3 interfaces, ensure that controller and CEM are configured.

To run a BERT on clear channel T3 interface, perform the following tasks in global configuration mode.

```
enable
configure terminal
controller t3 0/4/12
no channelized
bert pattern 0s interval 30 direction line
exit
```



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

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

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

### Verifying the BERT Configuration for T3 Interfaces

Use the **show controller** command to verify the BERT configuration for clear channel T3 interfaces:

```
# show controllers t3 0/4/12 | sec BERT
BERT test result (running)
Running Bit Error Rate Testing
Test Pattern : 2^15, Status : Not Sync, Sync Detected : 0
DSX3 BERT direction : Line
Interval : 5 minute(s), Time Remain : 3 minute(s)
Bit Errors (since BERT started): 0 bits,
Bits Received (since BERT started): 0 Kbits
Bit Errors (since last sync): 0 bits
Bits Received (since last sync): 0 Kbits
```

Use the **show controller** command to verify the BERT configuration of channelized T3/T1 interfaces:

```
# show controllers t3 0/4/12

Hardware is ASR900-IMA3G-IMSG
Applique type is Channelized T3/T1
No alarms detected.
MDL transmission is disabled
FEAC code received: No code is being received
Framing is C-BIT Parity, Line Code is B3ZS, Cablelength Short less than 225ft
BER thresholds: SF = 10e-10 SD = 10e-10
Clock Source is internal
Equipment customer loopback
Data in current interval (240 seconds elapsed):
Near End
  0 Line Code Violations, 0 P-bit Coding Violations
  0 C-bit Coding Violations, 0 P-bit Err Secs
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
  0 Unavailable Secs, 0 Line Errored Secs
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  0 Severely Errored Line Secs, 0 Path Failures
  0 AIS Defect Secs, 0 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs
Data in Interval 1:
Near End
  0 Line Code Violations, 0 P-bit Coding Violations
  0 C-bit Coding Violations, 0 P-bit Err Secs
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
  20 Unavailable Secs, 20 Line Errored Secs
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  20 Severely Errored Line Secs, 1 Path Failures
  0 AIS Defect Secs, 20 LOS Defect Secs
```

```

Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs
Total Data (last 1 15 minute intervals):
Near End
  0 Line Code Violations, 0 P-bit Coding Violations,
  0 C-bit Coding Violations, 0 P-bit Err Secs,
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
  20 Unavailable Secs, 20 Line Errored Secs,
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  20 Severely Errored Line Secs, 1 path failures
  0 AIS Defect Secs, 20 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs

T1 28 is up
timeslots:
FDL per AT&T 54016 spec.
No alarms detected.
Framing is unframed, Clock Source is Internal
BERT test result (running)
Test Pattern : 2^23, Status : Not Sync, Sync Detected : 0
DSX1 BERT direction : Line
Interval : 5 minute(s), Time Remain : 4 minute(s)
Bit Errors (since BERT started): 0 bits,
Bits Received (since BERT started): 0 Kbits
Bit Errors (since last sync): 0 bits
Bits Received (since last sync): 0 Kbits
Data in current interval (250 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 Stuffed 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
  2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
  0 Unavailable Secs, 0 Stuffed Secs
  1 Path Failures, 2 SEF/AIS Secs
Far End
  0 Line Code Violations, 0 Path Code Violations
  0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
  3 Errored Secs, 0 Bursty Err Secs, 3 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
  2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
  0 Unavailable Secs, 0 Stuffed Secs
  1 Path Failures, 2 SEF/AIS Secs
Far End

```

```

0 Line Code Violations,0 Path Code Violations
0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
0 Unavailable Secs, 0 Path Failures

```

## Loopback on T1/T3 Interfaces

You can use the following loopback on the clear and channelized T3/T1 interfaces.

Loopback	Description
<b>loopback local</b>	Loops the transmitting signal back to the receiver.
<b>loopback network line</b>	Loops the incoming signal back to the interface 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 driver.

### Configuring Loopback for T3 Interfaces

To set a loopback local on the clear channel T3 interface, perform the following tasks in global configuration mode:

```

enable
configure terminal
controller t3 0/4/12
loopback local
exit

```

To set a loopback network on the clear channel T3 interface, perform the following tasks in global configuration mode:

```

enable
configure terminal
controller t3 0/4/12
loopback network line
exit

```

To set a loopback local on the channelized channel T3/T1 interface, perform the following tasks in global configuration mode:

```

enable
configure terminal
controller t3 0/4/12
channelized
t1 1 loopback local
exit

```

To set a loopback network on the channelized channel T3/T1 interface, perform the following tasks in global configuration mode:

```

enable
configure terminal
controller t3 0/4/12
channelized

```

```
t1 1 loopback network line
exit
```



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



**Note** Network payload configuration is not supported on 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 and T3 Interfaces

The remote loopback configuration attempts to put the far-end T1 or T3 into a loopback.

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

### Restrictions for Loopback Remote

E1 and E3 loopback remote are not supported.

### Configuring Loopback Remote on T1 and T3 Interface Module

To set T3 loopback remote line/payload for DS3, perform the following tasks in global configuration mode:

```
enable
configure terminal
controller t3 0/0/1
loopback remote {line | payload}
exit
```

To set T1 loopback remote iboc fac1/fac2/csu for DS3, perform the following tasks in global configuration mode:

```
enable
configure terminal
controller t3 0/0/1
t1 1 loopback remote iboc {fac1 | fac2 | csu}
exit
```

To set T1 loopback remote iboc esf line csu/esf payload for DS3, perform the following tasks in global configuration mode:

```
enable
configure terminal
controller t3 0/0/1
t1 1 loopback remote iboc esf {line csu | payload}
```

### Verifying the Loopback Remote Configuration on T1/T3 Interfaces

Use the following command to check the loopback remote configuration on a T3 interface module:

```

router# show running-config | sec 0/0/1
controller MediaType 0/0/1
mode t3
controller T3 0/0/1
threshold sd-ber 6
threshold sf-ber 3
no channelized
framing c-bit
cablelength short
loopback remote line

```

Use the following command to verify the loopback remote configuration on a T3 interface module:

```

router(config-controller)# do show controller t3 0/0/1
T3 0/0/1 is up. (Configured for Remotely Looped)
Currently in Remotely Line Looped
Hardware is A900-48T3E3-CE
Applique type is Subrate T3
Receiver has no alarms.
MDL transmission is disabled
FEAC code received: No code is being received
Framing is C-BIT Parity, Line Code is B3ZS, Cablelength Short less than 225ft
BER thresholds: SF = 10e-10 SD = 10e-10
Clock Source is internal
Equipment customer loopback
Data in current interval (240 seconds elapsed):
Near End
  0 Line Code Violations, 0 P-bit Coding Violations
  0 C-bit Coding Violations, 0 P-bit Err Secs
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
  0 Unavailable Secs, 0 Line Errored Secs
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  0 Severely Errored Line Secs, 0 Path Failures
  0 AIS Defect Secs, 0 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs
Data in Interval 1:
Near End
  0 Line Code Violations, 0 P-bit Coding Violations
  0 C-bit Coding Violations, 0 P-bit Err Secs
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
  20 Unavailable Secs, 20 Line Errored Secs
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  20 Severely Errored Line Secs, 1 Path Failures
  0 AIS Defect Secs, 20 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs
Total Data (last 1 15 minute intervals):
Near End
  0 Line Code Violations, 0 P-bit Coding Violations,
  0 C-bit Coding Violations, 0 P-bit Err Secs,
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
  20 Unavailable Secs, 20 Line Errored Secs,
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  20 Severely Errored Line Secs, 1 path failures
  0 AIS Defect Secs, 20 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs

```

```

T1 1 is up
timeslots:
FDL per AT&T 54016 spec.
No alarms detected.
Framing is ESF, Clock Source is Internal
Data in current interval (250 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 Stuffed 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
  2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
  0 Unavailable Secs, 0 Stuffed Secs
  1 Path Failures, 2 SEF/AIS Secs
Far End
  0 Line Code Violations, 0 Path Code Violations
  0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
  3 Errored Secs, 0 Bursty Err Secs, 3 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
  2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
  0 Unavailable Secs, 0 Stuffed Secs
  1 Path Failures, 2 SEF/AIS Secs
Far End
  0 Line Code Violations,0 Path Code Violations
  0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
  3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
  0 Unavailable Secs, 0 Path Failures

```

Use the following command to check the loopback remote configuration on a T1 interface module:

```

Router#show run | sec 0/4/15
controller MediaType 0/4/15
mode t3
controller T3 0/4/15
threshold sd-ber 6
threshold sf-ber 3
framing c-bit
cablelength short
t1 1 Loopback remote iboc fac1

```

Use the following command to verify the loopback remote configuration on a T1 interface module:

```

Router#show controller t3 0/4/15 | be T1 1
T1 1 is up
timeslots:
FDL per AT&T 54016 spec.
Configured for NIU FAC1 Line Loopback with IBOC
Currently in Inband Remotely Line Looped

```



```

Receiver has no alarms.
Framing is ESF, Clock Source is Internal
Data in current interval (250 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 Stuffed 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
  Far End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    3 Errored Secs, 0 Bursty Err Secs, 3 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
  Far End
    0 Line Code Violations,0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
    0 Unavailable Secs, 0 Path Failures

```

## Associated Commands

The commands used to configure the interfaces.

Commands	URL
<b>controller mediatype</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp3512725718">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp3512725718</a>
<b>mode t3/e3</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp5688885940">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp5688885940</a>
<b>controller t1</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1472647421">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1472647421</a>

Commands	URL
<b>controller t3</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1921350260">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1921350260</a>
<b>controller e3</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp4240965734">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp4240965734</a>
<b>clock source</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp6081785140">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp6081785140</a>
<b>channelized</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp7026926390">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp7026926390</a>
<b>cem</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2184138077">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2184138077</a>
<b>cem-group</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600</a>
<b>xconnect</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp8578094790">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp8578094790</a>
<b>t1/e1 cem-group</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp8472041760">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp8472041760</a>
<b>payload-size dejitter-buffer</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp3946673156">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp3946673156</a>
<b>bert pattern</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp3620978929">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp3620978929</a>
<b>loopback</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp2513399572">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp2513399572</a>
<b>t1/e1 loopback</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp3852360411">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp3852360411</a>
<b>show controllers t3</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp1987423547">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp1987423547</a>



## CHAPTER 5

# Configuring Pseudowire

Cisco Pseudowire Emulation Edge-to-Edge (PWE3) allows you to transport traffic by using traditional services such as T1 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 or T3 links.

- [Information About Pseudowire, on page 61](#)
- [Additional References for Configuring Pseudowire, on page 66](#)

## Information About Pseudowire

The following sections describe how to configure pseudowire on the interface module of the chassis.

### Overview of 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.

### Overview of 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 chassis encapsulates the TDM data in the MPLS packets and sends the data over a CEM pseudowire to the remote Provider Edge (PE) chassis. As a result, CEM functions as a physical communication link across the packet network.

The chassis supports the pseudowire type that utilizes CEM transport: Structure-Agnostic TDM over Packet (SAToP).

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

The RSP switchover with physical SSO is above 50 ms as follows:

- R0 to R1 is 5 seconds
- R1 to R0 is 10 seconds

## Structure-Agnostic TDM over Packet

Structure-Agnostic TDM over Packet (SAToP) encapsulates Time Division Multiplexing (TDM) bit-streams as pseudowires over public switched networks. It disregards any structure that may be imposed on streams, in particular the structure imposed by the standard TDM framing.

The protocol used for emulation of these services does not depend on the method in which attachment circuits are delivered to the Provider Edge (PE) chassis. For example, a T1 attachment circuit is treated the same way for all delivery methods, including copper, multiplex in a T3 circuit, a virtual tributary of a SONET circuit, or unstructured Circuit Emulation Service (CES).

In SAToP mode, the interface is considered as a continuous framed bit stream. The packetization of the stream is done according to IETF RFC 4553. All signaling is carried out transparently as a part of a bit stream.

## How to Configure Pseudowire

The following sections describe how to configure pseudowire.

### Configuring CEM

This section provides information about how to configure CEM. CEM provides a bridge between a Time Division Multiplexing (TDM) network and a packet network, MPLS. The chassis encapsulates the TDM data in the MPLS packets and sends the data over a CEM pseudowire to the remote Provider Edge (PE) chassis.

The following sections describe how to configure CEM.

#### Configuring CEM Restriction

Not all combinations of payload size and dejitter buffer size are supported. If you apply an incompatible payload size or dejitter buffer size configuration, the chassis rejects it and reverts to the previous configuration.




---

**Note** CEM interface does *not* support `idle-cas` parameter.

---

### Configuring CEM Group for SAToP for T1 Interfaces

To configure a CEM group for SAToP:

```
enable
configure terminal
controller t1 0/4/0
cem-group 0 unframed
end
```

### Configuring CEM Classes

A CEM class allows you to create a single configuration template for multiple CEM pseudowires. Follow these steps to configure a CEM class:

**Note**

- The CEM parameters can be configured either by using CEM class or on CEM interface directly.
- The CEM parameters at the local and remote ends of a CEM circuit must match; otherwise, the pseudowire between the local and remote PE chassis does not come up.

```
enable
configure terminal
class cem mycemclass
payload-size 512
dejitter-buffer 12
exit
interface cem 0/4/0
cem 0
cem class mycemclass
xconnect 10.10.10.10 200 encapsulation mpls
exit
```

## Configuring CEM Parameters

The following sections describe the parameters you can configure for CEM circuits.

### Configuring Payload Size

To specify the number of bytes encapsulated into a single IP packet, use the **payload-size** command. The size argument specifies the number of bytes in the payload of each packet. The range is from 32 to 1312 bytes.

Default payload sizes for an unstructured CEM channel are as follows:

- T1 = 192 bytes
- DS0 = 32 bytes

Default payload sizes for a structured CEM channel depend on the number of time slots that constitute the channel. Payload size (L in bytes), number of time slots (N), and packetization delay (D in milliseconds) have the following relationship:  $L = 8 * N * D$ . The default payload size is selected in such a way that the packetization delay is always 1 millisecond. For example, a structured CEM channel of 16xDS0 has a default payload size of 128 bytes.

**Note**

Both payload-size and dejitter-buffer must be configured simultaneously.

### Configuring Payload Size for T3 Interfaces

To specify the number of bytes encapsulated into a single IP packet, use the payload-size command. The size argument specifies the number of bytes in the payload of each packet.

Default payload sizes are as follows:

- T3 clear channel = 1024 bytes
- T3 channelized = 192 bytes

Default payload sizes for a structured CEM channel depend on the number of time slots that constitute the channel. Payload size (L in bytes), number of time slots (N), and packetization delay (D in milliseconds) have the following relationship:  $L = 8 * N * D$ . The default payload size is selected in such a way that the packetization delay is always 1 millisecond.




---

**Note** Both payload-size and dejitter-buffer must be configured simultaneously.

---

### Setting the Dejitter Buffer Size

To specify the size of the dejitter-buffer used to compensate for the network filter, use the **dejitter-buffer** command. The configured dejitter-buffer size is converted from milliseconds to packets and rounded up to the next integral number of packets. Use the size argument to specify the size of the buffer, in milliseconds. The range is from 1 to 32; the default is 5.

### Shutting Down a CEM Channel

To shut down a CEM channel, use the **shutdown** command in CEM configuration mode. The **shutdown** command is supported only under CEM mode and not under the CEM class.

### Configuring CEM Parameter on CEM Interface

The CEM parameters can be configured directly on CEM interface. Follow these steps to configure CEM parameters:

```
enable
configure terminal
interface cem 0/4/0
cem 0
payload-size 512 dejitter-buffer 12
xconnect 10.10.10.10 200 encapsulation mpls
exit
```

### Verifying the Interface Configuration

Use the following commands to verify the pseudowire configuration:

- **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 **xconnect** is configured under the circuit, the command output also includes information about the attachment circuit status.

```
Router# show cem circuit
?

<0-504>    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
-----
CEM 0/4/0     1   UP     UP      ACTIVE    --/--
CEM 0/4/0     2   UP     UP      ACTIVE    --/--
CEM 0/4/0     3   UP     UP      ACTIVE    --/--
```

```
CEM 0/4/0      4    UP      UP      ACTIVE    --/--
CEM 0/4/0      5    UP      UP      ACTIVE    --/--
```

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

```
Router# show cem circuit 0

CEM 0/4/0, ID: 0, Line: UP, Admin: UP, Ckt: ACTIVE
Controller state: down, T3 state: up
Idle Pattern: 0x55, Idle CAS: 0x8
Dejitter: 10 (In use: 0)
Payload Size: 1024
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 for each interface.

```
Router# show cem circuit summary

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

- **show running configuration**—The **show running configuration** command shows detail on each CEM group.

## Associated Commands

The following commands are used to configure pseudowire:

Commands	URL
<b>cem-group</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-cl.html#wp2440628600">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-cl.html#wp2440628600</a>
<b>payload-size dejitter-buffer</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp3946673156">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp3946673156</a>
<b>class cem</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-cl.html#wp2169323859">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-cl.html#wp2169323859</a>

Commands	URL
<b>controller t1</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1472647421">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1472647421</a>
<b>xconnect</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp8578094790">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp8578094790</a>
<b>show controllers t3</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp1987423547">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp1987423547</a>

## Additional References for Configuring Pseudowire

### Related Documents

Related Topic	Document Title
Cisco IOS commands	<a href="#">Cisco IOS Master Commands List, All Releases</a>

### Standards and RFCs

Standard/RFC	Title
—	<i>There are no standards and RFCs for this feature.</i>

### MIBs

MIB	MIBs Link
—	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>



**Technical Assistance**

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<p><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></p>





## CHAPTER 6

# Clock Recovery System for SAToP

The Clock Recovery System recovers the service clock using Adaptive Clock Recovery (ACR) and Differential Clock Recovery (DCR).

- [Finding Feature Information](#), on page 69
- [Information About Clock Recovery](#), on page 69
- [Prerequisites for Clock Recovery](#), on page 71
- [Restrictions for Clock Recovery](#), on page 71
- [How to Configure ACR and DCR](#), on page 71
- [Associated Commands](#), on page 74
- [Additional References for Clock Recovery](#), on page 74

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

## Information About Clock Recovery

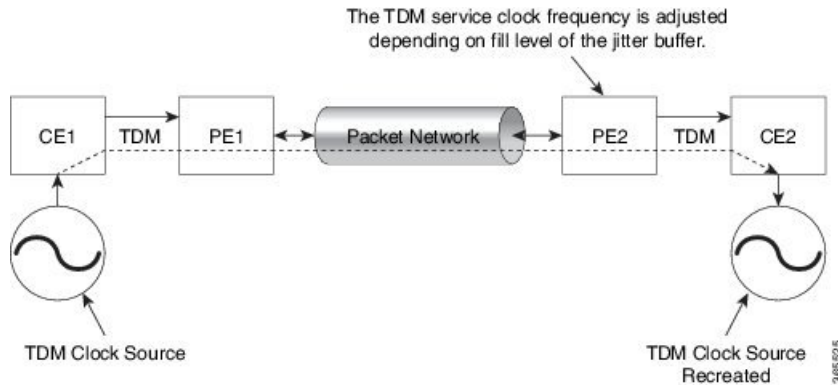
### Adaptive Clock Recovery (ACR)

Adaptive Clock Recovery (ACR) is an averaging process that negates the effect of random packet delay variation and captures the average rate of transmission of the original bit stream. ACR recovers the original clock for a synchronous data stream from the actual payload of the data stream. In other words, a synchronous clock is derived from an asynchronous packet stream. ACR is a technique where the clock from the TDM domain is mapped through the packet domain, but is most commonly used for Circuit Emulation (CEM). ACR is supported on unframed and framed modes of SAToP.



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

Effective Cisco IOS XE Everest 16.5.1, ACR is supported on the 8-port T1/E1 interface module.

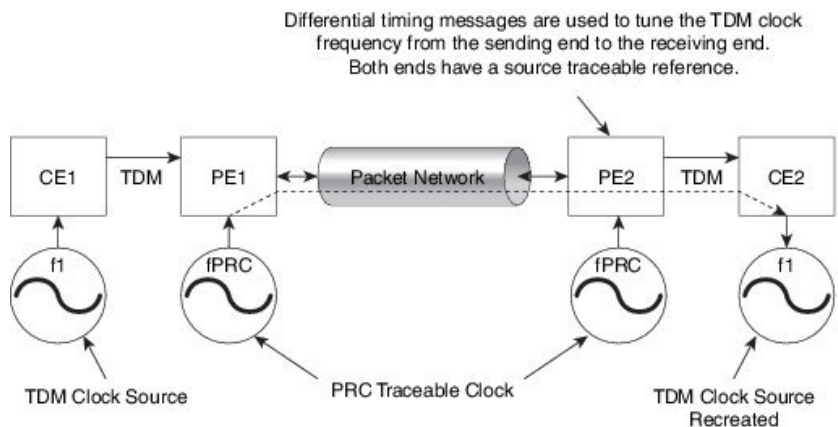


## Differential Clock Recovery (DCR)

Differential Clock Recovery (DCR) is another technique used for Circuit Emulation (CEM) to recover clocks based on the difference between PE clocks. TDM clock frequency are tuned to receive differential timing messages from the sending end to the receiving end. A traceable clock is used at each end, which ensures the recovered clock is not affected by packet transfer. DCR is supported on unframed and framed modes of SAToP.



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



## Benefits of Clock Recovery

- Customer-edge devices (CEs) can have different clock from that of the Provide-edge devices (PEs).

**Scaling Information**

IM Card	Pseudowires Supported (Number of Clocks Derived)
T1 CEM Interface Module	1476

## Prerequisites for Clock Recovery

- The clock of interface modules must be used as service clock.
- CEM must be configured before configuring the global clock recovery.
- RTP must be enabled for DCR in CEM, as the differential clock information is transferred in the RTP header.

## Restrictions for Clock Recovery

- The reference clock source is used and locked to a single clock.
- The clock ID should be unique for a particular interface module for ACR or DCR configuration.
- When CEM group is configured, dynamic change in clock source is not allowed.
- ACR clock configuration under each controller should be performed before configuring CEM group.

## How to Configure ACR and DCR

### Configuring Adaptive Clock Recovery of T1 Interfaces for SAToP

Before configuring Adaptive Clock Recovery, CEM must be configured. Below are the guidelines to configure clock recovery:

- The node (chassis) on which the DS1 is configured for ACR, must have its own clock derived from BITS/GPS/Stratum clock.
- The minimum packet size of CEM pseudowires on the network that delivers robust clock recovery is 64 bytes.

To configure the clock on T1 interfaces for SAToP in controller mode:

```
enable
configure terminal
controller t1 0/4/0
cem-group 0 unframed
clock source recovered 1
exit
```

To configure the clock recovery on T1 interfaces in global configuration mode, use the following commands:

```
recovered-clock 0 1
clock recovered 1 adaptive cem 1 0
exit
```



**Note** The clock configuration on controller must be done before configuring the clock recovery on global configuration mode.

To remove the clock configuration in ACR and DCR, you must remove the recovery clock configuration in global configuration mode and then remove the controller configuration.

## Configuring Adaptive Clock Recovery of T3 Interfaces for SAToP

Before configuring Adaptive Clock Recovery, CEM must be configured. Below are the guidelines to configure clock recovery:

- The node (router) on which the interface module is configured for ACR, must have its own clock derived from BITS/GPS/Stratum clock.
- The minimum packet size of CEM pseudowires on the network that delivers robust clock recovery is 256 bytes.

To configure the clock on T3 interfaces for SAToP in controller mode:

```
enable
configure terminal
controller t3 0/4/12
cem-group 0 unframed
clock source recovered 1
exit
```

To configure the clock recovery on T3 interfaces in global configuration mode, use the following commands:

```
recovered-clock 0 1
clock recovered 1 adaptive cem 1 0
exit
```



**Note** The clock configuration on controller must be done before configuring the clock recovery on global configuration mode.

To remove the clock configuration in ACR and DCR, you must remove the recovery clock configuration in global configuration mode and then remove the controller configuration.

## Verifying Adaptive Clock Recovery Configuration of T3 Interfaces for SAToP

Use the **show recovered-clock** command to verify the adaptive clock recovery of T3 interfaces for SAToP:

```
Router# show recovered-clock
Recovered clock status for subslot 0/1
-----
Clock      Type   Mode      CEM   Status   Frequency Offset (ppb) Circuit-No
0          DS3    ADAPTIVE  0     ACQUIRED n/a         12 (Port)
```

Use the **show running-config | section** command to verify the configuration of adaptive clock of T3 interfaces:

```
Router# show running-config | section 0/4/12
controller MediaType 0/4/12
mode t3
controller T3 0/4/12
cem-group 0 unframed
clock source recovered 1
cablelength 224
interface CEM 0/4/12
no ip address
cem 0
```

Use the **show running-config | section recovered-clock** command to verify the recovery of adaptive clock of T3 interfaces:

```
Router# show running-config | section recovered-clock
recovered-clock 0 0
clock recovered 1 adaptive cem 12 0
```

## Configuring Differential Clock Recovery of T3 Interfaces for SAToP

- Before you start configuring DCR, RTP must be enabled on the CEM interface. The RTP is used to carry the differential time.
- The minimum packet size of CEM pseudowires on the network that delivers robust clock recovery is 256 bytes.

To configure differential clock recovery on T3 interface for SAToP in controller mode:

```
enable
configure terminal
controller t3 0/4/12
cem-group 0 unframed
clock source recovered 1
exit
```

To configure RTP header under interface, use the following commands:

```
interface cem 0/4/12
cem 0
rtp-present
```

To configure differential clock recovery of T3 interface in global configuration mode, use the following commands:

```
recovered-clock 0 1
clock recovered 1 differential cem 12 0
exit
```



**Note** The clock configuration on controller must be done before configuring the clock recovery on global configuration mode.

## Associated Commands

The commands used to configure adaptive clock recovery and differential clock recovery are:

Commands	URL
<b>clock recovered adaptive cem</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp8894393830">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp8894393830</a>
<b>clock recovered differential cem</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp8894393830">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp8894393830</a>
<b>cem-group</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600</a>
<b>recovered-clock</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp8262293900">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp8262293900</a>
<b>controller t1/e1</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1472647421">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1472647421</a>
<b>clock-source</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp6081785140">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp6081785140</a>
<b>network-clock input-source</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html</a>

## Additional References for Clock Recovery

### Related Documents

Related Topic	Document Title
Cisco IOS commands	<a href="#">Cisco IOS Master Commands List, All Releases</a>

### Standards and RFCs

Standard/RFC	Title
ITU -T G.8261	<i>Timing and synchronization aspects in packet networks</i>



**MIBs**

<b>MIB</b>	<b>MIBs Link</b>
—	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

**Technical Assistance**

<b>Description</b>	<b>Link</b>
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>





## CHAPTER 7

# CEM over MPLS QoS

The QoS EXP matching feature allows you to classify and mark network traffic by modifying the Multiprotocol Label Switching (MPLS) experimental bits (EXP) field in IP packets. This module contains conceptual information and the configuration tasks for classifying and marking network traffic using the MPLS EXP field.

- [Finding Feature Information, on page 77](#)
- [Information About CEM over MPLS QoS, on page 77](#)
- [How to Classify and Mark MPLS EXP, on page 78](#)
- [Configuration Examples, on page 79](#)
- [Additional References for CEM over MPLS QoS, on page 81](#)

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

## Information About CEM over MPLS QoS

### Classifying and Marking MPLS EXP Overview

The QoS EXP matching feature allows you to organize network traffic by setting values for the MPLS EXP field in MPLS packets. By choosing different values for the MPLS EXP field, you can mark packets so that packets have the priority that they require during periods of congestion. Setting the MPLS EXP value allows you to:

- Classify traffic

The classification process selects the traffic to be marked. Classification accomplishes this by partitioning traffic into multiple priority levels, or classes of service. Traffic classification is the primary component of class-based QoS provisioning.

- Police and mark traffic

Policing causes traffic that exceeds the configured rate to be discarded or marked to a different drop level. Marking traffic is a way to identify packet flows to differentiate them. Packet marking allows you to partition your network into multiple priority levels or classes of service.

## Prerequisites for CEM over MPLS QoS

The device must be configured as an MPLS provider edge (PE) or provider (P) chassis, which can include the configuration of a valid label protocol and underlying IP routing protocols.

## Restrictions for CEM over MPLS QoS

- MPLS classification and marking can only occur in an operational MPLS Network.
- MPLS EXP classification and marking is supported on the main chassis interfaces for MPLS packet switching and imposition (simple IP imposition and Ethernet over MPLS (EoMPLS) imposition) and on Ethernet virtual circuits (EVCs) or Ethernet flow points (EFPs) for EoMPLS imposition.
- MPLS EXP topmost classification is not supported for bridged MPLS packets on Ethernet virtual circuits (EVC) or Ethernet flow points (EFP).
- MPLS EXP marking in the ingress direction only.
- If a packet is classified by IP type of service (ToS) or class of service (CoS) at ingress, it cannot be reclassified by MPLS EXP at egress (imposition case). However, if a packet is classified by MPLS at ingress it can be reclassified by Quality of Service (QoS) group at egress (disposition case).
- If a packet is encapsulated in MPLS, the MPLS payload cannot be checked for other protocols such as IP for classification or marking. Only MPLS EXP marking affects packets encapsulated by MPLS.

# How to Classify and Mark MPLS EXP

## Classifying MPLS Encapsulated Packets

You can use the **match mpls experimental topmost** command to define traffic classes based on the packet EXP values, inside the MPLS domain. You can use these classes to define services policies to mark the EXP traffic using the **police** command.

```
enable
configure terminal
class-map [match-all | match-any] class-map-name
match mpls experimental topmost mpls-exp-value
end
```

## Marking MPLS EXP on Imposed Labels

In typical configurations, marking MPLS packets at imposition is used with ingress classification on IP ToS or CoS fields. However, generic matching with the class default value is supported with other ingress attributes such as **vlan**.



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**Note** For EVC configuration, a policy map that performs matching based on the CoS, and that sets the EXP imposition value, should be used to copy CoS values to the EXP value.

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**Note** The **set mpls experimental imposition** command works only on packets that have new or additional MPLS labels added to them.

---

```
enable
configure terminal
policy-map policy-map-name
class class-map-name
set mpls experimental imposition mpls-exp-value
end
```

## Classifying and Marking MPLS EXP



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**Note** The **set mpls experimental topmost** command works only on packets that are already MPLS encapsulated.

---

```
enable
configure terminal
policy-map policy-map-name
class class-map-name
set mpls experimental topmost mpls-exp-value
end
```

## Configuration Examples

### Example: Defining an MPLS EXP Class Map

#### Example: Defining an MPLS EXP Class Map

The following example defines a class map named `exp3` that matches packets that contains MPLS experimental value 3:

```
Router(config)# class-map exp3
Router(config-cmap)# match mpls experimental topmost 3
Router(config-cmap)# exit
```

## Example: Defining a Policy Map and Applying the Policy Map to an Ingress Interface

### Example: Defining a Policy Map and Applying the Policy Map to an Ingress Interface

The following example uses the class map created in the example above to define a policy map. This example also applies the policy map to a physical interface for ingress traffic.

```
Router(config)# policy-map change-exp-3-to-2
Router(config-pmap)# class exp3
Router(config-pmap-c)# set mpls experimental topmost 2
Router(config-pmap)# exit
Router(config)# interface GigabitEthernet 0/0/0
Router(config-if)# service-policy input change-exp-3-to-2
Router(config-if)# exit
```

## Example: Defining a Policy Map and Applying the Policy Map to an Egress Interface

### Example: Defining a Policy Map and Applying the Policy Map to an Egress Interface

The following example uses the class map created in the example above to define a policy map. This example also applies the policy map to a physical interface for egress traffic.

```
Router(config)# policy-map WAN-out
Router(config-pmap)# class exp3
Router(config-pmap-c)# shape average 10000000
Router(config-pmap-c)# exit
Router(config-pmap)# exit
Router(config)# interface GigabitEthernet 0/0/0
Router(config-if)# service-policy output WAN-out
Router(config-if)# exit
```

## Example: Applying the MPLS EXP Imposition Policy Map to a Main Interface

### Example: Applying the MPLS EXP Imposition Policy Map to a Main Interface

The following example applies a policy map to Gigabit Ethernet interface 0/0/0:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface GigabitEthernet 0/0/0
Router(config-if)# service-policy input mark-up-exp-2
Router(config-if)# exit
```

## Example: Defining an MPLS EXP Label Switched Packets Policy Map

### Example: Defining an MPLS EXP Label Switched Packets Policy Map

The following example defines a policy map that sets the MPLS EXP topmost value to 2 according to the MPLS EXP value of the forwarded packet:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# class-map exp012
Router(config-cmap)# match mpls experimental topmost 0 1 2
Router(config-cmap)# exit
Router(config-cmap)# policy-map mark-up-exp-2
Router(config-pmap)# class exp012
Router(config-pmap-c)# set mpls experimental topmost 2
Router(config-pmap-c)# exit
Router(config-pmap)# exit
```

## Example: Applying the MPLS EXP Label Switched Packets Policy Map to a Main Interface

### Example: Applying the MPLS EXP Label Switched Packets Policy Map to a Main Interface

The following example shows how to apply the policy map to a main interface:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface GigabitEthernet 0/0/0
Router(config-if)# service-policy input mark-up-exp-2
Router(config-if)# exit
```

## Additional References for CEM over MPLS QoS

### Related Documents

Related Topic	Document Title
Cisco IOS commands	<a href="#">Cisco IOS Master Commands List, All Releases</a>

### Standards

Standards	Title
—	There are no standards for this feature.

**MIBs**

MIB	MIBs Link
—	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

**RFCs**

RFCs	Title
—	There are no RFCs for this feature.

**Technical Assistance**

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>





## CHAPTER 8

# Configuring SONET

This module describes how to configure Synchronous Optical Network (SONET). SONET defines optical signals and a synchronous frame structure for multiplexed digital traffic. SONET equipment is generally used in North America.

The transport network using SONET provides much more powerful networking capabilities than existing asynchronous systems.

- [Overview of SONET, on page 83](#)
- [Restrictions for SONET, on page 84](#)
- [SONET Switching , on page 84](#)
- [SONET Hierarchy, on page 85](#)
- [STS-1 and STS-3 Frames, on page 86](#)
- [SONET Line and Section Configuration Parameters, on page 87](#)
- [BERT, on page 88](#)
- [Concatenated SONET Frames, on page 89](#)
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- [Channelized SONET Frames, on page 90](#)
- [SONET T1 Configuration Parameters, on page 90](#)
- [SONET T3 Configuration Parameters, on page 90](#)
- [SONET VT Configuration Parameters, on page 90](#)
- [Alarms at SONET Layers, on page 91](#)
- [How to Configure SONET, on page 93](#)
- [ONS Pluggables, on page 109](#)
- [Loopback Remote on T1 and T3 Interfaces, on page 112](#)
- [Associated Commands, on page 114](#)

## Overview of SONET

SONET is a set of standards that define the rates and formats for optical networks specified in GR-253-CORE. SONET is based on a structure that has a basic frame format and speed. The frame format used by SONET is the Synchronous Transport Signal (STS), with STS-1 as the base-level signal at 51.84 Mbps. An STS-1 frame can be carried in an OC-1 signal.

SONET has a hierarchy of signaling speeds.

## Restrictions for SONET

- Rate combinations are 1 port of OC-48 or 4 ports of OC-12 or OC-3.
- Only 16 BERT Patterns can be configured at a time.
- VT1.5 VT cannot be configured if VT1.5 T1/DS1 is configured with the same KLM value.
- PMON fields are not supported for VT1.5 VT and DS3 or T3.
- PMON Far-end parameters are not supported.

### Restrictions on Bandwidth

- Total available bandwidth is 10G.

The following configuration is blocked and an error message is displayed after the maximum bandwidth is utilized:

```
rate OC3| OC12| OC48| OC192
```

The bandwidth of adjacent ports should not exceed OC-48.

The following table shows the bandwidth used by different rates:

**Table 7: Bandwidth Used by Different Rates**

Rate	Bandwidth
OC-3	155.52 Mbps
OC-12	622.08 Mbps
OC-48	2.4 Gbps

### Restrictions for Clock Source Configuration

- Only 4 ports can be configured in SONET line for clock source configuration per chassis.
- You should configure the clock source line and network-clock sync together to receive the clock from a remote port that is connected to the SONET port.

## SONET Switching

SONET Switching is achieved on optical interface modules by circuit emulation. Circuit Emulation (CEM) is a way to carry TDM circuits over packet switched network. CEM embeds TDM bits into packets, encapsulates them into an appropriate header and then sends that through Packet Switched Network (PSN). The receiver side of CEM restores the TDM bit stream from packets.

### Modes of CEM:

- **Structure Agnostic TDM over Packet (SAToP)** (RFC 4553) – Structure-Agnostic TDM over Packet (SAToP) mode is used to encapsulate T1 or T3 unstructured (unchannelized) services over packet switched networks. In SAToP mode, the bytes are sent out as they arrive on the TDM line. Bytes do not have to be aligned with any framing.

In this mode, the interface is considered as a continuous framed bit stream. The packetization of the stream is done according to IETF RFC 4553. All signaling is carried transparently as a part of a bit stream.

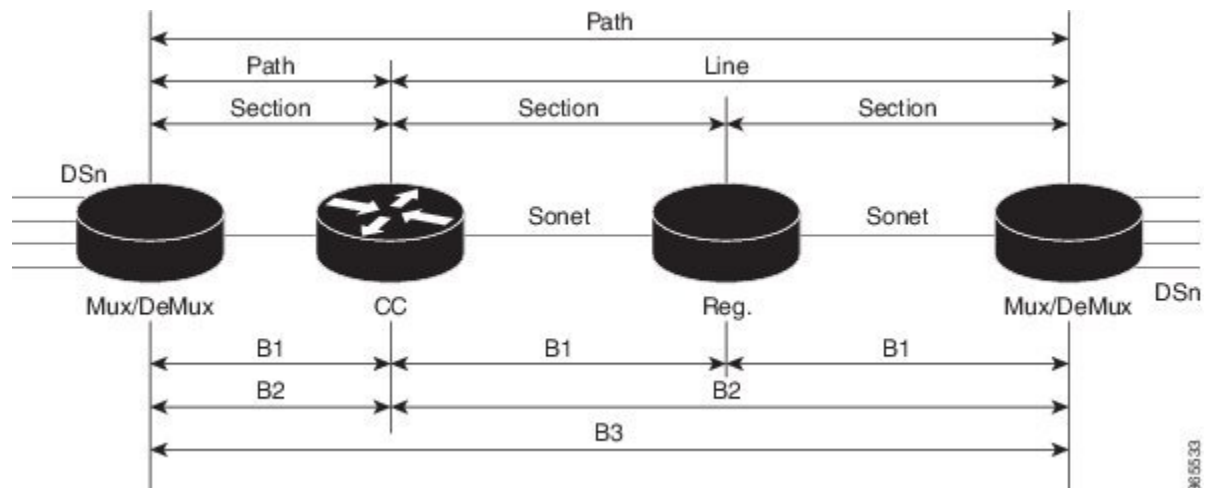
- **Circuit Emulation Service over Packet (CEP)** (RFC 4842) - CEP mode is used to encapsulate SONET payload envelopes (SPEs) like VT1.5 or VT2 or STS-1 or STS-Nc over packet switched networks. In this mode, the bytes from the corresponding SPE are sent out as they arrive on the TDM line. The interface is considered as a continuous framed bit stream. The packetization of the stream is done according to IETF RFC 4842.

Table 8: Modes of CEM

Mode	CEM	Ports
STS-48C	CEP	OC-48, OC-192
STS-12C	CEP	OC-12, OC-48, OC-192
STS-3C	CEP	OC-3, OC-12, OC-48, OC-192
STS-1	CEP	OC-3, OC-12, OC-48, OC-192
DS3	SAToP	OC-3, OC-12, OC-48, OC-192
DS3-T1	SAToP	OC-3, OC-12, OC-48, OC-192
VT 1.5	CEP	OC-3, OC-12, OC-48, OC-192
VT DS1	SAToP	OC-3, OC-12, OC-48, OC-192

## SONET Hierarchy

Figure 4: A SONET Link



Each level of the SONET hierarchy terminates its corresponding fields in the SONET payload, as follows:

## Section

A section is a single fiber run that can be terminated by a network element (Line or Path) or an optical regenerator.

The main function of the section layer is to properly format the SONET frames, and to convert the electrical signals to optical signals. Section Terminating Equipment (STE) can originate, access, modify, or terminate the section header overhead.

## Line

Line-Terminating Equipment (LTE) originates or terminates one or more sections of a line signal. The LTE does the synchronization and multiplexing of information on SONET frames. Multiple lower-level SONET signals can be mixed together to form higher-level SONET signals. An Add/Drop Multiplexer (ADM) is an example of LTE.

## Path

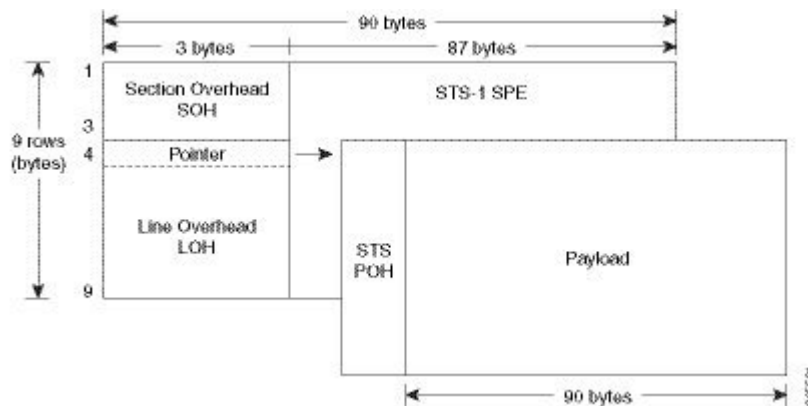
Path-Terminating Equipment (PTE) interfaces non-SONET equipment to the SONET network. At this layer, the payload is mapped and demapped into the SONET frame. For example, an STS PTE can assemble 25 1.544 Mbps DS1 signals and insert path overhead to form an STS-1 signal.

This layer is concerned with end-to-end transport of data.

## STS-1 and STS-3 Frames

A standard STS-1 frame is nine rows by 90 bytes. The first three bytes of each row represent the Section and Line overhead. These overhead bits comprise framing bits and pointers to different parts of the SONET frame.

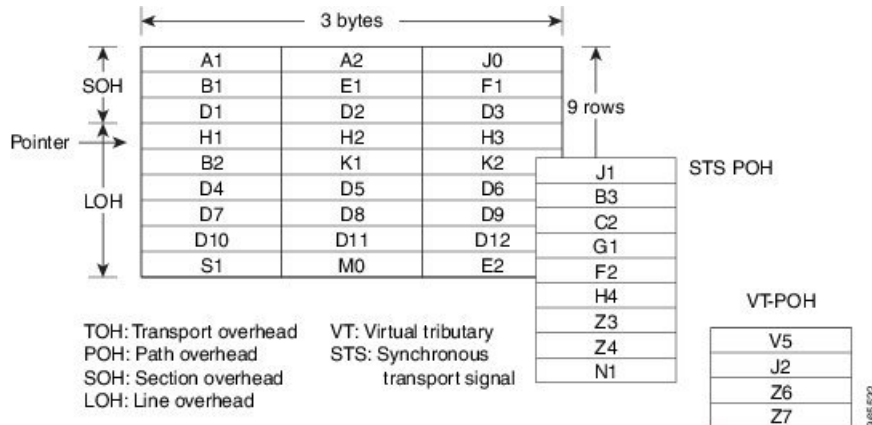
**Figure 5: STS-1 Frame Structure**



There is one column of bytes in the payload that represents the STS path overhead. This column frequently "floats" throughout the frame. Its location in the frame is determined by a pointer in the Section and Line overhead.

The combination of the Section and Line overhead comprises the transport overhead, and the remainder is the SPE.

Figure 6: STS-1 SONET Overhead



For STS-1, a single SONET frame is transmitted in 125 microseconds, or 8000 frames per second.  $8000 \text{ fps} * 810 \text{ B/frame} = 51.84 \text{ Mbs}$ , of which the payload is roughly 49.5 Mbs, enough to encapsulate 28 DS-1s, a full DS-3, or 21 CEPT-1s.

An STS-3 frame is nine rows by 270 bytes. The first nine columns contain the transport overhead section, and the rest is SPE. For both STS-3 and STS-3c, the transport overhead (Line and Section) is the same.

For an STS-3 frame, the SPE contains three separate payloads and three separate path overhead fields. In essence, it is the SPE of three separate STS-1s packed together, one after another.

For more information on Section Overhead, Line Overhead, and Path Overhead, refer the following:

- <http://www.cisco.com/c/en/us/support/docs/optical/synchronous-digital-hierarchy-sdh/5462-sdh-overview.html>
- <http://www.cisco.com/c/en/us/support/docs/optical/synchronous-optical-network-sonet/13567-sonet-tech-tips.html>
- <http://www.cisco.com/c/en/us/tech/optical/synchronous-optical-network-sonet/tsd-technology-support-troubleshooting-technotes-list.html>

## SONET Line and Section Configuration Parameters

The following parameters affect SONET configuration at the line and section levels:

- **Overhead** — Sets the SONET overhead bytes in the frame header to a specific standards requirement, or to ensure interoperability with equipment from another vendors.
  - **J0** — Sets the J0 or C1 byte value in the SONET section overhead.



**Note** 1 byte, 16 bytes, and 64 bytes are the supported values for J0.

- **S1S0** — Sets the SS bits value of the H1 byte in the SONET line overhead.
- **Loopback** — Sets a loopback to test the SONET port.
- **AIS-Shut** — Configures the SONET port to send the Alarm Indication Signal (AIS) at shutdown.
- **Shut** — Disables an interface.

- **Alarm Reporting** — Enables reporting for all or selected alarms.
  - **lias** — Enables line alarm indication signal.
  - **lrldi** — Enables line remote defect indication signal.
  - **pais** — Enables path alarm indication signal.
  - **plop** — Enables loss of pointer failure signal for a path.
  - **pplm** — Enables path payload mismatch indication.
  - **prdi** — Enables path remote defect indication signal.
  - **sd-ber** — Sets Signal Degrade BER threshold.
- **Clock** — Specifies the clock source, where:
  - **line** — The link uses the recovered clock from the line.
  - **internal** — The link uses the internal clock source. This is the default setting.

## BERT

Bit-Error Rate Testing (BERT) is used for analyzing quality and for problem resolution of digital transmission equipment. BERT tests the quality of an interface by directly comparing a pseudorandom or repetitive test pattern with an identical locally generated test pattern.

The BERT operation is data-intensive. Regular data cannot flow on the path while the test is in progress. The path is reported to be in alarm state when BERT is in progress and restored to a normal state after BERT has been terminated.

The supported BERT patterns are  $2^{15}$ ,  $2^{20}$ ,  $2^{23}$ , all 0s.

BERT is supported in the following two directions:

- Line - Supports BERT in TDM direction.
- System - Supports BERT in PSN direction.

The following table shows the SONET level of BERT patterns supported.

Modes	Patterns
SONET Path Level	<ul style="list-style-type: none"> <li>• 0s - Repeating pattern of zeros</li> <li>• <math>2^{15}</math> - O.151 - Error and Jitter measurement of 1544, 2048, 6312, 8448, 32064, 44736 kbps</li> <li>• <math>2^{20}</math> - O.153</li> <li>• <math>2^{20}</math> - O.151 - Error and Jitter measurement upto 72 kbps</li> <li>• <math>2^{23}</math> - O.151 - Error and Jitter measurement of 34368 kbps and 139264 kbps</li> </ul>

Modes	Patterns
SONET T3 or CT3 (T1) or VTG T1 or VT levels	<ul style="list-style-type: none"> <li>• 0s - Repeating pattern of zeros</li> <li>• <math>2^{11} 2^{11-1}</math> test pattern</li> <li>• <math>2^{15}</math> - O.151 - Error and Jitter measurement of 1544, 2048, 6312, 8448, 32064, 44736 kbps</li> <li>• <math>2^{20}</math> - O.153</li> <li>• <math>2^{20}</math> - O.151 - Error and Jitter measurement upto 72 kbps</li> <li>• <math>2^{23}</math> - O.151 - Error and Jitter measurement of 34368 kbps and 139264 kbps</li> <li>• <math>2^{31} 2^{31-1}</math> test pattern</li> <li>• <math>2^9 2^9-1</math> test pattern</li> </ul>

## Concatenated SONET Frames

Twenty-eight VTs make up one STS-1. Three STS-1s made up an STS-3 and so on. Any one byte within the STS frame has a direct relationship to a base VT that helps to make up the STS.

A lower-case "c" in the STS rate stands for "concatenated", and indicates that the interface hardware is not channelized. Examples of concatenated interfaces are STS-3c and STS-12c.

The STS-1s may be concatenated into sets of 3 or 12 or 24 or 48 or 192 to form STS-3c, STS-12c, and so on. The STS-1s may be combined only at specific STS-n boundaries within an OC port.

## SONET Path Level Configuration Parameters

The following parameters affect SONET configuration at the path level:

- **BERT** — Starts the BERT test.
- **Clock** — Specifies the clock source for a path.
- **Exit** — Exits from SONET path configuration mode.
- **Loopback** — Sets the entire path in the loopback mode.
- **Mode** — Specifies the path operation mode.
- **No** — Negates a command or sets its defaults.
- **Overhead** — Configures SONET path overhead flags.
- **Shutdown** — Disables the SONET path.
- **Threshold** — Sets the path BER threshold values.
- **vtg** — Sets the VT-15 configuration.

## Channelized SONET Frames

A channelized SONET interface is a composite of lower-speed STS streams. However, a channelized SONET interface maintains the streams as independent frames with unique payload pointers. The frames are simply multiplexed before transmission to increase the carrying capacity of the physical fiber. This process is similar to multiplexing 24 digital signal level 0 channels into a DS1 or multiplexing 28 DS1 streams into a DS3.

## SONET T1 Configuration Parameters

The following parameters affect SONET T1 configuration:

- **BERT** — Starts the BERT test.
- **Clock** — Specifies the clock source for T1 interface.
- **Description** — Specifies the description of the controller.
- **Framing** — Specifies the type of a framing on T1 interface.
- **Loopback** — Sets the T1 interface in the loopback mode.
- **Shutdown** — Disables the T1 interface.

## SONET T3 Configuration Parameters

The following parameters affect SONET T3 configuration:

- **Clock** — Specifies the clock source for T3 link.
- **Description** — Specifies the description of the controller.
- **Framing** — Specifies the type of a framing on T3 interface.
- **Loopback** — Sets the T3 link in the loopback mode.
- **Shutdown** — Disables the T3 interface.

## SONET VT Configuration Parameters

The following parameters affect SONET VT configuration:

- **BERT** — Starts the BERT test.
- **CEM Group** — Specifies the time slots for CEM group mapping.
- **Clock** — Specifies the clock source for VT.
- **Description** — Specifies the description of the controller.
- **Loopback** — Sets the VT in the loopback mode.



- **Overhead** — Configures VT line path overhead flags.
- **Shutdown** — Disables the VT interface.
- **Threshold** — Configures the VT threshold values.

## Alarms at SONET Layers

SONET equipment detects events and alarms at each of SONET's three layers — section, line and path. Typically, a SONET chassis sends alarms both upstream and downstream in order to notify other devices of the problem condition.

### SONET Alarm Surveillance

SONET alarm surveillance uses two terms:

- **State**—Condition that is reported or detected. A SONET chassis enters a state when the chassis detects the occurrence of an event. A SONET chassis exits that state when the chassis no longer detects the event.
- **Indication**—Prompted by a change of state. This indicates the presence of a condition. This document discusses the Alarm Indication Signal (AIS), and Remote Defect Indicator (RDI).

The interface of active alarm or defect is maintained in a down/down state. The process used to troubleshoot down/down SONET interfaces is similar to that for digital interfaces, such as T1 and T3.

### Section Alarms

The following section alarms are supported:

- **LOS** — Loss of Signal
- **LOF** — Loss of Frame
- **SEF** — Severely Error Frame

### Line Alarms

The following line alarms are supported:

- **AIS-L** — Line AIS
- **REI-L** — Line Remote Error Indication
- **RDI-L** — Line Remote Defect Indication
- **B2** — Line BIP Error (SF/SD)
- **TCA** for B2

### Path Alarms

The following path alarms are supported:

- AIS-P — STS Path AIS
- LOP-P — STS Path Loss of Pointer
- B3 (SF/SD) — STS Path BIP Error
- UNEQ-P — STS Path unequipped
- REI-P — STS Path Remote Error
- RDI-P — STS Path Remote Defect Indication
- PLM-P — STS path Payload Label Mismatch
- LOM — Loss of MultiFrame
- TCA for B3

## VT Alarms

The following VT alarms are supported:

- AIS-V — VT Path AIS
- LOP-V — VT Loss of Pointer
- V-BIP (SF/SD) — VT Path BIP error
- UNEQ-V — VT Path Unequipped
- REI-V — VT Path Remote Error
- RDI-V — VT Path Remote Defect Indication
- PLM-V — VT path Payload Label Mismatch
- TCA for VT Level BIP

## T1 Alarms

The following T1 alarms are supported:

- LOS — DS1 Line loss of Signal
- AIS — DS1 Path Alarm Indication Signal
- AIS-CI — DS1 Path Alarm Indication Signal Customer Installation
- LOF — DS1 Path Loss of Frame
- RDI/RAI — Remote Defect Indication or Remote Alarm Indication
- RAI-CI — Remote Alarm Indication Customer Installation
- TCA for Line and Path DS1

## T3 Alarms

The following T3 or path alarms are supported:

- LOS — DS3 Line Loss of Signal
- OOF — DS3 Path Loss of Frame
- SEF — DS3 Path Severely Errored Frame
- AIS — DS3 Path Alarm Indication Signal
- SEF/AIS-FE — Far End SEF/AIS
- TCA for Line and Path DS3

## Alarm Indicators

Typically, a failure condition detected by a SONET chassis results in one or more error conditions sent both upstream and downstream on the network. An AIS is sent in order to alert downstream chassis of a problem and in order to prevent consequential downstream failures or alarms from being raised.

## How to Configure SONET

This section describes how to configure SONET.

Each SFP port (0-7) can be configured as OC-3, OC-12, OC-48, or Gigabit Ethernet. SFP+ port (8) can be configured as OC-192 or 10 Gigabit Ethernet.

## Prerequisites for Configuring SONET

You must select the MediaType controller to configure and enter the controller configuration mode.

You must configure the controller as a SONET port.

## Configuring MediaType Controller

To configure MediaType Controller, use the following commands:

```
enable
configure terminal
controller MediaType 0/0/16
mode sonet
end
```

## Configuring SONET Ports

To configure SONET ports, use the following commands:

```
enable
configure terminal
controller MediaType 0/0/16
mode sonet
controller sonet 0/0/16
rate OC12
end
```

The above example shows how to configure SONET ports in OC-12 mode.

## Managing and Monitoring SONET Line

This section describes how to manage and monitor SONET.

### Configuring Line and Section Overhead

To configure line and section overhead, use the following commands:

```
enable
configure terminal
controller MediaType 0/0/16
mode sonet
controller sonet 0/0/16
overhead s1s0 2
overhead j0 tx length 1-byte
end
```




---

**Note** To restore the system to its default condition, use the **no** form of the command.

---

### Configuring Line Loopback

To configure loopback, use the following commands:

```
enable
configure terminal
controller sonet 0/0/16
loopback local
end
```




---

**Note** To restore the system to its default condition, use the **no** form of the command.

---

### Configuring AIS Shut

To configure AIS-Shut, use the following commands:

```
enable
configure terminal
controller sonet 0/0/16
ais-shut
end
```




---

**Note** The **no ais-shut** command will not send AIS.

---

### Configuring Shut

To configure Shut, use the following commands:

```
enable
configure terminal
controller sonet 0/0/16
shutdown
end
```



---

**Note** Use the **no shutdown** command to disable the interface.

---

## Configuring Alarm Reporting

To configure alarm reporting, use the following commands:

```
enable
configure terminal
controller sonet 0/0/16
alarm-report b2-tcs
end
```



---

**Note** To restore the system to its default condition, use the **no** form of the command.

---

## Configuring Clock

To configure clock, use the following commands:

```
enable
configure terminal
controller MediaType 0/0/16
mode sonet
controller sonet 0/0/16
clock source line
end
```



---

**Note** The default mode is internal.

---



---

**Note** To restore the system to its default condition, use the **no** form of the command.

---

### Configuring Network-Clock SONET

To configure network-clock SONET, use the following commands:

```
enable
configure terminal
network-clock input-source 1 controller sonet 0/0/16
end
```

## Configuring STS-1 Modes

To configure STS-1 modes, use the following commands:

```
enable
configure terminal
controller sonet 0/0/16
sts-1 1
mode vt-15
end
```



**Note** There is no default mode. The following modes are supported:

- mode vt-15
- mode ct3
- mode t3
- mode unframed



**Note** To restore the system to its default condition, use the **no** form of the command.

### Configuring DS1/T1 CT3 mode of STS-1

To configure DS1/T1 CT3 mode of STS-1, you can configure the T1 link using the following steps:

```
enable
configure terminal
controller sonet 0/0/16
sts-1 1
mode ct3
t1 1 clock source internal
t1 1 framing unframed
end
```



**Note** To restore the system to its default condition, use the **no** form of the command.

### Configuring STS-Nc - Contiguous Concatenation

To configure STS-Nc - contiguous concatenation, use the following commands:

```
enable
configure terminal
controller sonet 0/0/16
sts-1 1-3 mode sts-3c
end
```



**Note** To restore the system to its default condition, use the **no** form of the command.



**Note** To configure STS-3c or STS-12c, use the numbers as multiples for 3 or 12, respectively.

## Verification of SONET Configuration

The following sample output shows the verification of SONET configuration:

```

Router#show controllers sonet 0/0/16
SONET 0/0/16 is up.                    =====> this is the controller/port
status.
  Hardware is A900-IMA3G-IMSG

  Port configured rate: OC3              =====> this is the rate the port is configured
  on it.
  Applique type is Channelized Sonet / SDH
  Clock Source is Line                  ==> the clocking config
Medium info:
  Type: Sonet, Line Coding: NRZ,
SECTION:
  LOS = 0          LOF = 0              =====> the section level alarm
counter (from last clear counters)

SONET Section Tables
  INTERVAL      CV    ES    SES  SEFS
  12:00-12:07   0    0    0    0
  11:45-12:00   15   1    0    0
Total of Data in Current and Previous Intervals
  11:45-12:07   15   1    0    0                    ==> PMON for
the port

LINE:
  AIS = 0          RDI = 0          REI = 0          BIP(B2) = 0          =====> the line level
alarm counter (from last clear counters)
Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None          =====> present active
alarms on the port.
Alarm reporting enabled for: SLOS SLOF SF B2-TCA
BER thresholds: SF = 10e-3 SD = 10e-6          =====> ber thresholds
TCA thresholds: B2 = 10e-6

Rx: S1S0 = 00
   K1 = 00,    K2 = 00          ==> k1k2 values
   J0 = 00
   RX S1 = 00
Tx: S1S0 = 00
   K1 = 00,    K2 = 00
   J0 = 00

Tx J0 Length : 64
Tx J0 Trace :

  52 6F 75 74 65 72 20 20 20 20 20 20 20 20 20 20  Router
  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  20 20 20 20 20 20 20 20 20 20 20 20 20 20 00 00      ..

Expected J0 Length : 64
Expected J0 Trace :

  52 6F 75 74 65 72 20 20 20 20 20 20 20 20 20 20  Router
  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20

```

```

20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
20 20 20 20 20 20 20 20 20 20 20 20 20 20 00 00 ..

```

Rx J0 Length : 64  
Rx J0 Trace :

```

01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 .....
01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 .....
01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 .....
01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 00 .....

```

SONET Line Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASF
12:00-12:07	0	0	0	0	0	0	0	0
11:45-12:00	48	1	0	0	53	1	0	0
Total of Data in Current and Previous Intervals								
11:45-12:07	48	1	0	0	53	1	0	0

High Order Path:

PATH 1:

```

Clock Source is internal          =====> path level clock

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0          =====> path
layer alarms counter
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

```

```

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None          =====> present alarms
on the path.
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

```

```

TCA threshold: B3 = 10e-6
Rx: C2 = 00          =====> rx and tx C2 byte..
Tx: C2 = 02
PATH TRACE BUFFER : UNSTABLE

```

```

00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... =====> path trace of the
path
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

```

SONET Path Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASF
12:00-12:07	0	0	0	0	0	0	0	389
11:45-12:00	0	1	1	0	0	0	0	900
Total of Data in Current and Previous Intervals								
11:45-12:07	0	1	1	0	0	0	0	1289

PATH 2:

```

Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

```

```

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: PLOP
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

```



```
TCA threshold: B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 04
52 6F 75 74 65 72 20 30 2F 32 2F 30 2E 32 00 00 Router 0/2/0.2..
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
```

```
Expected J1 Length : 64
Expected J1 Trace
```

```
52 6F 75 74 65 72 20 30 2F 32 2F 30 2E 32 00 00 Router 0/2/0.2..
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
```

PATH TRACE BUFFER : UNSTABLE

```
Rx J1 Length : 0
Rx J1 Trace
```

SONET Path Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASFE
12:00-12:07	0	0	0	389	0	0	0	0
11:45-12:00	0	0	0	900	0	0	0	0
Total of Data in Current and Previous Intervals								
11:45-12:07	0	0	0	1289	0	0	0	0

```
PATH 3:
Clock Source is internal
```

```
AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
LOP = 1          PSE = 0          NSE = 0          NEWPTR = 0
LOM = 0          PLM = 0          UNEQ = 1
```

```
Active Defects: None
Detected Alarms: PLOP LOM
Asserted/Active Alarms: PLOP
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA
```

```
TCA threshold: B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 02
```

```
Tx J1 Length : 64
Tx J1 Trace
```

```
52 6F 75 74 65 72 20 30 2F 32 2F 30 2E 33 00 00 Router 0/2/0.3..
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
```

```
Expected J1 Length : 64
Expected J1 Trace
```

```
52 6F 75 74 65 72 20 30 2F 32 2F 30 2E 33 00 00 Router 0/2/0.3..
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
```

PATH TRACE BUFFER : UNSTABLE

```
Rx J1 Length : 0
Rx J1 Trace
```

## SONET Path Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASFEE
12:00-12:07	0	0	0	389	0	0	0	0
11:45-12:00	0	0	0	894	0	0	0	0

Total of Data in Current and Previous Intervals

11:45-12:07	0	0	0	1283	0	0	0	0
-------------	---	---	---	------	---	---	---	---

```
OC3.STS1 0/0/16 is up.      =====> present status of the path
Hardware is A900-IMA3G-IMSG
```

```
Applique type is VT1.5      =====> mode of the path
```

```
STS-1 1, VTG 1, T1 1 (VT1.5 1/1/1) is down  =====> status of the SPE (t1)
VT Receiver has no alarm.
Receiver is getting AIS.                                     =====> alarm of the SPE (t1)
Framing is unframed, Clock Source is Internal              =====> framing of the T1, clock of the
t1
```

```
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
```

```
STS-1 1, VTG 1, T1 2 (VT1.5 1/1/2) is down
VT Receiver has no alarm.
Receiver is getting AIS.
```

The following table shows each field and its description.

**Table 9: Field Description**

Field	Description
SONET 0/0/16 is up	Shows that the SONET controller is operating. The controller's state can be up, down, or administratively down.
Port configured rate: OC3	Shows the rate configured on the port.
SECTION: LOS = 0 LOF = 0 BIP = 0	Shows the section level alarm counters.
SONET Section Tables: INTERVAL CV ES SES SEFS 05:50-05:58 0 0 0 0	Shows the PMON for the port.
LINE: AIS = 0 RDI = 0 REI = 0 BIP(B2) = 0	Shows the line level alarm counters.
Asserted/Active Alarms: None	Shows the active alarms on the port.
BER thresholds: SF = 10e-3 SD = 10e-6	Shows BER thresholds.
K1 = 00, K2 = 00	Shows the K1 and K2 values.
PATH 1: Clock Source is internal	Shows the path level clock.
AIS = 0 RDI = 0 REI = 0 BIP(B3) = 0 LOP = 0 PSE = 0 NSE = 0 NEWPTR = 0 LOM = 0 PLM = 0 UNEQ = 0	Shows the path layer alarm counters.
Active Defects: None Detected Alarms: None Asserted/Active Alarms: None Alarm reporting enabled for: PLOP LOM B3-TCA	Shows the alarms on the path.
TCA threshold: B3 = 10e-6 Rx: C2 = 00 =====> rx and tx C2 byte.. Tx: C2 = 02 PATH TRACE BUFFER : UNSTABLE	shows the Rx and Tx C2 bytes.
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....	Shows the path trace.
OC3.STS1 0/3/3.1 is up.	Shows the status of the path.
Applique type is VT1.5	Shows the mode of the path.
STS-1 1, VTG 1, T1 1 (VT1.5 1/1/1) is down	Shows the status of SPE (T1).

Field	Description
Receiver is getting AIS.	Shows the alarm of SPE (T1).
Framing is unframed, Clock Source is Internal	Shows the framing of T1 and clock of the T1.

## Configuring CEM Group for Framed SAToP

To configure a CEM group for Framed SAToP:

```
enable
configure terminal
controller mediatype 0/4/16
mode sonet
controller sonet 0/4/16
rate oc12
sts-1 1
mode vt-15
vtg 1 t1 1 cem-group 0 framed
end
```

## Configuring VT-15 mode of STS-1 for Framed SAToP

To configure VT-15 mode of STS-1 for framed SAToP:

```
enable
configure terminal
controller mediatype 0/0/16
mode sonet
controller sonet 0/0/16
rate oc3
sts-1 1
mode vt-15
vtg 1 t1 1 cem-group 0 framed
end
```

## Configuring DS1/T1 CT3 mode of STS-1 for Framed SAToP

To configure DS1/T1 CT3 mode of STS-1 for framed SAToP:

```
enable
configure terminal
controller mediatype 0/0/16
mode sonet
controller sonet 0/0/16
rate oc3
sts-1 2
mode ct3
t3 framing c-bit
t1 1 cem-group 1 framed
end
```

## Performance Monitoring Use Cases or Deployment Scenarios

You can view the statistics or error count generated on the TDM lines.

To view the statistics or error count generated, use the **show controller sonet** command:

```

Router# show controller sonet 0/2/0
SONET 0/2/0 is up.
  Hardware is

  Port configured rate: OC3
  Applique type is Channelized Sonet
  Clock Source is Internal
Medium info:
  Type: Sonet, Line Coding: NRZ,
  Alarm Throttling: OFF
SECTION:
  LOS = 0          LOF = 0          BIP(B1) = 0

SONET Section Tables
  INTERVAL      CV      ES      SES      SEFS
  12:00-12:07   0       0       0       0
  11:45-12:00   15      1       0       0
Total of Data in Current and Previous Intervals
  11:45-12:07   15      1       0       0

LINE:
  AIS = 0          RDI = 0          REI = 0          BIP(B2) = 0
Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: SLOS SLOF LAIS SF SD LRDI B1-TCA B2-TCA
BER thresholds:  SF = 10e-3  SD = 10e-6
TCA thresholds:  B1 = 10e-6  B2 = 10e-6
Rx: S1S0 = 00
    K1 = 00,    K2 = 00
    J0 = 00

    RX S1 = 00

Tx: S1S0 = 00
    K1 = 00,    K2 = 00
    J0 = 04

Tx J0 Length : 64
Tx J0 Trace :

  52 6F 75 74 65 72 20 20 20 20 20 20 20 20 20 20  Router
  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  20 20 20 20 20 20 20 20 20 20 20 20 20 20 00 00  ..

Expected J0 Length : 64
Expected J0 Trace :

  52 6F 75 74 65 72 20 20 20 20 20 20 20 20 20 20  Router
  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  20 20 20 20 20 20 20 20 20 20 20 20 20 20 00 00  ..

Rx J0 Length : 64
Rx J0 Trace :

  01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01  .....
  01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01  .....
  01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01  .....
```

```
01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 00 .....
```

## SONET Line Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASFE
12:00-12:07	0	0	0	0	0	0	0	0
11:45-12:00	48	1	0	0	53	1	0	0
Total of Data in Current and Previous Intervals								
11:45-12:07	48	1	0	0	53	1	0	0

## High Order Path:

## PATH 1:

Clock Source is internal

```
AIS = 0          RDI = 0          REI = 41350871   BIP(B3) = 9
LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
LOM = 0          PLM = 0          UNEQ = 1
```

Active Defects: None

Detected Alarms: None

Asserted/Active Alarms: None

Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6

Rx: C2 = 04

Tx: C2 = 04

Tx J1 Length : 64

Tx J1 Trace

```
52 6F 75 74 65 72 20 30 2F 32 2F 30 2E 31 00 00   Router 0/2/0.1..
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   .....
```

Expected J1 Length : 64

Expected J1 Trace

```
52 6F 75 74 65 72 20 30 2F 32 2F 30 2E 31 00 00   Router 0/2/0.1..
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   .....
```

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 64

Rx J1 Trace

```
BB 43 45 5F 31 5F 31 20 30 2F 34 2F 33 2E 31 00   .CE_1_1 0/4/3.1.
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   .....
```

## SONET Path Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASFE
12:00-12:07	0	0	0	0	0	0	0	389
11:45-12:00	0	1	1	0	0	0	0	900
Total of Data in Current and Previous Intervals								
11:45-12:07	0	1	1	0	0	0	0	1289

## PATH 2:

Clock Source is internal

```

AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
LOP = 1          PSE = 0          NSE = 0          NEWPTR = 0
LOM = 0          PLM = 0          UNEQ = 1
    
```

```

Active Defects: None
Detected Alarms: PLOP
Asserted/Active Alarms: PLOP
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA
    
```

```

TCA threshold: B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 04
    
```

```

Tx J1 Length : 64
Tx J1 Trace
    
```

```

52 6F 75 74 65 72 20 30 2F 32 2F 30 2E 32 00 00 Router 0/2/0.2..
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
    
```

```

Expected J1 Length : 64
Expected J1 Trace
    
```

```

52 6F 75 74 65 72 20 30 2F 32 2F 30 2E 32 00 00 Router 0/2/0.2..
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
    
```

PATH TRACE BUFFER : UNSTABLE

```

Rx J1 Length : 0
Rx J1 Trace
    
```

SONET Path Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASFE
12:00-12:07	0	0	0	389	0	0	0	0
11:45-12:00	0	0	0	900	0	0	0	0

```

Total of Data in Current and Previous Intervals
11:45-12:07 0 0 0 1289 0 0 0 0
    
```

```

PATH 3:
Clock Source is internal
    
```

```

AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
LOP = 1          PSE = 0          NSE = 0          NEWPTR = 0
LOM = 0          PLM = 0          UNEQ = 1
    
```

```

Active Defects: None
Detected Alarms: PLOP LOM
Asserted/Active Alarms: PLOP
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA
    
```

```

TCA threshold: B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 02
    
```

```

Tx J1 Length : 64
Tx J1 Trace
    
```

```

52 6F 75 74 65 72 20 30 2F 32 2F 30 2E 33 00 00 Router 0/2/0.3..
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
    
```

```

00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
Expected J1 Length : 64
Expected J1 Trace

52 6F 75 74 65 72 20 30 2F 32 2F 30 2E 33 00 00 Router 0/2/0.3..
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace

```

```

SONET Path Tables
INTERVAL      CV      ES      SES      UAS      CVFE      ESFE      SESFE      UASFE
12:00-12:07   0        0        0      389        0        0        0        0
11:45-12:00   0        0        0      894        0        0        0        0
Total of Data in Current and Previous Intervals
11:45-12:07   0        0        0     1283        0        0        0        0

```

SONET 0/2/0.1 T3 is down.

```

Applique type is T3
Receiver is getting AIS.
MDL transmission is disabled

```

```

FEAC code received: No code is being received
Framing is C-BIT Parity, Cablelength is 224
BER thresholds: SF = 10e-3 SD = 10e-6
Clock Source is internal
Equipment customer loopback
Data in current interval (390 seconds elapsed):
Near End
 0 Line Code Violations, 0 P-bit Coding Violations
 0 C-bit Coding Violations, 0 P-bit Err Secs
 0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
389 Unavailable Secs, 0 Line Errored Secs
 0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
 0 Severely Errored Line Secs, 0 Path Failures
 0 AIS Defect Secs, 0 LOS Defect Secs
Far End
 0 Errored Secs, 0 Severely Errored Secs
 0 C-bit Unavailable Secs, 0 Path Failures
 0 Code Violations, 0 Service Affecting Secs
Data in Interval 1:
Near End
 0 Line Code Violations, 0 P-bit Coding Violations
 0 C-bit Coding Violations, 0 P-bit Err Secs
 0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
910 Unavailable Secs, 0 Line Errored Secs
 0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
 0 Severely Errored Line Secs, 1 Path Failures
 0 AIS Defect Secs, 0 LOS Defect Secs
Far End
 0 Errored Secs, 0 Severely Errored Secs
 0 C-bit Unavailable Secs, 0 Path Failures
 0 Code Violations, 0 Service Affecting Secs
Total Data (last 1 15 minute intervals):
Near End

```



```

    0 Line Code Violations, 0 P-bit Coding Violations,
    0 C-bit Coding Violations, 0 P-bit Err Secs,
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
    910 Unavailable Secs, 0 Line Errored Secs,
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
    0 Severely Errored Line Secs, 1 path failures
    0 AIS Defect Secs, 0 LOS Defect Secs
Far End
    0 Errored Secs, 0 Severely Errored Secs
    0 C-bit Unavailable Secs, 0 Path Failures
    0 Code Violations, 0 Service Affecting Secs

T1 1 is up
timeslots:
FDL per AT&T 54016 spec.
No alarms detected.
Framing is ESF, Clock Source is Internal
Data in current interval (250 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 Stuffed 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    3 Errored Secs, 0 Bursty Err Secs, 3 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations,0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
    0 Unavailable Secs, 0 Path Failures

SONET 0/2/0.2 T3 is down.
Hardware is

Applique type is Channelized T3 to T1
Receiver is getting AIS.
MDL transmission is disabled

FEAC code received: No code is being received
Framing is C-BIT Parity, Cablelength is 224
BER thresholds: SF = 10e-3 SD = 10e-6

```

```

Clock Source is internal
Equipment customer loopback
Data in current interval (400 seconds elapsed):
Near End
  0 Line Code Violations, 0 P-bit Coding Violations
  0 C-bit Coding Violations, 0 P-bit Err Secs
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
  399 Unavailable Secs, 0 Line Errored Secs
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  0 Severely Errored Line Secs, 0 Path Failures
  0 AIS Defect Secs, 0 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs
Data in Interval 1:
Near End
  0 Line Code Violations, 0 P-bit Coding Violations
  0 C-bit Coding Violations, 0 P-bit Err Secs
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
  910 Unavailable Secs, 0 Line Errored Secs
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  0 Severely Errored Line Secs, 1 Path Failures
  0 AIS Defect Secs, 0 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs
Total Data (last 1 15 minute intervals):
Near End
  0 Line Code Violations, 0 P-bit Coding Violations,
  0 C-bit Coding Violations, 0 P-bit Err Secs,
  0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
  910 Unavailable Secs, 0 Line Errored Secs,
  0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  0 Severely Errored Line Secs, 1 path failures
  0 AIS Defect Secs, 0 LOS Defect Secs
Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs
T1 1 is up
timeslots:
FDL per AT&T 54016 spec.
No alarms detected.
Framing is ESF, Clock Source is Internal
Data in current interval (250 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 Stuffed 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
  2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
  0 Unavailable Secs, 0 Stuffed Secs

```

```

    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    3 Errored Secs, 0 Bursty Err Secs, 3 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations,0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
    0 Unavailable Secs, 0 Path Failures
STS-1 2, T1 1 (CT3 2-1) is down
timeslots:
FDL per ANSI T1.403 and AT&T 54016 spec.
Receiver is getting AIS.
Framing is ESF, Clock Source is Internal
Data in current interval (390 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
    389 Unavailable Secs, 0 Stuffed 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
Data in Interval 1:
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
    900 Unavailable Secs, 0 Stuffed 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
Total Data (last 1 15 minute intervals):
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
    900 Unavailable Secs, 0 Stuffed 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

```

## ONS Pluggables

A comprehensive range of pluggable optical modules is available. .

## Configuring ONS Pluggables

To configure ONS Pluggables, use the following commands:

```
enable
configure terminal
controller mediatype 0/0/16
mode sonet
exit
controller sonet 0/0/16
rate oc3
```

## Verifying the Supported Pluggables

Before you configure the ONS pluggables, use the following commands to verify the supported pluggables:

**show hw-module subslot <slot/bay> transceiver <port> status:**

```
The Transceiver in slot 0 subslot 7 port 4 is enabled.
Module temperature                = +46.636 C
Transceiver Tx supply voltage     = 3291.5 mVolts
Transceiver Tx bias current       = 17264 uAmps
Transceiver Tx power              = -2.9 dBm
Transceiver Rx optical power     = -7.4 dBm
```



**Note** The **show hw-module subslot <slot/bay> transceiver <port> status** displays as **Enabled** if the pluggables are supported and the command displays as **Disabled** if the pluggables are not supported.

**show hw-module subslot <slot/bay> transceiver <port> idprom:**

```
show hw-module subslot 0/7 transceiver 6 idprom detail
IDPROM for transceiver SPA-1T8S-10CS_7/6:
Description                       = SFP or SFP+ optics (type 3)
Transceiver Type:                  = ONS SE Z1 (406)
Product Identifier (PID)           = ONS-SE-Z1
Vendor Revision                    = A
Serial Number (SN)                 = FNS19251NPM
Vendor Name                        = CISCO-FINISAR
Vendor OUI (IEEE company ID)      = 00.90.65 (36965)
CLEI code                          = WMOTCZPAAA
Cisco part number                  = 10-1971-04
Device State                       = Enabled.
Date code (yy/mm/dd)              = 15/06/19
Connector type                     = LC.
Encoding                           = 8B10B
                                   NRZ
                                   Manchester
Nominal bitrate                    = OC48/STM16 (2500 Mbits/s)
Minimum bit rate as % of nominal bit rate = not specified
Maximum bit rate as % of nominal bit rate = not specified
The transceiver type is 406
Link reach for 9u fiber (km)       = IR-1 (15km) (15)
Link reach for 50u fiber (m)      = SR(2km) (0)
                                   IR-1 (15km) (0)
                                   IR-2 (40km) (0)
                                   LR-1 (40km) (0)
                                   LR-2 (80km) (0)
                                   LR-3 (80km) (0)
                                   DX (40KM) (0)
```

```

HX(40km) (0)
ZX(80km) (0)
VX(100km) (0)
1xFC, 2xFC-SM(10km) (0)
ESCON-SM(20km) (0)
Link reach for 62.5u fiber (m) = SR(2km) (0)
IR-1(15km) (0)
IR-2(40km) (0)
LR-1(40km) (0)
LR-2(80km) (0)
LR-3(80km) (0)
DX(40KM) (0)
HX(40km) (0)
ZX(80km) (0)
VX(100km) (0)
1xFC, 2xFC-SM(10km) (0)
ESCON-SM(20km) (0)
Nominal laser wavelength = 1310 nm.
DWDM wavelength fraction = 1310.0 nm.
Supported options = Tx disable
Tx fault signal
Loss of signal (standard implementation)
Supported enhanced options = Alarms for monitored parameters
Software Rx LOS monitoring
Diagnostic monitoring = Digital diagnostics supported
Diagnostics are externally calibrated
Rx power measured is "Average power"
Transceiver temperature operating range = -40 C to 85 C (industrial)
Minimum operating temperature = -40 C
Maximum operating temperature = 85 C
High temperature alarm threshold = +90.000 C
High temperature warning threshold = +85.000 C
Low temperature warning threshold = -40.000 C
Low temperature alarm threshold = -45.000 C
High voltage alarm threshold = 3630.0 mVolts
High voltage warning threshold = 3470.0 mVolts
Low voltage warning threshold = 3140.0 mVolts
Low voltage alarm threshold = 2971.2 mVolts
High laser bias current alarm threshold = 85.000 mAmps
High laser bias current warning threshold = 65.000 mAmps
Low laser bias current warning threshold = 4.000 mAmps
Low laser bias current alarm threshold = 2.000 mAmps
High transmit power alarm threshold = 4.0 dBm
High transmit power warning threshold = 2.0 dBm
Low transmit power warning threshold = -7.0 dBm
Low transmit power alarm threshold = -9.0 dBm
High receive power alarm threshold = 1.0 dBm
Low receive power alarm threshold = -26.0 dBm
High receive power warning threshold = -1.0 dBm
Low receive power warning threshold = -24.9 dBm
External Calibration: bias current slope = 1.000
External Calibration: bias current offset = 0

```

**show hw-module subslot <slot/bay> transceiver <port> idprom brief:**

```

sh hw-module subslot 0/7 transceiver 6 idprom brief
IDPROM for transceiver SPA-1T8S-10CS_7/6:
Description = SFP or SFP+ optics (type 3)
Transceiver Type: = ONS SE Z1 (406)
Product Identifier (PID) = ONS-SE-Z1
Vendor Revision = A
Serial Number (SN) = FNS19251NQ0
Vendor Name = CISCO-FINISAR
Vendor OUI (IEEE company ID) = 00.90.65 (36965)
CLEI code = WMOTCZPAAA

```

```

Cisco part number           = 10-1971-04
Device State                = Enabled.
Date code (yy/mm/dd)       = 15/06/19
Connector type              = LC.
Encoding                    = 8B10B
                           NRZ
                           Manchester
Nominal bitrate             = OC48/STM16 (2500 Mbits/s)
Minimum bit rate as % of nominal bit rate = not specified
Maximum bit rate as % of nominal bit rate = not specified

```

## Loopback Remote on T1 and T3 Interfaces

The remote loopback configuration attempts to put the far-end T1 or T3 into a loopback.

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

### Restrictions for Loopback Remote

E1 and E3 loopback remote are not supported.

### Configuring Loopback Remote in Sonet

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

```

enable
configure terminal
controller sonet 0/0/1
mode ct3
t1 1 loopback remote iboc {fac1 | fac2 | csu}
mode vt-15
vtg 1 t1 1 loopback remote iboc {fac1 | fac2 | csu}

```

To set T1 loopback remote iboc esf line csu/esf payload for OCX sonet, perform the following tasks in global configuration mode:

```

enable
configure terminal
controller sonet 0/0/1
mode ct3
t1 1 loopback remote iboc esf {line csu | payload}
mode vt-15
vtg 1 t1 1 loopback remote esf {line csu | payload}

```

To set T3 loopback remote line/payload for OCX in sonet, perform the following tasks in global configuration mode:

```

enable
configure terminal
controller sonet 0/0/1
mode t3
t3 loopback remote {line | payload}

```



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

## Verifying the Loopback Remote Configuration

Use the following command to check the T1 loopback remote configuration:

```
router# show run | sec 0/0/1
controller SONET 0/0/1
rate OC3
no ais-shut
alarm-report all
clock source internal
!
sts-1 1
!
sts-1 2
  clock source internal
  mode ct3
  t3 framing c-bit
  t3 clock source internal
  t1 1 Loopback remote iboc fac1
  t1 1 framing SF
```

Use the following command to verify the T1 loopback remote configuration:

```
Router(config-ctrlr-sts1)# show controller sonet 0/0/1 | b STS-1 2, T1 1
STS-1 2, T1 1 (CT3 2-1) is up
  timeslots:
    Configured for NIU FAC1 Line Loopback with IBOC
    Currently in Inband Remotely Line Looped
  Receiver has no alarms.
  Framing is SF, Clock Source is Internal
```

Use the following command to check T3 loopback remote configuration:

```
Router# show run | sec 0/0/1
controller SONET 0/0/1
rate OC3
no ais-shut
alarm-report all
clock source internal
!
sts-1 1
!
sts-1 2
!
sts-1 3
  clock source internal
  mode t3
  t3 framing c-bit
  t3 loop remote line
  t3 clock source internal
```

Use the following command to verify T3 loopback remote configuration:

```
Router(config-ctrlr-sts1)# do show controller sonet 0/0/1 | b Path 3
```

```

OC3.STS1 0/0/1 Path 3 is up. (Configured for Remotely Looped)
  Currently in Remotely Line Looped
  Hardware is NCS4200-1T8S-10CS

  Applique type is T3
  Receiver has no alarms.
  MDL transmission is disabled

```

## Associated Commands

The following table shows the Associated Commands for SONET configuration:

Commands	Links
<b>ais-shut</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp7654966010">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp7654966010</a>
<b>alarm-report</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp2800999060">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp2800999060</a>
<b>aps adm</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp8015117230">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp8015117230</a>
<b>aps group</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp1674734739">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp1674734739</a>
<b>aps protect</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp2073867702">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp2073867702</a>
<b>aps revert</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp4063780600">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp4063780600</a>
<b>aps unidirectional</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp5340799170">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp5340799170</a>
<b>aps working</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp8949584630">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp8949584630</a>
<b>cem-group</b> <i>cem-group-number</i> <b>cep</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600</a>
<b>controller mediatype</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1201337639">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1201337639</a>



Commands	Links
<b>controller protection-group</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-03.html">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-03.html</a>
<b>controller sonet</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp2020468554">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp2020468554</a>
<b>clock source</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp3604380959">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp3604380959</a>
<b>loopback</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp2735045490">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp2735045490</a>
<b>mode sonet</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp2327088950">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp2327088950</a>
<b>mode sts-nc</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp1791424945">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp1791424945</a>
<b>mode vt-15</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp1137973905">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp1137973905</a>
<b>overhead c2</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp1973678817">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp1973678817</a>
<b>overhead j0</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp4338698890">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp4338698890</a>
<b>overhead j1</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp1987243836">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp1987243836</a>
<b>overhead s1s0</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp2779929239">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp2779929239</a>
<b>protection-group</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-10.html">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-10.html</a>
<b>protection-group [working   protect]</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-10.html">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-10.html</a>
<b>rate [OC3   OC12   OC48   OC192]</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp4442889730">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp4442889730</a>
<b>shutdown</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s6.html#wp3364503641">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s6.html#wp3364503641</a>

Commands	Links
<b>show controllers sonet</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp1341372847">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp1341372847</a>
<b>show hw-module subslot transceiver</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s4.html#wp6553420000">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s4.html#wp6553420000</a>
<b>show protection-group</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-14.html">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-14.html</a>
<b>sts-1</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s6.html#wp2423232697">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s6.html#wp2423232697</a>
<b>t1 t1-line-number framing</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2623191253">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2623191253</a>
<b>t1 t1-line-number clock source</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp3480850667">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp3480850667</a>
<b>threshold</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2311589330">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2311589330</a>
<b>type sts48c</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-15.html">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-15.html</a>
<b>vtg vtg-line-number t1 t1-line-number loopback</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp3494199143">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp3494199143</a>



## CHAPTER 9

# Configuring SDH

SDH is a standard that defines optical signals as well as a synchronous frame structure for multiplexed digital traffic. It is used in Europe by the International Telecommunication Union Telecommunication Standardization Sector (ITU-T). The SDH equipment is used everywhere except North America. The IM supports the entire SDH hierarchy (except VC-2/C-2).

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- [Services Provided by SDH Configuration, on page 120](#)
- [SDH Multiplexing, on page 123](#)
- [Configuring AU-4 — TUG-3 — TUG-2 — VC-12 for Framed SAToP, on page 134](#)
- [Configuring AU-3 — TUG-2 — VC-11 — T1 for Framed SAToP, on page 134](#)
- [Verifying SDH Configuration for Framed SAToP, on page 134](#)
- [Restrictions for SDH, on page 135](#)
- [Configuring Mediatype Controller, on page 136](#)
- [Configuring Rate on SDH Ports, on page 136](#)
- [SDH Line and Section Configuration Parameters, on page 137](#)
- [Configuring BERT in SDH for SAToP, on page 155](#)
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- [SDH VC Configuration Parameters for SAToP, on page 160](#)
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- [Loopback Remote on T1 and T3 Interfaces, on page 164](#)

## Overview of SDH

SDH was defined by European Telecommunications Standards Institute (ETSI) and is now being controlled by the ITU-T standards body. SDH standard is prevalently used everywhere outside North America and Japan.

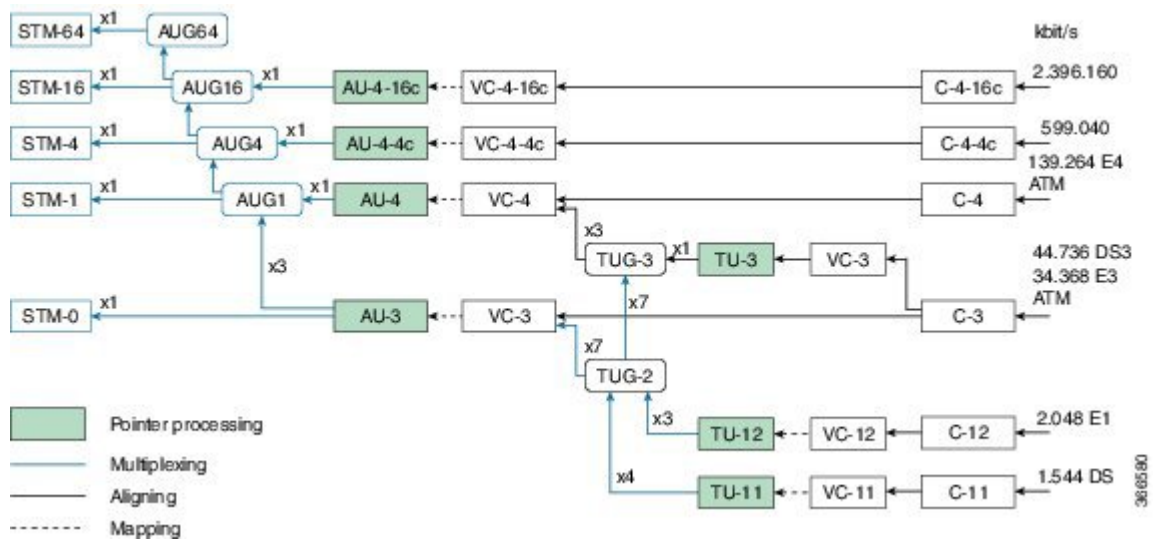
The following are true for SDH:

- Network Node Interface (NNI) defined by CCITT/ITU-TS for worldwide use and partly compatible with SONET
- One of the two options for the User-Network Interface (UNI) (the customer connection) and formally the U reference point interface for support of BISDN

## Basic SDH Signal

The basic format of an SDH signal allows it to carry many different services in its VC because SDH signal is bandwidth-flexible. This capability allows the transmission of high-speed packet-switched services, ATM, contribution video, and distribution video. However, SDH still permits transport and networking at the 2 Mbit/s, 34 Mbit/s, and 140 Mbit/s levels, accommodating the existing digital hierarchy signals. In addition, SDH supports the transport of signals based on the 1.5 Mbit/s hierarchy.

## SDH Hierarchy



## SDH Frame Structure

The STM-1 frame is the basic transmission format for SDH. The frame lasts for 125 microseconds, therefore, there are 8000 frames per second. The STM-1 frame consists of overhead plus a Virtual Container (VC) capacity.

The SDH frame consists of 270 columns. The first nine columns of each frame make up the Section Overhead, and the last 261 columns make up the VC capacity. The VC plus the pointers (H1, H2, H3 bytes) are called the Administrative Unit (AU). Carried within the VC capacity, which has its own frame structure of nine rows and 261 columns, is the Path Overhead and the Container. The first column is for Path Overhead; it is followed by the payload container, which can itself carry other containers. VCs can have any phase alignment within the Administrative Unit, and this alignment is indicated by the Pointer in row four. Within the Section Overhead, the first three rows are used for the Regenerator Section Overhead, and the last five rows are used for the Multiplex Section Overhead. The STM frame is transmitted in a byte-serial fashion, row-by-row, and is scrambled immediately prior to transmission to ensure adequate clock timing content for downstream regenerators.

Figure 7: STM1 Frame Structure

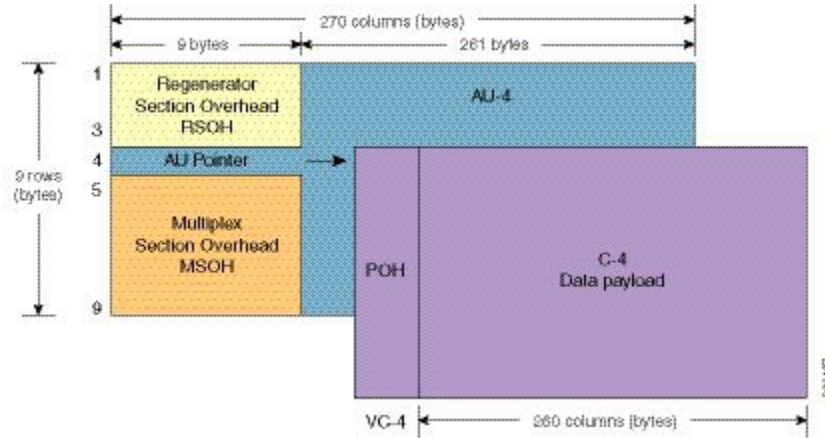
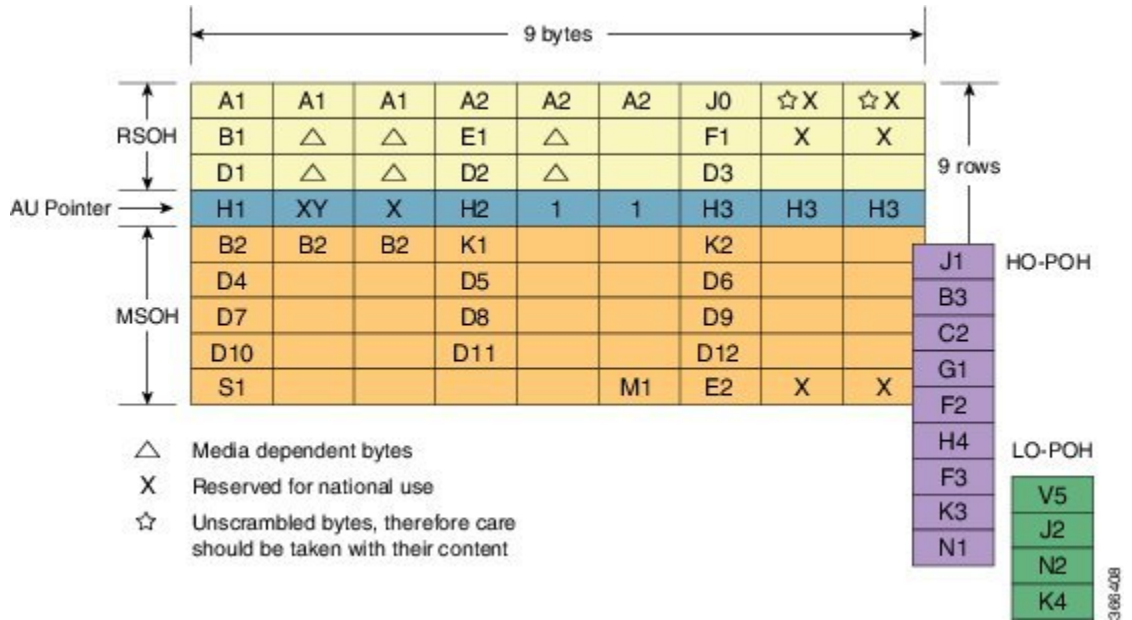


Figure 8: STM1 Section Overhead



## VC

SDH supports a concept called VC. Through the use of pointers and offset values, VCs can be carried in the SDH payload as independent data packages. VCs are used to transport lower-speed tributary signals. Note that it can start (indicated by the J1 path overhead byte) at any point within the STM-1 frame. The start location of the J1 byte is indicated by the pointer byte values. VCs can also be concatenated to provide more capacity in a flexible fashion.

## CEM Overview

Circuit Emulation (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.

## Modes of CEM

- **Structure Agnostic TDM over Packet (SAToP)** (RFC 4553) – SAToP mode is used to encapsulate T1/E1 or T3/E3 unstructured (unchannelized) services over packet switched networks. In SAToP mode, the bytes are sent out as they arrive on the TDM line. Bytes do not have to be aligned with any framing.

In this mode, the interface is considered as a continuous framed bit stream. The packetization of the stream is done according to IETF RFC 4553. All signaling is carried transparently as a part of a bit stream.

- **Circuit Emulation Service over Packet (CEP)** (RFC 4842) - CEP mode is used to encapsulate SDH payload envelopes (SPEs) like VC11, VC12, VC4, or VC4-Nc over PSN. In this mode, the bytes from the corresponding SPE are sent out as they arrive on the TDM line. The interface is considered as a continuous framed bit stream. The packetization of the stream is done according to IETF RFC 4842.

**Table 10: SDH CEM Channelization Modes**

SDH Modes	CEM	Ports
VC4-16c	CEP	STM16
VC4-4c	CEP	STM4, STM16
VC4	CEP	STM1, STM4, STM16
TUG-3-E3	SAToP	STM1, STM4, STM16
TUG-3-T3	SAToP	STM1, STM4, STM16
TUG-2-VC11	CEP	STM1, STM4, STM16
TUG-2-VC12	CEP	STM1, STM4, STM16
TUG-2-T1	SAToP	STM1, STM4, STM16
TUG-2-E1	SAToP	STM1, STM4, STM16

## Services Provided by SDH Configuration

The following services are provided by SDH Configuration:

SDH Circuits	Configuration Details
Configuring VC4 CEP circuit	<ul style="list-style-type: none"> <li>• <i>Configuring Mediatype Controller</i></li> <li>• <i>Configuring Rate on SDH Ports</i></li> <li>• <i>Configuring AU-3 or AU-4 Mapping</i></li> <li>• <i>Configuring Modes under AU-4 Mapping</i></li> <li>• <i>Configuring Mode VC4 CEP</i></li> </ul>

SDH Circuits	Configuration Details
Configuring VC4-4c circuit or Configuring VC4-16c circuit	<ul style="list-style-type: none"> <li>• <i>Configuring Mediatype Controller</i></li> <li>• <i>Configuring Rate on SDH Ports</i></li> <li>• <i>Configuring AU-3 or AU-4 Mapping</i></li> <li>• <i>Configuring Modes under AU-4 Mapping</i></li> <li>• <i>Configuring Mode VC-4 Nc</i></li> </ul>
Configuring VC4—TUG3—E3 circuit	<ul style="list-style-type: none"> <li>• <i>Configuring Mediatype Controller</i></li> <li>• <i>Configuring Rate on SDH Ports</i></li> <li>• <i>Configuring AU-3 or AU-4 Mapping</i></li> <li>• <i>Configuring Mode TUG-3</i></li> </ul>
Configuring VC4—TUG3—T3 circuit	<ul style="list-style-type: none"> <li>• <i>Configuring Mediatype Controller</i></li> <li>• <i>Configuring Rate on SDH Ports</i></li> <li>• <i>Configuring AU-3 or AU-4 Mapping</i></li> <li>• <i>Configuring Mode TUG-3</i></li> <li>• <i>Configuring AU-4—TUG-3—VC-3—DS3</i></li> </ul>
Configuring VC4—TUG-3—TUG-2—VC-12 circuit	<ul style="list-style-type: none"> <li>• <i>Configuring Mediatype Controller</i></li> <li>• <i>Configuring Rate on SDH Ports</i></li> <li>• <i>Configuring AU-3 or AU-4 Mapping</i></li> <li>• <i>Configuring Mode TUG-3</i></li> <li>• <i>Configuring VC4—TUG-3—TUG-2—VC-12—VC</i></li> </ul>
Configuring VC4 — TUG-3 — TUG-2 — VC-12 — E1 circuit	<ul style="list-style-type: none"> <li>• <i>Configuring Mediatype Controller</i></li> <li>• <i>Configuring Rate on SDH Ports</i></li> <li>• <i>Configuring AU-3 or AU-4 Mapping</i></li> <li>• <i>Configuring Mode TUG-3</i></li> <li>• <i>Configuring AU-4—TUG-3—TUG-2—VC-12</i></li> </ul>

SDH Circuits	Configuration Details
Configuring VC4—TUG-3—TUG-2—VC-11 circuit	<ul style="list-style-type: none"> <li>• <i>Configuring Mediatype Controller</i></li> <li>• <i>Configuring Rate on SDH Ports</i></li> <li>• <i>Configuring AU-3 or AU-4 Mapping</i></li> <li>• <i>Configuring Mode TUG-3</i></li> <li>• <i>Configuring AU-4—VC4—TUG-3—TUG-2—VC-11—T1</i></li> </ul>
Configuring AU-3—VC-3—E3 circuit	<ul style="list-style-type: none"> <li>• <i>Configuring Mediatype Controller</i></li> <li>• <i>Configuring Rate on SDH Ports</i></li> <li>• <i>Configuring AU-3 or AU-4 Mapping</i></li> <li>• <i>Configuring AU-3—VC-3—E3</i></li> </ul>
Configuring AU-3—VC-3—DS3 circuit	<ul style="list-style-type: none"> <li>• <i>Configuring Mediatype Controller</i></li> <li>• <i>Configuring Rate on SDH Ports</i></li> <li>• <i>Configuring AU-3 or AU-4 Mapping</i></li> <li>• <i>Configuring AU-3—VC-3—DS3 circuit</i></li> </ul>
Configuring (AU-3) VC-3—TUG-2—VC-12—T1 circuit	<ul style="list-style-type: none"> <li>• <i>Configuring Mediatype Controller</i></li> <li>• <i>Configuring Rate on SDH Ports</i></li> <li>• <i>Configuring AU-3 or AU-4 Mapping</i></li> <li>• <i>Configuring Mode VC-1x</i></li> <li>• <i>Configuring AU-3—TUG-2—VC-11—T1</i></li> </ul>
Configuring (AU-3) VC-3—TUG-2—VC-12 circuit	<ul style="list-style-type: none"> <li>• <i>Configuring Mediatype Controller</i></li> <li>• <i>Configuring Rate on SDH Ports</i></li> <li>• <i>Configuring AU-3 or AU-4 Mapping</i></li> <li>• <i>Configuring Mode VC-1x</i></li> <li>• <i>Configuring AU-3—TUG-2—VC-12—E1</i></li> </ul>
Configuring (AU-3) VC-3—TUG-2—VC11 circuit	<ul style="list-style-type: none"> <li>• <i>Configuring Mediatype Controller</i></li> <li>• <i>Configuring Rate on SDH Ports</i></li> <li>• <i>Configuring AU-3 or AU-4 Mapping</i></li> <li>• <i>Configuring Mode VC-1x</i></li> <li>• <i>Configuring AU-3—TUG-2—VC-11—T1</i></li> </ul>



SDH Circuits	Configuration Details
Configuring (AU-3) VC-3—TUG-2—VC11—E1 circuit	<ul style="list-style-type: none"> <li>• <i>Configuring Mediatype Controller</i></li> <li>• <i>Configuring Rate on SDH Ports</i></li> <li>• <i>Configuring AU-3 or AU-4 Mapping</i></li> <li>• <i>Configuring Mode VC-1x</i></li> <li>• <i>Configuring AU-3—TUG-2—VC-12—E1</i></li> </ul>

## SDH Multiplexing

The terms and definitions of SDH multiplexing principles are:

- **Mapping** – A process used when tributaries are adapted into VCs by adding justification bits and Path Overhead (POH) information.
- **Aligning** – This process takes place when a pointer is included in a Tributary Unit (TU) or an Administrative Unit (AU), to allow the first byte of the VC to be located.
- **Multiplexing** – This process is used when multiple lower-order path layer signals are adapted into a higher-order path signal, or when the higher-order path signals are adapted into a Multiplex Section.
- **Stuffing** – As the tributary signals are multiplexed and aligned, some spare capacity is designed into the SDH frame to provide enough space for all the various tributary rates. Therefore, at certain points in the multiplexing hierarchy, this space capacity is filled with “fixed stuffing” bits that carry no information, but are required to fill up the particular frame.

## Modes of SDH

A Synchronous Transport Module (STM) signal is the Synchronous Digital Hierarchy (SDH) equivalent of the SONET STS. In this document, STM term refers to both path widths and optical line rates. The paths within an STM signals are called administrative units (AUs).

An AU is the information structure that provides adaptation between the higher-order path layer and the multiplex section layer. It consists of an information payload (the higher-order VC) and an AU pointer, which indicates the offset of the payload frame start relative to the multiplex section frame start.

The AU-3 pointer is composed of 3 bytes; the AU-4 pointer is composed of 9 bytes.

The payload of the STM-1 frame consists of one AU-4 unit or three AU-3 units.

### Augment Mapping

An administrative unit group (AUG) consists of one or more administrative units occupying fixed, defined positions in an STM payload. Augment mapping is supported at STM1 level. The following types of augment mapping are supported:

- Augment Mapping AU-4




---

**Note** This is the default augment mapping mode.

---

- Augment Mapping AU-3
- Mixed (AU-3 and AU-4) Augment Mapping

The supported modes of SDH are:

- AU-4-16c (VC4-16c)
- AU-4-4c (VC4-4c)
- AU-4 (VC4)
- AU-4 — TUG-3 — VC-3 — DS3
- AU-4 — TUG-3 — VC-3 — E3
- AU-4 — TUG-3 — TUG-2 — VC-11 — T1
- AU-4 — TUG-3 — TUG-2 — VC-12 — E1
- AU-4 — TUG-3 — TUG-2 — VC-11
- AU-4 — TUG-3 — TUG-2 — VC-12
- AU-3 — VC-3 — DS3
- AU-3 — TUG-2 — VC-11 — T1
- AU-3 — TUG-2 — VC-12 — E1
- AU-3 — TUG-2 — VC-11
- AU-3 — TUG-2 — VC-12
- AU-3 — VC-3 — E3

## Configuring AUG Mapping

This section describes the configuration of Administration Units Group (AUG) mapping.

### Configuring AU-3 or AU-4 Mapping

To configure AU-3 or AU-4 mapping:

```
configure terminal
aug mapping [au-3 | au-4]
end
```




---

**Note** The **aug mapping** command is available only when SDH framing is configured.

---




---

**Note** The AUG mapping mode is AU-4 by default. AUG mapping is supported at STM-1 level.

---

## Configuring Mixed AU-3 and AU-4 Mapping

To configure mixed AU-3 and AU-4 mapping:

```
configure terminal
aug mapping [au-3 | au-4] stm [1-1] stm1 number [1-4]
end
```




---

**Note** Use the following command to change the AUG mapping of a particular STM-1 to AU-3:

```
aug mapping au-3 stm [1-16] path number 1-16
```

After configuring this command for STM-4 the AUG mapping of path 2, 3, and 4 is AU-4 and for path 1 it is AU-3.

---

## Verifying AUG Mapping Configuration

Use **show running-configuration** command to verify the AUG mapping configuration.

```
show running-config | sec 0/3/4
PDT: %SYS-5-CONFIG_I: Configured from console by console
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead s1s0 0
aug mapping au-4 stm 1
aug mapping au-3 stm 2
aug mapping au-4 stm 3
aug mapping au-4 stm 4
au-4 1
!
au-3 4
!
au-3 5
!
au-3 6
!au-4 3
!au-4 4
!
```

## Configuring Modes under AU-4 Mapping

This section describes the configuration of modes under AU-4 mapping.

## Configuring Mode VC-4 CEP

To configure mode VC-4 CEP:

```
enable
configure terminal
controller sdh 0/0/16
rate stm 4
aug mapping au-4
au-4 1
mode vc4
cem-group 100 cep
end
```




---

**Note** Overhead C2 should match with the peer end else it will result in PPLM alarm.

---

## Verifying Mode VC-4 Configuration

Use the **show running-configuration** command to verify the mode VC-4 configuration.

```
#show running-config | sec 0/3/4
PDT: %SYS-5-CONFIG_I: Configured from console by console
platform enable
controller MediaType 0/0/16 oc12
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode vc4
clock source internal
au-4 2
!
au-4 3
!
au-4 4
```

## Configuring Mode TUG-3

To configure mode TUG-3:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
end
```




---

**Note** Mode TUG-3 creates three TUG-3 paths. TUG-3 range is 1 to 3.

---

**Configuring AU-4 — TUG-3 — VC-3 — DS3**

To configure AU-4 — TUG-3 — VC-3 — DS3:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode t3
cem-group 100 unframed
end
```

**Verifying DS3 Configuration**

Use **show running-configuration** command to verify DS3 configuration:

```
#show running-configuration | sec 0/3/4
platform enable controller MediaType 0/0/16 oc12
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode tug-3
clock source internal
tug-3 1mode T3
t3 clock source internal
t3 framing c-bit
!
tug-3 2
!
tug-3 3
!
au-4 2
!
au-4 3
!
au-4 4
```

**Configuring AU-4 — TUG-3 — VC-3 — E3**

To configure AU-4 — TUG-3 — VC-3 — E3:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode e3
cem-group 100 unframed
end
```

## Verifying E3 Configuration

Use **show running-configuration** command to verify E3 configuration.

```
#show running-configuration | sec 0/0/16
platform enable
controller MediaType 0/0/16 oc12
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode tug-3
clock source internal
tug-3 1
mode E3
e3 clock source internal
e3 framing g751
!
tug-3 2
!
tug-3 3
!
au-4 2
```

## Configuring Mode VC-1x

To configure mode VC-1x:

```
enable
configure terminal
controller sdh 0/0/16
rate stm1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode VC1x
tug-2 1 payload VC11
tug-2 2 payload VC11
tug-2 3 payload VC11
tug-2 4 payload VC11
tug-2 5 payload VC11
tug-2 6 payload VC11
tug-2 7 payload VC11
end
```



**Note** When you configure mode VC-1x, seven TUG-2 payloads are created. TUG-2 payloads can be of two types, VC-11 and VC-12. Default for TUG-2 payload mode is VC-11.

TUG-2 payload VC-11 can be configured as VC or T1 and the range is 1 to 4.

TUG-2 payload VC-12 can be configured as VC or E1 and the range is 1 to 3.

### Configuring AU-4 — TUG-3 — TUG-2 — VC-11 — T1

To configure AU-4 — TUG-3 — TUG-2 — VC-11 — T1:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode vclx
tug-2 1 payload vc11
t1 1 cem-group 10 unframed
vc 1 overhead v5 2
interface cem 0/0/16
cem 100
xconnect 2.2.2.2 10 encapsulation mpls
end
```



**Note** Overhead v5 has to be matched with the peer end.

### Configuring AU-4 — TUG-3 — TUG-2 — VC-12

Use the following commands to configure AU-4 — TUG-3 — TUG-2 — VC-12:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode vclx
tug-2 3 payload vc12
e1 1 cem-group 10 unframed
vc 1 overhead v5 2
end
```



**Note** Overhead v5 should match with the peer end.

### Configuring AU-4 — TUG-3 — TUG-2 — VC-11 — VC

To configure AU-4 — TUG-3 — TUG-2 — VC-11 — VC:

```

enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode vc1x
tug-2 2 payload vc11
vc 1 cem-group 2 cep
end

```

### Configuring AU-4 — TUG-3 — TUG-2 — VC-12 — VC

To configure AU-4 — TUG-3 — TUG-2 — VC-12 — VC:

```

enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode vc1x
tug-2 4 payload vc12
vc 1 cem-group 10 cep
end

```

### Verifying Mode VC-1x Configuration

Use **show running-configuration** command to verify mode VC-1x configuration.

```

#show running-configuration
controller MediaType 0/3/4
mode sdh
controller SDH 0/3/4
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead sis0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode VC1x
tug-2 1 payload VC11
t1 1 cem-group 1 unframed
tug-2 2 payload VC11
vc 1 cem-group 2 cep
tug-2 3 payload VC12
e1 1 cem-group 3 unframed
tug-2 4 payload VC12
vc 1 cem-group 4 cep
tug-2 5 payload VC11
tug-2 6 payload VC11
tug-2 7 payload VC11
!
tug-3 2
!
tug-3 3
!

```



```

au-4 2
!
au-4 3
!
au-4 4

```

## Configuring Mode VC-4 Nc

To configure mode VC-4 Nc:

```

enable
configure terminal
controller sdh 0/0/16
au-4 1 - 4 mode vc4-4c
cem-group 100 cep
end

```




---

**Note** Overhead C2 should match with the peer end else it will result in PPLM alarm.

---

## Verifying Mode VC-4 Nc Configuration

Use **show running-configuration** command to verify mode VC-4 Nc configuration.

```

#show running-configuration
platform enable
controller MediaType 0/0/16 oc12
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1 - 4 mode vc4-4c
clock source internal
cem-group 10 cep
interface CEM 0/0/16
no ip address
cem 10

```

## Configuring AU-3 — VC-3 — DS3

To configure AU-3 — VC-3 — DS3:

```

enable
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
au-3 1
mode t3
cem-group 100 unframed
end

```

## Configuring AU-3 — VC-3 — E3

To configure AU-3 — VC-3 — E3:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-3 1
mode e3
cem-group 100 unframed
end
```

## Configuring Modes under AU-3 Mapping

This section describes the configuration of modes under AU-3 mapping.

### Configuring Mode VC-1x

To configure mode VC-1x:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-3 1
mode VC1x
tug-2 1 payload VC11
tug-2 2 payload VC11
tug-2 3 payload VC11
tug-2 4 payload VC11
tug-2 5 payload VC11
tug-2 6 payload VC11
tug-2 7 payload VC11
end
end
```

### Configuring AU-3 — TUG-2 — VC-11 — VC

To configure AU-3 — TUG-2 — VC-11 — VC:

```
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
au-3 1
mode vclx
tug-2 1 payload vc11
vc 1 cem-group 10 cep
end
```

### Configuring AU-3 — TUG-2 — VC-12 — VC

To configure AU-3 — TUG-2 — VC-12 — VC:

```
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
```

```

au-3 1
mode vclx
tug-2 1 payload vc12
vc 1 cem-group 10 cep
end

```

### Configuring AU-3 — TUG-2 — VC-11 — T1

To configure AU-3 — TUG-2 — VC-11 — T1:

```

configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
au-3 1
mode vclx
tug-2 1 payload vc11
t1 1 cem-group 10 unframed
vc 1 overhead v5 2
interface cem 0/0/16
cem 100
xconnect 2.2.2.2 10 encapsulation mpls
end

```

### Configuring AU-3 — TUG-2 — VC-12 — E1

To configure AU-3 — TUG-2 — VC-12 — E1:

```

configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
au-3 1
mode vclx
tug-2 3 payload vc12
e1 1 cem-group 10 unframed
vc 1 overhead v5 2
end

```

### Verifying Mode VC-1x Configuration

Use **show running-configuration** command to verify mode VC-1x configuration.

```

#show running-configuration
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM4
no ais-shut
alarm-report all
threshold sf-ber 3
clock source internal
overhead s1s0 0
aug mapping au-3
au-3 1
clock source internal
mode VClx
tug-2 1 payload VC11
t1 1 cem-group 1 unframed
tug-2 2 payload VC11
vc 1 cem-group 2 cep

```

```
tug-2 3 payload VC12
tug-2 4 payload VC12
vc 1 cem-group 4 cep
tug-2 5 payload VC11
tug-2 6 payload VC11
tug-2 7 payload VC11
```

## Configuring AU-4 — TUG-3 — TUG-2 — VC-12 for Framed SAToP

Use the following commands to configure AU-4 — TUG-3 — TUG-2 — VC-12 for framed SAToP under mode VC-1x (AU-4 mapping):

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug-3
tug-3 1
mode vclx
tug-2 3 payload vc12
e1 1 cem-group 1 framed
vc 1 overhead v5 2
end
```

## Configuring AU-3 — TUG-2 — VC-11 — T1 for Framed SAToP

To configure AU-3 — TUG-2 — VC-11 — T1 for framed SAToP under mode VC-1x (AU-3 mapping):

```
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
au-3 1
mode vclx
tug-2 1 payload vc11
t1 1 cem-group 0 framed
vc 1 overhead v5 2
interface cem 0/0/16
cem 100
xconnect 2.2.2.2 10 encapsulation mpls
end
```

## Verifying SDH Configuration for Framed SAToP

Use **show running configuration** command to verify SDH configuration for Framed SAToP:

```
Router#show running configuration | sec 0/0/16
platform enable controller mediatype 0/0/16 oc3
controller mediatype 0/0/16
mode sdh
controller sdh 0/0/16
rate stm1
no ais-shut
alarm-report all
```

```

clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode vclx
tug-2 1 payload vc11
tug-2 2 payload vc12
e1 1 cem-group 1 framed
tug-2 3 payload vc11
tug-2 4 payload vc11
tug-2 5 payload vc11
tug-2 6 payload vc11
tug-2 7 payload vc11
!
interface cem 0/0/16
no ip address
cem 0
!
cem 1
!
cem 2
!
cem 3
!
Router#

```

## Restrictions for SDH

- The maximum supported bandwidth is STM-16.
- Any Port (16-19) is configurable for STM-1, STM-4 or STM-16.
- The IM has 4 X STM-4 ports. You can configure STM-1 or STM-4 on all four ports. If you configure rate STM-16 on any of the four ports, others ports will not be available.
- This IM does not support CEP on AU-4 — VC-4 — TUG-3 — VC-3.
- This IM does not support CT3, CE3, CT3-E1 under the VC3 container. Only clear channel T3 services are supported.
- This IM does not support the framed SAToP CESoPSN.
- Eight BERT engines are supported for Higher Order and 16 BERT engines are supported for Lower Order hierarchy.
- If a port is configured as SDH, all ports can only be configured as SDH unless the mode SDH is removed from all the ports on the IM.
- VC-4-64c and VC-2 are not supported.
- AU-4 CT3, AU-4 CE3, AU-4 CT3-E1, AU-3-CT3, AU-3-CE3, and AU-3 CT3-E1 are not supported.  
AU-4 — VC-4 — TUG-3 — VC-3 — DS3 — T1/E1, AU-4 — VC-4 — TUG-3 — VC-3 — E3 — E1, AU-3 — VC-3 — DS3 — T1/E1, and AU-3 — VC-3 — E3 — E1 are not supported.
- Concatenation VC-4-Nc is only supported for augment mapping AU-4.

- MDL is not supported.
- SNCP is not supported.

### Restrictions on Bandwidth

- Total available bandwidth is 2.5G.

The following configuration is blocked and an error message is displayed after the maximum bandwidth is utilized:

```
rate stm1 | rate stm4 | rate stm16
```

**Table 11: Bandwidth Used by Different Rates**

Rate	Bandwidth (kbit/s)
STM-1	150,336
STM-4	601,344
STM-16	2,405,376

### Restrictions for Scale PW Circuits

- Only 1000 CEM PW Circuits per OCN Interface modules are supported.

## Configuring Mediatype Controller

Each SFP port (16-19) can be configured as STM-1, STM-4, STM-16.

You must select the MediaType controller to configure and enter the controller configuration mode.

You must configure the controller as a SDH port.

To configure MediaType Controller:

```
enable
configure terminal
controller MediaType 0/0/16
mode sdh
end
```

## Configuring Rate on SDH Ports

To configure rate on SDH ports:

```
enable
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate [stm1 | stm4 | stm16]
end
```



**Note** The configuration of **no** form of the command is not supported. To restore to the default condition, use **no mode sdh** command under Mediatype controller after removing all configuration under that port. .

## SDH Line and Section Configuration Parameters

The following parameters affect SDH configuration at the line and section levels.

### Overhead

Sets the SDH overhead bytes in the frame header to a specific standards requirement, or to ensure interoperability with equipment from another vendors.

- **J0** — Sets the J0 or C1 byte value in the SDH section overhead.



**Note** The supported values of J0 are 1 byte, 16 bytes, and 64 bytes.

- **S1S0** — Sets the SS bits value of the H1 byte in the SDH line overhead.

### Configuring Line and Section Overhead

To configure line and section overhead:

```
enable
configure terminal
controller sdh 0/0/16
overhead s1s0 2
overhead j0 expected length 16-byte
overhead j0 expected tracebuffer rx Message
overhead j0 tx length 1-byte
overhead j0 tx tracebuffer tx Message
end
```



**Note** To restore the system to its default condition, use the **no** form of the **overhead j0** command.

### Threshold

Set the path BER threshold values.

- **b1-tca** — Enables Bit Error Rate (BER) threshold crossing alerts for B1.
- **b2-tca** — Enables BER threshold crossing alerts for B2.
- **sd-ber** — Enables the threshold of the Signal Degrade (SD) BER that is used to trigger a signal degrade alarm.

- **sf-ber** — Configures the threshold of the Signal Failure (SF) BER that is used to trigger a link state change.

## Configuring Line and Section Threshold

To configure line and section threshold:

```
enable
configure terminal
mode sdh
controller sdh 0/0/16
threshold b1-tca 5
threshold b2-tca 5
threshold sd-ber 5
threshold sf-ber 5
end
```




---

**Note** To restore the system to its default condition, use the **no** form of the threshold command.

---

## Loopback

Sets a loopback to test the SDH port.

- **local** — Loops the signal from Tx to Rx path. Sends alarm indication signal (AIS) to network.
- **network** — Loops the signal from Rx to Tx path.

## Configuring Line Loopback

To configure loopback:

```
enable
configure terminal
controller sdh 0/0/16
loopback [local | network]
end
```




---

**Note** To restore the system to its default condition, use the **no** form of the loopback command.

---




---

**Note** When loopback is configured as network, it is recommended to use the configuration of clock source as line.

---

## AIS-Shut

Enables automatic insertion of a Line Alarm Indication Signal (LAIS) in the sent SDH signal whenever the SDH port enters the administrative shutdown state.



## Configuring AIS Shut

To configure AIS-Shut:

```
enable
configure terminal
controller sdh 0/0/16
ais-shut
end
```



---

**Note** The **no ais-shut** command does not send AIS.

---

## Shutdown

Disables the interface.

## Configuring Shut

To configure Shut:

```
enable
configure terminal
controller sdh 0/0/16
shutdown
end
```



---

**Note** Use the **no shutdown** command to disable the interface.

---

## Alarm Reporting

Enables reporting for all or selected alarms.

- **b1-tca** — Enables BER threshold crossing alarm for B1.
- **b2-tca** — Enables BER threshold crossing alarm for B2.
- **b3-tca** — Enables BER threshold crossing alarm for B3.
- **lais** — Enables line alarm indication signal.
- **lom** — Enables loss of multiframe signal.
- **lrdi** — Enables line remote defect indication signal.
- **pais** — Enables path alarm indication signal.
- **plop** — Enables loss of pointer failure signal for a path.
- **pplm** — Enables path payload mismatch indication.
- **prdi** — Enables path remote defect indication signal.
- **puneq** — Enables path unequipped (path label equivalent to zero) signal.

- **sd-ber** — Enables LBIP BER in excess of SD threshold.
- **sf-ber** — Enables LBIP BER in excess of SF threshold.
- **slof** — Enables section loss of frame signal.
- **slos** — Enables section loss of signal.

## Configuring Alarm Reporting

To configure alarm reporting:

```
enable
configure terminal
controller sdh 0/0/16
alarm-report [b1-tca | b2-tca | b3-tca | lais | lom | lrdi | pais | plop | pplm | prdi |
puneq | sd-ber | sf-ber | lof | los]
end
```




---

**Note** To restore the system to its default condition, use the **no** form of the alarm report command.

---

## Clock Source

Specifies the clock source, where

- **line** —The link uses the recovered clock from the line.
- **internal** — The link uses the internal clock source. This is the default setting.

## Configuring Clock

To configure clock, use the following commands:

```
enable
configure terminal
controller sdh 0/0/16
clock source [line | internal]
end
```




---

**Note** The default mode is internal.

---




---

**Note** To restore the system to its default condition, use the **no** form of the command.

---

### Configuring Network-Clock SDH

To configure network-clock SDH, use the following commands:

```
enable
configure terminal
controller sdh 0/0/16
```

```

clock source line
end
enable
configure terminal
network-clock input-source 1 controller sdh 0/0/16
end

```

## Verifying SDH Line and Section Parameters Configuration

Use **show controllers** command to verify SDH Line and Section Parameters Configuration:

```

Rotuer#show controller sdh 0/7/7
SDH 0/7/7 is up.
Hardware is A900-IMA3G-IMSG
Port configured rate: STM16
Applique type is Channelized SDH
Clock Source is Internal, AUG mapping is AU4.
Medium info:
  Type: SDH, Line Coding: NRZ,
  Alarm Throttling: OFF
  Regenerator Section:
    LOS = 0          LOF = 0          BIP(B1) = 0

SDH Section Tables
  INTERVAL      CV      ES      SES      SEFS
  21:24-21:24   0       0       0       0

Multiplex Section:
  AIS = 0          RDI = 0          REI = 0          BIP(B2) = 0
Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: SLOS SLOF LAIS SF SD LRDI B1-TCA B2-TCA
BER thresholds: SF = 10e-3 SD = 10e-6
TCA thresholds: B1 = 10e-6 B2 = 10e-6
Rx: S1S0 = 00
   K1 = 00,   K2 = 00
   J0 = 00

   RX S1 = 00

Tx: S1S0 = 00
   K1 = 00,   K2 = 00
   J0 = 04

Tx J0 Length : 16
Tx J0 Trace :

  50 45 31 20 20 20 20 20 20 20 20 20 20 20 20 00    PE1      .

Expected J0 Length : 16
Expected J0 Trace :

  50 45 31 20 20 20 20 20 20 20 20 20 20 20 20 00    PE1      .

Rx J0 Length : 0
Rx J0 Trace :

SDH Line Tables
  INTERVAL      CV      ES      SES      UAS      CVFE      ESFE      SESFE      UASFE
  21:24-21:24   0       0       0       0       0       0       0       0

```

High Order Path:

PATH 1:

Clock Source is internal

```

AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
LOM = 0          PLM = 0          UNEQ = 0

```

Active Defects: None

Detected Alarms: PPLM

Asserted/Active Alarms: PPLM

Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6

Rx: C2 = FE

Tx: C2 = 01

Tx J1 Length : 16

Tx J1 Trace

```

50 45 31 20 30 2F 37 2F 37 2E 31 00 00 00 00 00    PE1 0/7/7.1.....

```

Expected J1 Length : 16

Expected J1 Trace

```

50 45 31 20 30 2F 37 2F 37 2E 31 00 00 00 00 00    PE1 0/7/7.1.....

```

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 16

Rx J1 Trace

CRC-7: 0xBA OK

```

4F 4E 54 20 48 4F 2D 54 52 41 43 45 20 20 20 00    ONT HO-TRACE .

```

SDH Path Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASFE
21:24-21:24	0	0	0	0	0	0	0	0

PATH 4:

Clock Source is internal

```

AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
LOM = 0          PLM = 0          UNEQ = 0

```

Active Defects: None

Detected Alarms: PPLM LOM

Asserted/Active Alarms: PPLM LOM

Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6

Rx: C2 = FE

Tx: C2 = 02

Tx J1 Length : 16

Tx J1 Trace

```

50 45 31 20 30 2F 37 2F 37 2E 32 00 00 00 00 00    PE1 0/7/7.2.....

```

Expected J1 Length : 16

Expected J1 Trace

```

50 45 31 20 30 2F 37 2F 37 2E 32 00 00 00 00 00      PE1 0/7/7.2.....
PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 16
Rx J1 Trace
CRC-7: 0xBA OK

4F 4E 54 20 48 4F 2D 54 52 41 43 45 20 20 20 00      ONT HO-TRACE .

SDH Path Tables
INTERVAL      CV      ES      SES      UAS      CVFE      ESFE      SESFE      UASFE
21:23-21:24   0       0       0       382      0        0        0        0

PATH 7:
Clock Source is internal

AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

50 45 31 20 30 2F 37 2F 37 2E 33 00 00 00 00 00      PE1 0/7/7.3.....

Expected J1 Length : 16
Expected J1 Trace

50 45 31 20 30 2F 37 2F 37 2E 33 00 00 00 00 00      PE1 0/7/7.3.....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace

SDH Path Tables
INTERVAL      CV      ES      SES      UAS      CVFE      ESFE      SESFE      UASFE
21:24-21:25   0       0       0       0        0        0        0        0

PATH 10:
Clock Source is internal

AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6

```

```

Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

    50 45 31 20 30 2F 37 2F 37 2E 34 00 00 00 00 00      PE1 0/7/7.4.....

Expected J1 Length : 16
Expected J1 Trace

    50 45 31 20 30 2F 37 2F 37 2E 34 00 00 00 00 00      PE1 0/7/7.4.....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace

SDH Path Tables
  INTERVAL      CV    ES    SES    UAS    CVFE    ESFE    SESFE    UASFE
  21:25-21:25    0     0     0     0     0     0     0     0

PATH 13:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

    50 45 31 20 30 2F 37 2F 37 2E 35 00 00 00 00 00      PE1 0/7/7.5.....

Expected J1 Length : 16
Expected J1 Trace

    50 45 31 20 30 2F 37 2F 37 2E 35 00 00 00 00 00      PE1 0/7/7.5.....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace

SDH Path Tables
  INTERVAL      CV    ES    SES    UAS    CVFE    ESFE    SESFE    UASFE
  21:25-21:25    0     0     0     0     0     0     0     0

PATH 16:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0

```

```

      LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

      50 45 31 20 30 2F 37 2F 37 2E 36 00 00 00 00 00      PE1 0/7/7.6.....

Expected J1 Length : 16
Expected J1 Trace

      50 45 31 20 30 2F 37 2F 37 2E 36 00 00 00 00 00      PE1 0/7/7.6.....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace

SDH Path Tables
  INTERVAL      CV      ES      SES      UAS      CVFE      ESFE      SESFE      UASFE
  21:25-21:25    0        0        0        0        0        0        0        0

PATH 19:
Clock Source is internal

      AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
      LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
      LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

      50 45 31 20 30 2F 37 2F 37 2E 37 00 00 00 00 00      PE1 0/7/7.7.....

Expected J1 Length : 16
Expected J1 Trace

      50 45 31 20 30 2F 37 2F 37 2E 37 00 00 00 00 00      PE1 0/7/7.7.....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace

SDH Path Tables

```

```

INTERVAL      CV    ES    SES    UAS    CVFE    ESFE    SESFE    UASFE
21:25-21:25   0    0    0    0    0    0    0    0

```

PATH 22:  
Clock Source is internal

```

AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
LOM = 0          PLM = 0          UNEQ = 0

```

Active Defects: None  
Detected Alarms: None  
Asserted/Active Alarms: None  
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6  
Rx: C2 = 00  
Tx: C2 = 00

Tx J1 Length : 16  
Tx J1 Trace

```

50 45 31 20 30 2F 37 2F 37 2E 38 00 00 00 00 00    PE1 0/7/7.8.....

```

Expected J1 Length : 16  
Expected J1 Trace

```

50 45 31 20 30 2F 37 2F 37 2E 38 00 00 00 00 00    PE1 0/7/7.8.....

```

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0  
Rx J1 Trace

SDH Path Tables

```

INTERVAL      CV    ES    SES    UAS    CVFE    ESFE    SESFE    UASFE
21:25-21:25   0    0    0    0    0    0    0    0

```

PATH 25:  
Clock Source is internal

```

AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
LOM = 0          PLM = 0          UNEQ = 0

```

Active Defects: None  
Detected Alarms: None  
Asserted/Active Alarms: None  
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6  
Rx: C2 = 00  
Tx: C2 = 00

Tx J1 Length : 16  
Tx J1 Trace

```

50 45 31 20 30 2F 37 2F 37 2E 39 00 00 00 00 00    PE1 0/7/7.9.....

```

Expected J1 Length : 16  
Expected J1 Trace

```

50 45 31 20 30 2F 37 2F 37 2E 39 00 00 00 00 00    PE1 0/7/7.9.....

```



PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0  
Rx J1 Trace

SDH Path Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASFE
21:25-21:25	0	0	0	0	0	0	0	0

PATH 28:

Clock Source is internal

AIS = 0	RDI = 0	REI = 0	BIP(B3) = 0
LOP = 0	PSE = 0	NSE = 0	NEWPTR = 0
LOM = 0	PLM = 0	UNEQ = 0	

Active Defects: None  
Detected Alarms: None  
Asserted/Active Alarms: None  
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6  
Rx: C2 = 00  
Tx: C2 = 00

Tx J1 Length : 16  
Tx J1 Trace

50 45 31 20 30 2F 37 2F 37 2E 31 30 00 00 00 00 PE1 0/7/7.10....

Expected J1 Length : 16  
Expected J1 Trace

50 45 31 20 30 2F 37 2F 37 2E 31 30 00 00 00 00 PE1 0/7/7.10....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0  
Rx J1 Trace

SDH Path Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASFE
21:25-21:25	0	0	0	0	0	0	0	0

PATH 31:

Clock Source is internal

AIS = 0	RDI = 0	REI = 0	BIP(B3) = 0
LOP = 0	PSE = 0	NSE = 0	NEWPTR = 0
LOM = 0	PLM = 0	UNEQ = 0	

Active Defects: None  
Detected Alarms: None  
Asserted/Active Alarms: None  
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6  
Rx: C2 = 00  
Tx: C2 = 00

Tx J1 Length : 16

```

Tx J1 Trace

 50 45 31 20 30 2F 37 2F 37 2E 31 31 00 00 00 00      PE1 0/7/7.11....

Expected J1 Length : 16
Expected J1 Trace

 50 45 31 20 30 2F 37 2F 37 2E 31 31 00 00 00 00      PE1 0/7/7.11....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace

SDH Path Tables
  INTERVAL      CV      ES      SES      UAS      CVFE      ESFE      SESFE      UASFE
  21:25-21:25    0       0       0       0       0       0       0       0

PATH 34:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

 50 45 31 20 30 2F 37 2F 37 2E 31 32 00 00 00 00      PE1 0/7/7.12....

Expected J1 Length : 16
Expected J1 Trace

 50 45 31 20 30 2F 37 2F 37 2E 31 32 00 00 00 00      PE1 0/7/7.12....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace

SDH Path Tables
  INTERVAL      CV      ES      SES      UAS      CVFE      ESFE      SESFE      UASFE
  21:25-21:25    0       0       0       0       0       0       0       0

PATH 37:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None

```

```

Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

    50 45 31 20 30 2F 37 2F 37 2E 31 33 00 00 00 00      PE1 0/7/7.13....

Expected J1 Length : 16
Expected J1 Trace

    50 45 31 20 30 2F 37 2F 37 2E 31 33 00 00 00 00      PE1 0/7/7.13....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace

SDH Path Tables
  INTERVAL      CV      ES      SES      UAS      CVFE      ESFE      SESFE      UASFE
  21:25-21:25    0        0        0        0        0        0        0        0

PATH 40:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

    50 45 31 20 30 2F 37 2F 37 2E 31 34 00 00 00 00      PE1 0/7/7.14....

Expected J1 Length : 16
Expected J1 Trace

    50 45 31 20 30 2F 37 2F 37 2E 31 34 00 00 00 00      PE1 0/7/7.14....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace

SDH Path Tables
  INTERVAL      CV      ES      SES      UAS      CVFE      ESFE      SESFE      UASFE
  21:26-21:26    0        0        0        0        0        0        0        0

PATH 43:

```

```

Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 35 00 00 00 00      PE1 0/7/7.15....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 35 00 00 00 00      PE1 0/7/7.15....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace

SDH Path Tables
  INTERVAL      CV      ES      SES      UAS      CVFE      ESFE      SESFE      UASFE
  21:26-21:26    0      0      0      0      0      0      0      0

PATH 46:
Clock Source is internal

  AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
  LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
  LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 16
Tx J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 36 00 00 00 00      PE1 0/7/7.16....

Expected J1 Length : 16
Expected J1 Trace

  50 45 31 20 30 2F 37 2F 37 2E 31 36 00 00 00 00      PE1 0/7/7.16....

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0

```

Rx J1 Trace

SDH Path Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASF
21:26-21:26	0	0	0	0	0	0	0	0

SDH 0/7/7.1 PATH mode vc4 is down  
 cep is configured: TRUE cem\_id :20  
 clock source internal

AU-4 2, TUG-3 1, TUG-2 1, VC12 1 (SDH 0/7/7.2/1/1/1 VC12) is down  
 VT Receiver has LP-RDI.

cep is configured: FALSE cem\_id (0)  
 fwd\_alarm\_ais :0 fwd\_alarm\_rai :0  
 Framing is unframed, Clock Source is Internal  
 BIP2-tca:6, BIP2-sf:3, BIP2-sd:6

Tx V5:1  
 Rx V5:6

Tx J2 Length=16

TX J2 Trace Buffer:  
 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

Expected J2 Length=16

Expected J2 Trace Buffer:  
 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

Rx J2 Length=16

RX J2 Trace Buffer:  
 CRC-7: 0x81 OK

4F 4E 54 20 4C 4F 2D 54 52 41 43 45 20 20 20 00 ONT LO-TRACE .

Data in current interval (140 seconds elapsed)

Near End  
 0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 269 Unavailable Secs  
 Far End  
 0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 0 Unavailable Secs

AU-4 2, TUG-3 1, TUG-2 1, E1 1 (SDH 0/7/7.2/1/1/1 E1) is down

Receiver is getting AIS.  
 Framing is unframed, Clock Source is Internal

Data in current interval (140 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  
 293 Unavail Secs, 0 Stuffed 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 Unavail Secs

AU-4 2, TUG-3 1, TUG-2 1, VC12 2 (SDH 0/7/7.2/1/1/2 VC12) is down

VT Receiver has LP-RDI.  
 cep is configured: FALSE cem\_id (0)  
 fwd\_alarm\_ais :0 fwd\_alarm\_rai :0  
 Framing is unframed, Clock Source is Internal  
 BIP2-tca:6, BIP2-sf:3, BIP2-sd:6  
 Tx V5:1  
 Rx V5:6  
 Tx J2 Length=16

```

TX J2 Trace Buffer:
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

Expected J2 Length=16
Expected J2 Trace Buffer:
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

Rx J2 Length=16
RX J2 Trace Buffer:
CRC-7: 0x81 OK

4F 4E 54 20 4C 4F 2D 54 52 41 43 45 20 20 20 00      ONT LO-TRACE .

Data in current interval (150 seconds elapsed)
Near End
  0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 483 Unavailable Secs
Far End
  0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 0 Unavailable Secs

AU-4 2, TUG-3 1, TUG-2 1, E1 2 (SDH 0/7/7.2/1/1/2 E1) is down
Receiver is getting AIS.
Framing is unframed, Clock Source is Internal
Data in current interval (150 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 Severly Err Secs
  90 Unavail Secs, 0 Stuffed 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 Severly Err Secs
  0 Unavail Secs

```

## Configuring SDH Path Parameters

This section describes the configuration of SDH path parameters.

### Path Overhead

#### J1 Flag

Sets the message length and the message text of the High Order Path Trace identifier (J1).

#### C2 Flag

Sets the C2 byte in the Path OverHead (POH) to indicate the contents of the payload inside the frame.

The path overheads, C2 flag and J1 flag can be configured for the following modes:

- AU-4 Mapping
  - Mode VC-4
  - Mode VC-4 Nc
  - Mode TUG-3

For more information, refer [Configuring Modes under AU-4 Mapping, on page 125](#).

- AU-3 Mapping

- Mode E3
- Mode T3

For more information, refer [Configuring Modes under AU-3 Mapping](#).

## Configuring C2 Flag

To configure the C2 flag:

```
enable
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
au-4 1
overhead c2 10
end
```

## J1 Flag

To configure the J1 flag:

```
enable
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
au-4 1
overhead j1 expected length 16
overhead j1 expected message expectedmessage
overhead j1 tx length 16
overhead j1 tx message testmessage
end
```

## Path Threshold

Set the path BER threshold values.

- **b3-tca** — Enables BER threshold crossing alerts for B3.
- **sd-ber** — Enables the threshold of the Signal Degrade (SD) BER that is used to trigger a signal degrade alarm.
- **sf-ber** — Configures the threshold of the Signal Failure (SF) BER that is used to trigger a link state change.

The path threshold can be configured for the following modes:

- AU-4 Mapping
  - Mode VC-4
  - Mode VC-4 Nc
  - Mode TUG-3

For more information, refer [Configuring Modes under AU-4 Mapping, on page 125](#).

- AU-3 Mapping

- For more information, refer [Configuring Modes under AU-3 Mapping](#).

## Configuring Path Threshold

To configure path threshold:

```
enable
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
au-4 1
threshold b3-ber_sd 7
threshold b3-ber_sf 7
end
```

## Path Loopback

Sets a loopback to test the SDH port.

- local — Loops the signal from Tx to Rx path. Sends alarm indication signal (AIS) to network.
- network — Loops the signal from Rx to Tx path.

## Configuring Path Loopback

To configure path loopback:

```
enable
configure terminal
controller sdh 0/0/16
au-4 1
loopback [local | network]
end
```




---

**Note** To restore the system to its default condition, use the **no** form of the command.

---

## Configuring Path BERT

For more information on BERT configuration, see [Configuring BERT in SDH for SAToP, on page 155](#) section.

## Verifying Path Parameters Configuration

Use **show running-configuration** command to verify path parameters configuration.

```
#show running-configuration
controller MediaType 0/0/16
mode sdh
controller SDH 0/0/16
rate STM16
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode vc4
```



```

clock source internal
loopback local
overhead c2 10
threshold b3-ber_sd 7
threshold b3-ber_sf 7
overhead j1 tx message STRING
overhead j1 expected message STRING
threshold b3-tca 5
au-4 2

```

## Configuring BERT in SDH for SAToP

Bit-Error Rate Testing (BERT) is used to analyze quality and to resolve problems of digital transmission equipment. BERT tests the quality of an interface by directly comparing a pseudorandom or repetitive test pattern with an identical locally generated test pattern.

The BERT operation is data-intensive. Regular data cannot flow on the path while the test is in progress. The path is reported to be in alarm state when BERT is in progress and restored to a normal state after BERT has terminated.

The supported BERT patterns are  $2^{15}$ ,  $2^{20}$ ,  $2^{23}$ , all 0s.

BERT is supported in the following two directions:

- Line - Supports BERT in TDM direction.
- System - Supports BERT in PSN direction. CEM must be configured before running BERT towards system direction.

The following table shows the SDH level of BERT patterns supported.

Modes	Patterns
SDH - VC4-4c, VC4-8c, VC4-16c, AU4-VC4, AU4-TUG3-VC3 levels	<ul style="list-style-type: none"> <li>• 0s - Repeating pattern of zeros</li> <li>• <math>2^{15}</math> - O.151 - Error and Jitter measurement of 1544, 2048, 6312, 8448, 32064, 44736 kbps</li> <li>• <math>2^{20}</math> - O.153</li> <li>• <math>2^{20}</math> - O.151 - Error and Jitter measurement upto 72 kbps</li> <li>• <math>2^{23}</math> - O.151 - Error and Jitter measurement of 34368 kbps and 139264 kbps</li> </ul>

Modes	Patterns
SDH - AU4-TUG3-CT3/CE3/E3 and AU4-TUG3-VC11/VC12 levels	<ul style="list-style-type: none"> <li>• 0s - Repeating pattern of zeros</li> <li>• 2<sup>11</sup> 2<sup>11</sup>-1 test pattern</li> <li>• 2<sup>15</sup> - O.151 - Error and Jitter measurement of 1544, 2048, 6312, 8448, 32064, 44736 kbps</li> <li>• 2<sup>20</sup> - O.153</li> <li>• 2<sup>20</sup> - O.151 - Error and Jitter measurement upto 72 kbps</li> <li>• 2<sup>23</sup> - O.151 - Error and Jitter measurement of 34368 kbps and 139264 kbps</li> </ul>

## Configuring BERT in Modes VC-4 and VC Nc

To configure BERT in modes VC-4 and VC Nc:

```
configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode vc4
clock source internal
bert pattern 2^15 internal 10 direction [line | system]
```

## Verifying BERT Configuration in Modes VC-4 and VC Nc

Use **show controllers** command to verify BERT Configuration in Modes VC-4 and VC Nc:

```
#show controller sdh 0/0/16 | sec BERT
BERT test result (running)Test Pattern : 2^15,
Status : Sync, Sync Detected : 0Interval : 10 minute(s),
Time Remain : 00:09:47
Bit Errors (since BERT started): 0 Mbits,Bits Received (since BERT started): 0 Mbits
Bit Errors (since last sync): 1943 bits
Bits Received (since last sync): 1943 Kbits
Direction : LineRouter#
```

## Configuring E1 Bert

To configure E1 Bert:

```
enable
configure terminal
controller MediaType 0/0/16
mode sdh
controller sdh 0/0/16
rate stm4
```

```

au-3 1
mode vclx
tug-2 1 payload vc12
e1 1 bert pattern 2^11 interval 10
end

```

## Configuring T1 Bert

To configure T1 Bert:

```

enable
configure terminal
controller sdh 0/0/16
rate stm4
au-3 1
mode vclx
tug-2 1 payload vc11
t1 1 bert pattern 2^11 interval 10
end

```

## Configuring BERT in Mode T3/E3

To configure BERT in Mode T3/E3 for both AUG mapping AU-3 and AU-4:

```

configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode tug-3
clock source internal
tug-3 1
mode t3
threshold b3-tca 0
overhead c2 0
t3 clock source internal
t3 bert pattern 2^15 internal 10 direction [line | system]

```

## Verifying BERT Configuration in Mode T3 or E3

Use **show controllers** command to verify BERT configuration in mode T3 or E3:

```

show controller sdh 0/0/16 | sec BERT
BERT test result (running)Test Pattern : 2^15,
Status : Sync, Sync Detected : 0Interval : 10 minute(s),
Time Remain : 00:09:47
Bit Errors (since BERT started): 0 Mbits,
Bits Received (since BERT started): 0 Mbits
Bit Errors (since last sync): 1943 bits
Bits Received (since last sync): 1943 Kbits
Direction : Line

```

## Configuring BERT in Mode VC-1x

To configure BERT in mode VC-1x for both AUG mapping AU-3 and AU-4:

```
configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
mode tug-3
clock source internal
tug-3 1
mode vc-1x
tug-2 1 payload VC11
vc 1 bert pattern 2^15 internal 10 direction [line | system]
```

## Verifying BERT Configuration in Mode VC-1x

Use **show controllers** command to verify BERT configuration in mode VC-1x:

```
#show controller sdh 0/0/16 | sec BERT
BERT test result (running)Test Pattern : 2^15,
Status : Sync, Sync Detected : 0Interval : 10 minute(s),
Time Remain : 00:09:47Bit Errors (since BERT started): 0 Mbits,Bits Received (since BERT
started): 0 Mbits
Bit Errors (since last sync): 1943 bits
Bits Received (since last sync): 1943 Kbits
Direction : Line
```

## SDH T1/E1 Configuration Parameters

The following parameters affect SDH T1/E1 configuration:

- **BERT** — Starts the BERT test.
- **CEM Group** — Creates a circuit emulation (CEM) channel from one or more time slots of a T1 or E1 line of an NM-CEM-4TE1 network module,
- **Clock** — Specifies the clock source for T1 or E1 interface.
- **Description** — Specifies the description of the controller.
- **Loopback** — Sets the T1 or E1 interface in the loopback mode.

## Configuring T1/E1 Parameters

To configure T1/E1 parameters:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-3 1
```

```

mode vclx
tug-2 1 payload vc11
t1 1 loopback [local | network line]
t1 1 clock source [line | internal | recovered]
end

```




---

**Note** Loopback network payload is not supported. This is applicable for AU-4 Vc-1x and AU-3 Vc-1x modes.

---




---

**Note** If T1/E1 is enabled on a particular J/K/L/M, you can only configure overhead and threshold for that J/K/L/M value.

---

## Verifying T1 or E1 Parameters Configuration

Use **show running-configuration** command to verify T1 or E1 parameters configuration:

```

#show running-configuration
controller SDH 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 2
mode VClx
tug-2 1 payload VC11
t1 1 loopback network line
t1 1 clock source line

```

## SDH T3/E3 Configuration Parameters

The following parameters affect SDH T3/E3 configuration:

- **Clock** — Specifies the clock source for T3 or E3 link.
- **Loopback** — Sets the T3 or E3 link in the loopback mode.
- **CEM Group** — Creates a circuit emulation (CEM) channel from one or more time slots of a T1 or E1 line.
- **BERT** — Bit-Error Rate Testing (BERT) is used for analyzing quality and for problem resolution of digital transmission equipment.

## Configuring SDH T3/E3 Parameters Configuration

To configure SDH T3/E3 parameters configuration:

```

enable
configure terminal
controller sdh 0/0/16
rate stm4
au-4 1
mode tug 3
tug-3 1
mode e3
e3 1 clock source [line | internal | recovered]
e3 framing [m13 | c-bit ] (applicable to for mode e3)
e3 1 loopback [local | network line]
e3 bert pattern 0s interval 2
tug-3 2
mode t3
t3 1 clock source [line | internal | recovered]
t3 framing [m13 | c-bit ] (applicable to for mode t3)
t3 1 loopback [local | network line]
t3 bert pattern 0s interval 2
end

```




---

**Note** This is applicable to AUG mapping AU-4 mode T3 and AU-3 mode T3.

---

## Verifying SDH T3 or E3 Parameters Configurations

Use **show running-configuration** command to verify SDH T3 or E3 parameters configurations:

```

# show running-configuration
controller sdh 0/0/16
rate stm1
au-4 2
mode tug-3
clock source internal
tug-3 1
mode E3
threshold b3-tca 0
overhead c2 0
e3 clock source internal
e3 framing g751
!tug-3 2mode T3
threshold b3-tca 0
overhead c2 0
t3 clock source internal
t3 framing c-bit!

```

## SDH VC Configuration Parameters for SAToP

The following parameters affect SDH VC configuration:

- **BERT** — Starts the BERT test.
- **CEM Group** — Specifies the time slots for CEM group mapping.
- **Clock** — Specifies the clock source for VC.
- **Loopback** — Sets the VC in the loopback mode.
- **Overhead** — Configures VC line path overhead flags.

- **Shutdown** — Disables the VC interface.

## Configuring VC Parameters

To configure VC parameters:

```
enable
configure terminal
controller sdh 0/0/16
rate stm4
au-3 1
mode vclx
tug-2 1 payload vc11
vc 1 loopback [local | network]
vc 1 clock source internal
vc 1 overhead j2 expected [16 | 64]
vc 1 overhead j2 expected message STRING
vc 1 overhead j2 tx [16 | 64]
vc 1 overhead j2 tx message STRING
vc 1 overhead v5 [0 - 7]
vc 1 [threshold bip2-sd 4 | threshold bip2-sf 4 | threshold bip2-tca 9]
end
```



**Note** v5 overhead should match with the far end tx v5.

## Verifying VC Configuration Parameters Configurations

Use **show running-configuration** command to verify VC configuration parameters configuration:

```
#show running-configuration
controller SDH 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode VC1x
tug-2 1 payload VC11
vc 1 overhead j2 tx message STRING
vc 1 overhead j2 expected message STRING
vc 1 threshold bip2-sd 4
vc 1 threshold bip2-sf 4
vc 1 threshold bip2-tca 9
```

## Configuring ACR

Adaptive Clock Recovery (ACR) is an averaging process that negates the effect of random packet delay variation and captures the average rate of transmission of the original bit stream. ACR recovers the original clock for a synchronous data stream from the actual payload of the data stream. In other words, a synchronous

clock is derived from an asynchronous packet stream. ACR is a technique where the clock from the TDM domain is mapped through the packet domain, but is commonly used for SAToP. Both unframed and framed SAToP modes are supported.

To configure E1 ACR:

```
enable
configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode vclx
tug-2 1 payload vc12
e1 1 cem-group 1 unframed
e1 1 clock source recovered 1
tug-2 2 payload vc11
tug-2 3 payload vc11
tug-2 4 payload vc11
end
```

To configure E3 ACR:

```
enable
configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode e3
overhead c2 0
cem-group 1 unframed
e3 clock source recovered 1
```

ACR Global Configuration

```
enable
configure terminal
recovered-clock 0 4
clock recovered 1 adaptive cem 0 1
end
```

## Verifying ACR Configuration

Use **show recovered clock** command to verify E1 ACR configuration:

```
#show recovered clock
Recovered clock status for subslot 0/16
```



```

-----
Clock      Type      Mode      CEM      Status      Frequency Offset (ppb)  Circuit-No
1          STMx-E1  ADAPTIVE  1        ACQUIRED    n/a                    0/1/1/1/1
(Port/au-4/tug3/tug2/e1)

```

Use **show recovered clock** command to verify T3 ACR configuration:

```

#show recovered clock
Recovered clock status for subslot 0/16
-----
Clock      Type      Mode      CEM      Status      Frequency Offset (ppb)  Circuit-No
1          STMx-E3  ADAPTIVE  1        ACQUIRED    n/a                    0/1/1 (Port/au-4/tug3)

```

## Configuring DCR

Differential Clock Recovery (DCR) is another technique used for Circuit Emulation (CEM) to recover clocks based on the difference between PE clocks. TDM clock frequency are tuned to receive differential timing messages from the sending end to the receiving end. A traceable clock is used at each end, which ensures the recovered clock is not affected by packet transfer. Both unframed and framed SAToP modes are supported.

To configure E1 DCR:

```

enable
configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode vclx
tug-2 1 payload vcl2
e1 1 cem-group 1 unframed
e1 1 clock source recovered 1
tug-2 2 payload vcl1
tug-2 3 payload vcl1
tug-2 4 payload vcl1
end

```

To configure E3 DCR:

```

enable
configure terminal
controller sdh 0/0/16
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
clock source internal
mode tug-3
tug-3 1
mode e3

```

```
overhead c2 0
cem-group 1 unframed
e3 clock source recovered 1

DCR Global Configuration

enable
configure terminal
recovered-clock 0 4
clock recovered 1 differential cem 0 1
end
```

## Verifying DCR Configuration

Use **show recovered clock** command to verify E1 DCR configuration:

```
#show recovered clockRecovered clock status for subslot 0/16
-----
Clock   Type      Mode           CEM   Status   Frequency Offset(ppb)  Circuit-No
1       STMx-E1   DIFFERENTIAL   1     ACQUIRED n/a           0/1/1/1/1
(Port/au-4/tug3/tug2/e1)
```

Use **show recovered clock** command to verify T3 DCR configuration:

```
#show recovered clock
Recovered clock status for subslot 0/16
-----
Clock   Type      Mode           CEM   Status   Frequency Offset(ppb)  Circuit-No
1       STMx-E3   DIFFERENTIAL   1     ACQUIRED n/a           0/1/1
(Port/au-4/tug3)
```

## Loopback Remote on T1 and T3 Interfaces

The remote loopback configuration attempts to put the far-end T1 or T3 into a loopback.

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

## Restrictions for Loopback Remote

E1 and E3 loopback remote are not supported.

## Configuring Loopback Remote in SDH

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

```
enable
configure terminal
controller sdh 0/2/0
mode vclx
tug-2 1 payload vclx
t1 1 loopback remote iboc {fac1 | fac2 | csu}
```

To set T1 loopback remote iboc esf line csu/esf payload for OCX in SDH, perform the following tasks in global configuration mode:

```

enable
configure terminal
controller sdh 0/2/0
mode vclx
tug-2 1 payload vclx
t1 1 loopback remote esf {line csu | payload}

```

To set T3 loopback remote line/payload for OCX in SDH, perform the following tasks in global configuration mode:

```

enable
configure terminal
controller sdh 0/2/0
mode t3
t3 loopback remote {line | payload}

```




---

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

---

## Verifying the Loopback Remote Configuration

Use the following command to check the T1 loopback remote configuration:

```

router# show run | sec 0/2/0
controller SDH 0/2/0
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
  clock source internal
mode tug-3
tug-3 1
  mode VC1x
  tug-2 1 payload VC11
  t1 1 Loopback remote iboc facl

```

Use the following command to verify the T1 loopback remote configuration:

```

Router(config-ctrlr-tug2-vcx)#do show controller sdh 0/2/0 | be T1 1
AU-4 1, TUG-3 1, TUG-2 1, T1 1 (C-11 1/1/1/1) is up
timeslots:
Configured for NIU FAC1 Line Loopback with IBOC
Currently in Inband Remotely Line Looped
Receiver has no alarms.
Framing is SF, Clock Source is Internal
Data in current interval (250 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 Stuffed 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    3 Errored Secs, 0 Bursty Err Secs, 3 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
Far End
    0 Line Code Violations,0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
    3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
    0 Unavailable Secs, 0 Path Failures

```

Use the following command to check the T3 loopback remote configuration:

```

Router#show run | sec 0/4/7
platform enable controller MediaType 0/4/7 oc3
controller MediaType 0/4/7
mode sdh
controller SDH 0/4/7
rate STM1
no ais-shut
alarm-report all
clock source internal
overhead s1s0 0
aug mapping au-4
au-4 1
    clock source internal
    mode tug-3
    tug-3 1
    mode T3
    t3 clock source internal
    t3 framing c-bit
    t3 loopback remote line

```

Use the following command to verify the T3 loopback remote configuration:

```

Router#show controll1 sdh 0/4/7 | be T3
SDH 0/4/7.1/1 T3 is up. (Configured for Remotely Looped)
Hardware is NCS4200-1T8S-10CS
Applique type is T3
Receiver has no alarms.
Data in current interval (240 seconds elapsed):
Near End
    0 Line Code Violations, 0 P-bit Coding Violations
    0 C-bit Coding Violations, 0 P-bit Err Secs
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs

```

```

    0 Unavailable Secs, 0 Line Errored Secs
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
    0 Severely Errored Line Secs, 0 Path Failures
    0 AIS Defect Secs, 0 LOS Defect Secs
  Far End
    0 Errored Secs, 0 Severely Errored Secs
    0 C-bit Unavailable Secs, 0 Path Failures
    0 Code Violations, 0 Service Affecting Secs
Data in Interval 1:
  Near End
    0 Line Code Violations, 0 P-bit Coding Violations
    0 C-bit Coding Violations, 0 P-bit Err Secs
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
    20 Unavailable Secs, 20 Line Errored Secs
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
    20 Severely Errored Line Secs, 1 Path Failures
    0 AIS Defect Secs, 20 LOS Defect Secs
  Far End
    0 Errored Secs, 0 Severely Errored Secs
    0 C-bit Unavailable Secs, 0 Path Failures
    0 Code Violations, 0 Service Affecting Secs
Total Data (last 1 15 minute intervals):
  Near End
    0 Line Code Violations, 0 P-bit Coding Violations,
    0 C-bit Coding Violations, 0 P-bit Err Secs,
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
    20 Unavailable Secs, 20 Line Errored Secs,
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
    20 Severely Errored Line Secs, 1 path failures
    0 AIS Defect Secs, 20 LOS Defect Secs
  Far End
    0 Errored Secs, 0 Severely Errored Secs
    0 C-bit Unavailable Secs, 0 Path Failures
    0 Code Violations, 0 Service Affecting Secs

T1 1 is up
timeslots:
FDL per AT&T 54016 spec.
No alarms detected.
Framing is ESF, Clock Source is Internal
Data in current interval (250 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 Stuffed 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
    0 Unavailable Secs, 0 Stuffed Secs
    1 Path Failures, 2 SEF/AIS Secs
  Far End
    0 Line Code Violations, 0 Path Code Violations
    0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    3 Errored Secs, 0 Bursty Err Secs, 3 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, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
  2 Errored Secs, 0 Bursty Err Secs, 2 Severely Err Secs
  0 Unavailable Secs, 0 Stuffed Secs
  1 Path Failures, 2 SEF/AIS Secs
Far End
  0 Line Code Violations,0 Path Code Violations
  0 Slip Secs, 2 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
  3 Errored Secs, 0 Bursty Err Secs, 3 Severely Err Secs
  0 Unavailable Secs, 0 Path Failures
```

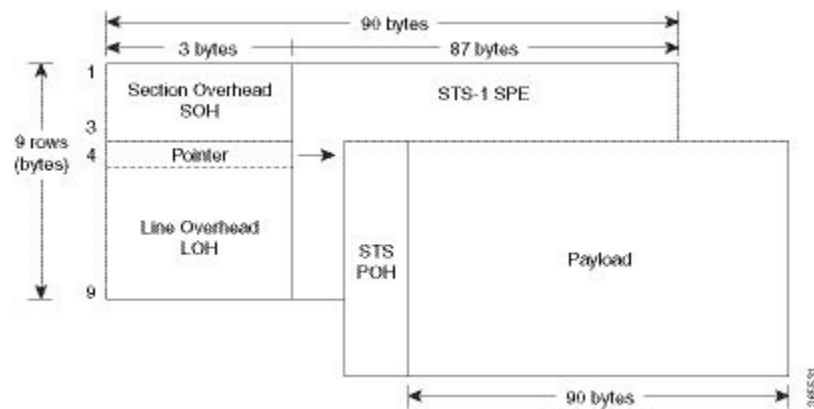


# CHAPTER 10

## STS-1 Electricals

A standard STS-1 frame is nine rows by 90 bytes. The first three bytes of each row represent the Section and Line overhead. These overhead bits comprise framing bits and pointers to different parts of the STS-1 frame.

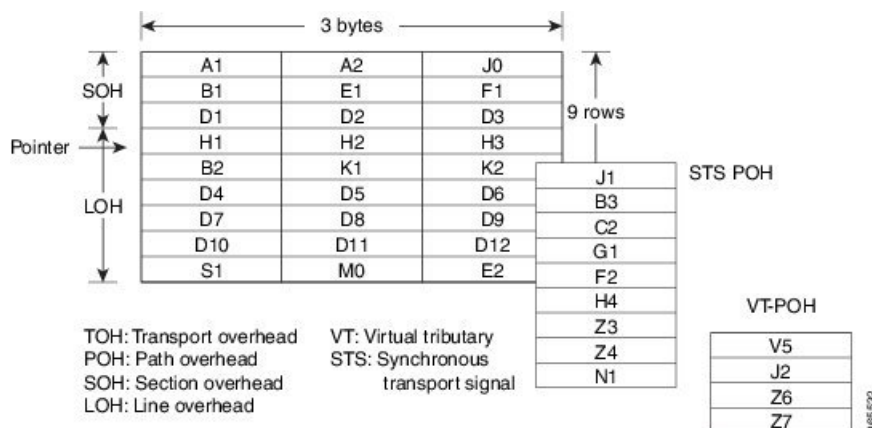
**Figure 9: STS-1 Frame Structure**



There is one column of bytes in the payload that represents the STS path overhead. This column frequently "floats" throughout the frame. Its location in the frame is determined by a pointer in the Section and Line overhead.

The combination of the Section and Line overhead comprises the transport overhead, and the remainder is the SPE.

Figure 10: STS-1 Overhead



For STS-1, a single frame is transmitted in 125 microseconds, or 8000 frames per second.  $8000 \text{ fps} * 810 \text{ B/frame} = 51.84 \text{ Mbps}$ , of which the payload is roughly 49.5 Mbps, enough to encapsulate 28 DS-1s, a full DS-3, or 21 CEPT-1s.

STS-1electrical ports are also supported. 4 Telcordia-compliant, GR-253 STS-1 electrical ports are supported per card. Each port operates at 51.840 Mbps over a single 75-ohm, 728A or equivalent coaxial span. Ports range from 12 to 15 are supported.

- [Restrictions for STS-1e, on page 170](#)
- [Prerequisites for Configuring STS-1e, on page 171](#)
- [Configuring MediaType Controller, on page 171](#)
- [Configuring STS-1e Modes, on page 171](#)
- [Configuring Line and Section Overhead, on page 173](#)
- [Configuring Line Loopback, on page 173](#)
- [Configuring AIS Shut, on page 173](#)
- [Configuring Shut, on page 173](#)
- [Configuring Clock, on page 174](#)
- [Verification of STS-1e Configuration, on page 174](#)
- [controller sts-1e, on page 184](#)
- [mode sts-1e, on page 184](#)

## Restrictions for STS-1e

- Only 16 BERT Patterns can be configured at a time.
- PMON fields are not supported for VT1.5 VT and DS3 or T3.
- PMON Far-end parameters are not supported.
- APS and card-protection are not supported for STS-1e port.
- In unframed mode, ACR and DCR are not supported.
- CESoPSN is not supported.
- Framed SAToP is not supported.



### Restrictions for Clock Source Configuration

- Only 4 ports can be configured in STS-1e line for clock source configuration per chassis.
- You should configure the clock source line and network-clock sync together to receive the clock from a remote port that is connected to the STS-1e port.

## Prerequisites for Configuring STS-1e

You must select the MediaType controller to configure and enter the controller configuration mode.

You must configure the controller as a STS-1e port.

## Configuring MediaType Controller

To configure MediaType Controller, use the following commands:

```
enable
configure terminal
controller MediaType 0/0/16
mode STS-1e
end
```

## Configuring STS-1e Modes

To configure STS-1e modes, use the following commands:

```
enable
configure terminal
controller sts-1e 0/0/16
sts-1 1
mode vt-15
end
```



---

**Note** There is no default mode. The following modes are supported:

- mode vt-15
- mode ct3
- mode t3
- mode unframed



---

**Note** To restore the system to its default condition, use the **no** form of the command.

---

## Configuring VT-15 Mode of STS-1e

```
enable
configure terminal
controller STS1E 0/3/14
no ais-shut
alarm-report all
clock source internal
!
sts-1 1
clock source internal
mode vt-15
vtg 1 t1 1 framing unframed
vtg 1 t1 1 cem-group 0 unframed
```

## Configuring DS1/T1 CT3 mode of STS-1e

To configure DS1/T1 CT3 mode of STS-1, you can configure the T1 link using the following steps:

```
enable
configure terminal
controller sts-1e 0/0/16
sts-1 1
mode ct3
t1 1 clock source internal
t1 1 framing unframed
end
```




---

**Note** To restore the system to its default condition, use the **no** form of the command.

---

## Configuring T3 mode of STS-1e

```
controller STS1E 0/3/14
no ais-shut
alarm-report all
clock source internal
!
sts-1 1
clock source internal
mode t3
cem-group 0 unframed
t3 clock source internal
```

## Configuring Unframed Mode of STS-1e

```
controller STS1E 0/3/14
no ais-shut
alarm-report all
clock source internal
!
sts-1 1
clock source internal
mode unframed
cem-group 0 cep
```

## Configuring Line and Section Overhead

To configure line and section overhead, use the following commands:

```
enable
configure terminal
controller MediaType 0/0/16
mode sts-1e
controller sts-1e 0/0/16
overhead s1s0 2
overhead j0 tx length 1-byte
end
```



---

**Note** To restore the system to its default condition, use the **no** form of the command.

---

## Configuring Line Loopback

To configure loopback, use the following commands:

```
enable
configure terminal
controller sts-1e 0/0/16
loopback local
end
```



---

**Note** To restore the system to its default condition, use the **no** form of the command.

---

## Configuring AIS Shut

To configure AIS-Shut, use the following commands:

```
enable
configure terminal
controller sts-1e 0/0/16
ais-shut
end
```



---

**Note** The **no ais-shut** command will not send AIS.

---

## Configuring Shut

To configure Shut, use the following commands:

```
enable
configure terminal
controller sts-1e 0/0/16
shutdown
end
```




---

**Note** Use the **no shutdown** command to disable the interface.

---

## Configuring Clock

To configure clock, use the following commands:

```
enable
configure terminal
controller MediaType 0/0/16
mode sts-1e
controller sts-1e 0/0/16
clock source line
end
```




---

**Note** The default mode is internal.

---




---

**Note** ACR and DCR clock recovery are also supported. Refer to [Clock Recovery System for SAToP, on page 69](#) for more information.

---




---

**Note** To restore the system to its default condition, use the **no** form of the command.

---

### Configuring Network-Clock STS-1e

To configure network-clock STS-1e, use the following commands:

```
enable
configure terminal
network-clock input-source 1 controller STS-1e 0/0/16
end
```

## Verification of STS-1e Configuration

The following sample output shows the verification of STS-1e configuration in unframed mode:

```
router#show controllers sts1e 0/3/14
STS1E 0/3/14 is up.                    =====> this is the controller/port status.

Hardware is A900-IMA3G-IMSG
```



```

AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
LOM = 0          PLM = 0          UNEQ = 0
    
```

```

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA
    
```

```

TCA threshold: B3 = 10e-6
Rx: C2 = 04
Tx: C2 = 01
    
```

```

Tx J1 Length : 64
Tx J1 Trace
    
```

```

52 53 50 32 20 30 2F 33 2F 31 34 2E 31 00 00 00      RSP2 0/3/14.1...
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
    
```

```

Expected J1 Length : 64
Expected J1 Trace
    
```

```

52 53 50 32 20 30 2F 33 2F 31 34 2E 31 00 00 00      RSP2 0/3/14.1...
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
    
```

PATH TRACE BUFFER : UNSTABLE

```

Rx J1 Length : 64
Rx J1 Trace
    
```

```

00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
    
```

SONET Path Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASFE
05:26-05:28	0	0	0	48	0	0	0	0

```

STS1E 0/3/14.1 PATH mode UNFRAMED is up
cep is configured: TRUE cem_id :0
clock source internal
    
```

The following sample output shows the verification of STS-1e configuration in VT-15 mode:

```

router#show controllers sts1e 0/3/14
STS1E 0/3/14 is up.
Hardware is A900-IMA3G-IMSG

Port configured rate: OC1
Applique type is Channelized STS1E
Clock Source is Internal
Medium info:
Type: STS1E, Line Coding: NRZ,
Alarm Throttling: OFF
SECTION:
LOS = 0          LOF = 0          BIP(B1) = 0

STS1E Section Tables
    
```



Verification of STS-1e Configuration

Tx J1 Length : 64  
Tx J1 Trace

```

52 53 50 32 20 30 2F 33 2F 31 34 2E 31 00 00 00      RSP2 0/3/14.1...
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
    
```

Expected J1 Length : 64  
Expected J1 Trace

```

52 53 50 32 20 30 2F 33 2F 31 34 2E 31 00 00 00      RSP2 0/3/14.1...
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
    
```

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 64  
Rx J1 Trace

```

00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
    
```

SONET Path Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASFE
05:33-05:33	0	0	0	0	0	0	0	0

STS1E 0/3/14.1 PATH is up.  
Hardware is A900-IMA3G-IMSG

Applique type is VT1.5

STS-1 1, VTG 1, VT 1 (STS1E 0/3/14.1/1/1 VT) is up  
No VT alarms detected.

cep is configured: FALSE cem\_id (0)  
fwd\_alarm\_ais :0 fwd\_alarm\_rai :0  
Framing is unframed, Clock Source is Internal  
BIP2-tca:6, BIP2-sf:3, BIP2-sd:6

Tx V5:1

Rx V5:2

Tx J2 Length=64

TX J2 Trace Buffer:

```

00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
    
```

Expected J2 Length=64

Expected J2 Trace Buffer:

```

00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....
    
```

Rx J2 Length=16

RX J2 Trace Buffer:

CRC-7: 0x80 OK

```

4A 44 53 55 00 00 00 00 00 00 00 00 00 00 00 00      JDSU.....
    
```





Expected J0 Trace :

```

52 53 50 32 20 20 20 20 20 20 20 20 20 20 20 20 20 20  RSP2
20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 00 00    ..
    
```

Rx J0 Length : 16

Rx J0 Trace :

CRC-7: 0xD8 ERROR

```

BC 4B 69 CC 79 24 1B 01 E8 EB 9C 36 FC 29 A9 00    .Ki.y$.6)...
    
```

STS1E Line Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASFE
05:35-05:35	0	0	0	73	0	0	0	0

High Order Path:

PATH 1:

Clock Source is internal

```

AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
LOM = 0          PLM = 0          UNEQ = 0
    
```

Active Defects: None

Detected Alarms: None

Asserted/Active Alarms: None

Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6

Rx: C2 = 04

Tx: C2 = 04

Tx J1 Length : 64

Tx J1 Trace

```

52 53 50 32 20 30 2F 33 2F 31 34 2E 31 00 00 00  RSP2 0/3/14.1...
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
    
```

Expected J1 Length : 64

Expected J1 Trace

```

52 53 50 32 20 30 2F 33 2F 31 34 2E 31 00 00 00  RSP2 0/3/14.1...
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
    
```

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 64

Rx J1 Trace

```

00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
    
```

SONET Path Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASFE



Verification of STS-1e Configuration

```

20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
20 20 20 20 20 20 20 20 20 20 20 20 20 20 00 00 ..

```

Expected J0 Length : 64  
 Expected J0 Trace :

```

52 53 50 32 20 20 20 20 20 20 20 20 20 20 20 20 RSP2
20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
20 20 20 20 20 20 20 20 20 20 20 20 20 20 00 00 ..

```

Rx J0 Length : 16  
 Rx J0 Trace :

```

CRC-7: 0xD8 ERROR

BC 4B 69 CC 79 24 1B 01 E8 EB 9C 36 FC 29 A9 00 .Ki.y$.6)..

```

STS1E Line Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASF
05:41-05:42	0	0	0	10	0	0	0	0

High Order Path:

PATH 1:  
 Clock Source is internal

```

AIS = 0          RDI = 0          REI = 0          BIP(B3) = 0
LOP = 0          PSE = 0          NSE = 0          NEWPTR = 0
LOM = 0          PLM = 0          UNEQ = 0

```

Active Defects: None  
 Detected Alarms: None  
 Asserted/Active Alarms: None  
 Alarm reporting enabled for: PAIS PRDI PUNEQ PLOP PPLM LOM B3-TCA

TCA threshold: B3 = 10e-6  
 Rx: C2 = 04  
 Tx: C2 = 04

Tx J1 Length : 64  
 Tx J1 Trace

```

52 53 50 32 20 30 2F 33 2F 31 34 2E 31 00 00 00 RSP2 0/3/14.1...
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

```

Expected J1 Length : 64  
 Expected J1 Trace

```

52 53 50 32 20 30 2F 33 2F 31 34 2E 31 00 00 00 RSP2 0/3/14.1...
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

```

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 64  
 Rx J1 Trace

```

00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

```

```
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
```

SONET Path Tables

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASF
05:42-05:42	0	0	0	0	0	0	0	0

STS1E 0/3/14.1 T3 is up.  
Hardware is A900-IMA3G-IMSG

Applique type is Channelized T3 to T1  
No alarms detected.  
MDL transmission is disabled

FEAC code received: No code is being received  
Framing is C-BIT Parity, Cablelength is 224  
BER thresholds: SF = 10e-3 SD = 10e-6  
Clock Source is internal  
Equipment customer loopback  
Data in current interval (60 seconds elapsed):  
Near End  
0 Line Code Violations, 0 P-bit Coding Violation  
0 C-bit Coding Violation, 0 P-bit Err Secs  
0 P-bit Severely Err Secs, 0 Severely Err Framing Secs  
25 Unavailable Secs, 0 Line Errored Secs  
0 C-bit Errored Secs, 0 C-bit Severely Errored Secs  
0 Severely Errored Line Secs, 0 Path Failures  
0 AIS Defect Secs, 0 LOS Defect Secs  
Far End  
0 Errored Secs, 0 Severely Errored Secs  
0 C-bit Unavailable Secs, 0 Path Failures  
0 Code Violations, 0 Service Affecting Secs

STS-1 1, T1 1 (STS1E 0/3/14.1/1 T1) is up  
No alarms detected.  
Framing is unframed, Clock Source is Internal  
Data in current interval (60 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  
25 Unavail Secs, 0 Stuffed 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 Unavail Secs

STS-1 1, T1 2 (STS1E 0/3/14.1/2 T1) is up  
timeslots:  
FDL per AT&T 54016 spec.  
No alarms detected.  
Framing is ESF, Clock Source is Internal  
Data in current interval (60 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  
26 Unavail Secs, 0 Stuffed 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 Unavail Secs

## controller sts-1e

To configure a STS-1e controller and enter controller configuration mode, use the **controller sts-1e** command in global configuration mode.

**controller sts-1e** *slot/subslot/port*

<i>slot</i>	Physical slot number. The slot is always 0.
<i>/subslot</i>	Physical sub-slot number. The range for sub-slot is 0-5.
<i>/port</i>	STS-1e port number. The range of port number for 3GMS is 12-15 and for 48 T3E3 CE is 0-47.

**Command Default** *port* : 0

**Command Modes** Global configuration

<b>Command History</b>	<b>Release</b>	<b>Modification</b>
	XE Fuji 16.9.1	This command was integrated into the Cisco ASR 900 Series, Cisco ASR 920 Series, and Cisco NCS 4200 Series Routers.

**Usage Guidelines** This command can be enabled only after configuring the **mode sts1e** command under **controller mediatype slot/subslot/port** command, as shown below:

```
Router(config)#controller mediaType 0/3/13
Router(config-controller)#mode
Router(config-controller)#mode sts1e
```

### Example

```
enable
configure terminal
controller sts-1e 0/0/16
sts-1 1
mode sts-1e
t1 1 clock source internal
t1 1 framing unframed
end
```

## mode sts-1e

Use this command to configure the sts-1e mode.

None.

**Command Default** None.

**Command Modes** Controller configuration.

---

**Command History****Release****Modification**

---

IOS XE Fuji 16.9.1 This command was integrated into the Cisco ASR 900 Series, Cisco ASR 920 Series, and the Cisco NCS 4200 Series.

---

---

**Usage Guidelines**

You can change the mode of a controller only when there are no subinterfaces defined for the controller.

**Example**

```
enable
configure terminal
controller MediaType 0/0/16
mode STS-1e
end
```







## CHAPTER 11

# Unidirectional Path Switching Ring Over HDLC

- [Unidirectional Path Switching Ring Over HDLC Overview, on page 187](#)
- [Limitations for HDLC UPSR, on page 187](#)
- [How to Configure UPSR over HDLC, on page 188](#)
- [Configuration Examples for HDLC UPSR, on page 191](#)

## Unidirectional Path Switching Ring Over HDLC Overview

A Unidirectional Path Switching Ring (UPSR) is a unidirectional network with two rings, one ring used as the working ring and the other as the protection ring. The traffic on a working ring or path is always in one direction (clockwise) and on a protection path is in the opposite direction (counterclockwise). The same signal flows through both working and protection rings using a selector switch.

The UPSR monitoring is performed at the path layer. A node receives two copies of the electrical signals at the path layer, compares them, and chooses the one with the better quality. When a signal fail condition is detected, the hardware initiates an interrupt to software which switches from the working path to the protection path or the opposite way.

In an access network, the UPSR serial traffic is processed with an HDLC encapsulation protocol. The termination CE end may be Ethernet traffic. Between the access routers, the network can be a SONET network, where the data path in the network is protected by UPSR. The data terminating router in the network selects the working or protection path.

UPSR is supported on modes such as VT 1.5, STS 3c, and T3.

## Limitations for HDLC UPSR

- HDLC UPSR is supported only on the 1 port OC-48/ 4 port OC-12/OC-3 + 12 port T1/E1 + 4 port T3/E3 CEM interface module.
- HDLC UPSR is applicable only for the OCx ports of the 1 port OC-48/ 4 port OC-12/OC-3 + 12 port T1/E1 + 4 port T3/E3 CEM interface module.
- Work path and protection path should be in the different interface modules.
- The modes supported for configuring HDLC UPSR are VT 1.5, T3, and STS-3c.
- The HDLC UPSR is supported only on RSP2 module.

- HDLC UPSR switching does not happen when there is any alarm at PDH level, for example T1 or T3. The switching happens at VT or STS path alarm.

## How to Configure UPSR over HDLC

You can configure HDLC UPSR in anyone of the following ways:

- Create protection group first and then add working or protect member under physical controller. The channel group can be configured under protection group controller once the protection group is created.
- Add working or protect member under physical controller which creates the protection group controller. The channel group can be added under the protection group controller once protection group is created.

### Configuring Protection Group

You need to create protection group serial interface.

You can create protection group for anyone of the following types: T3, VT 1.5 T1, and STS-3c.

```
enable
configure terminal
controller protection-group 401 type STS3c
channel-group chan-num timeslots 1-24
end
```

### Configuring Channel Group

You can configure channel group under protection controller to create a protection group (PG) serial interface.

#### Creating Protection Group Serial Interface for VT 1.5 T1 Mode

Once the protection group is created, you can configure the controller using the protection group name and mode. You need to specify the channel group number with timeslots to create a PG serial interface.

To configure the channel group under the controller for VT 1.5 T1 mode, enter the following commands:

```
enable
configure terminal
controller protection-group pg_grp_num type vt1.5
channel-group chan_num timeslots 1-24
end
```

#### Creating Protection Group Serial Interface for T3 or STS-3c Mode

You can configure protection group for the controller mode types T3 or STS-3c using specific channel group.

To configure channel group under protection controller for mode T3, enter the following commands:

```
enable
configure terminal
protection-group pg_grp_num type sts1
controller sonet x/y/z
sts-1 3
mode t3
```

```

protection-group pg_grp_num working
end

```

To configure channel group under protection controller for mode types STS-3c, enter the following commands:

```

enable
configure terminal
protection-group pg_grp_num type sts1
controller sonet x/y/z
sts-3c
mode t3
protection-group pg_grp_num working
end

```

The following example details on how to create protection group serial interface for T3 mode:

```

Router(config)#protection-group 6 type sts1
Router(config-ctrlr-sts1)#controller sonet 0/5/17
Router(config-controller)#sts-1 3
Router(config-ctrlr-sts1)#mode t3
Router(config-ctrlr-sts1)#protection-group 6 working

```

## Creating Protection Group Serial Interface for VT 1.5 T1 Mode

Once the protection group is created, you can configure the controller using the protection group name and mode. You need to specify the channel group number with timeslots to create a PG serial interface.

To configure the channel group under the controller for VT 1.5 T1 mode, enter the following commands:

```

enable
configure terminal
controller protection-group pg_grp_num type vt1.5
channel-group chan_num timeslots 1-24
end

```

## Creating Protection Group Serial Interface for T3 or STS-3c Mode

You can configure protection group for the controller mode types T3 or STS-3c using specific channel group.

To configure channel group under protection controller for mode T3, enter the following commands:

```

enable
configure terminal
protection-group pg_grp_num type sts1
controller sonet x/y/z
sts-1 3
mode t3
protection-group pg_grp_num working
end

```

To configure channel group under protection controller for mode types STS-3c, enter the following commands:

```

enable
configure terminal
protection-group pg_grp_num type sts1
controller sonet x/y/z
sts-3c
mode t3
protection-group pg_grp_num working
end

```

The following example details on how to create protection group serial interface for T3 mode:

```
Router(config)#protection-group 6 type stS1
Router(config-ctrlr-sts1)#controller sonet 0/5/17
Router(config-controller)#sts-1 3
Router(config-ctrlr-sts1)#mode t3
Router(config-ctrlr-sts1)#protection-group 6 working
```

## Adding Protection Group to Controller Under VT 1.5 Mode

You can add protection group as working or protect under specific SONET controller mode on the SONET controller interface.

To add protection group to SONET controller under VT 1.5 mode, enter the following commands:

```
enable
configure terminal
controller sonet <x/y/z>
sts-1 1
mode vt-15
vtg 1 t1 1
protection-group pg_grp_num type {working | protect}
end
```

## Adding Protection Group to Controller Under T3 Mode

You can add protection group for T3 framing type such as M13, c-bit.

To add protection group to SONET controller under T3 mode, enter the following commands:

```
enable
configure terminal
controller sonet <x/y/z>
sts-1 1
mode t3
protection-group pg_grp_num type {working | protect}
end
```

## Adding Protection Group to Controller Under STS-3c Mode

To add protection group to SONET controller under STS-3c mode, enter the following commands:

```
enable
configure terminal
controller sonet <x/y/z>
sts-1 1 - 3
mode sts-3c
protection-group pg_grp_num type {working | protect}
end
```

## Configuring Cross-Connect Under Protection Group Serial Interface Pseudowire

The **xconnect** command binds the attachment circuit to a pseudowire for cross connect service. The identifier creates the binding between a pseudowire that is configured on a PE router and an attachment circuit in a CE device.

To perform cross connection between a pseudowire and attachment circuit, use the following commands:

```
router(config)#interface serial-pg <pg-group-name>.<chan_num>
router(config-if)#xconnect ip-address id encapsulation type pw-class
```

## Verifying UPSR Over HDLC Configuration

Use the following **show** commands to verify the UPSR over HDLC configuration:

```
Router#show ip int br | sec PG
Serial-PG1.0          unassigned      YES unset  up          up
Serial-PG2.0          unassigned      YES unset  up          up
Router#sh protection-group
PGN   Type      Working I/f          Protect I/f          Active Status
-----
1     VT15     SONENT0/5/17.1/1/1  W                    A
2     VT15     SONENT0/5/17.2/2/2  W                    A

Router#show xconnect all | sec PG
DN pri   ac Se-PG1.0(HDLC)          UP mpls 10.10.10.10:2      DN

Router#sh controller sonet 0/5/17 | sec prot
Working member of protection-group: 1
Working member of protection-group: 2

Router#show run | sec 0/5/17
platform enable controller MediaType 0/5/17 oc3
controller MediaType 0/5/17
mode sonet
controller SONET 0/5/17
rate OC3
no ais-shut
alarm-report all
clock source internal
!
sts-1 1
  clock source internal
  mode vt-15
  vtg 1 t1 1 protection-group 1 working
!
sts-1 2
  clock source internal
  mode vt-15
  vtg 2 t1 2 protection-group 2 working
```

## Configuration Examples for HDLC UPSR

This section provides examples to configure HDLC UPSR:

### Use Case 1

The following example details on how UPSR is configured over HDLC:

- Protection group of 3 configured under VT 1.5 T1 mode.

- Channel group of zero with timeslot configured under the protection group created.
- SONET controller is configured for mode VT 1.5 T1 on interface 0/5/17.
- Protection group of 3 added as working ring under SONET controller mode VT 1.5 T1.
- Perform cross connection under attachment circuit

```
Router(config)#protection-group 3 type vt1.5
Router(config)#controller protection-group 3
Router(config-controller)#type vt1.5
Router(config-ctrlr-sts1)#channel-group 0 timeslots 1-24
Router(config-ctrlr-sts1)#controller sonet 0/5/17
Router(config-controller)#sts-1 1
Router(config-ctrlr-sts1)#mode vt-15
Router(config-ctrlr-sts1)#vtg 1 t1 1 protection-group 3 working
```

Verify the configuration using the following **show** commands:

```
Router#show protection-group
```

PGN	Type	Working I/f	Protect I/f	Active	Status
1	VT15			-	A
2	VT15			-	A
3	VT15	SONET0/5/17.1/1/1		W	A

```
Router#show controller sonet 0/5/17 | sec protection
Working member of protection-group: 3
```

```
Router#show ip int br | sec PG
Serial-PG3.0          unassigned      YES unset  up          up
```

```
Router(config)#interface Serial-PG3.0
Router(config-if)#xconnect 10.10.10.10 1 encapsulation mpls pw-
Router(config-if)#$.10.10.10 1 encapsulation mpls pw-class serial_pg
```

If you want to remove the configuration performed, use the following commands:

```
Router(config-if-xconn)#int Serial-PG3.0
Router(config-if)#no xconnect

Router(config)#controller sonet 0/5/17
Router(config-controller)#sts-1 1
Router(config-ctrlr-sts1)#no vtg 1 t1 1 protection-group 3 working

Router(config)#controller protection-group 3
Router(config-controller)#type vt1.5
Router(config-ctrlr-sts1)#no channel-group 0
Router(config-ctrlr-sts1)#no protection-group 3
```

## Use Case 2

The following example details on how UPSR is configured over HDLC:

- SONET controller is configured for mode VT 1.5 T1 on interface 0/5/17.
- Protection group of 3 added as working ring under SONET controller mode VT 1.5 T1.

- Protection group of 3 configured under VT 1.5 T1 mode.
- Channel group of zero with timeslot configured under the protection group created.
- Perform cross connection under attachment circuit

```
Router(config)#controller sonet 0/5/17
Router(config-controller)#sts-1 1
Router(config-ctrlr-sts1)#mode vt-15
Router(config-ctrlr-sts1)#vtg 1 t1 1 protection-group 3 working
Router(config-ctrlr-sts1)#exit
Router(config-controller)#exit
Router(config)#controller protection-group 3
Router(config-controller)#type vt1.5
Router(config-ctrlr-sts1)#channel-group 0 timeslots 1-24
```

Verify the configuration using the following **show** commands:

```
Router#show protection-group
```

PGN	Type	Working I/f	Protect I/f	Active	Status
1	VT15			-	A
2	VT15			-	A
3	VT15	SONET0/5/17.1/1/1		W	A

```
Router#show controller sonet 0/5/17 | sec protection
Working member of protection-group: 3
```

```
Router#show ip int br | sec PG
Serial-PG3.0          unassigned      YES unset  up          up
```

```
Router(config)#int Serial-PG3.0
Router(config-if)#xconnect 10.10.10.10 1 encapsulation mpls pw-
Router(config-if)#$.10.10.10 1 encapsulation mpls pw-class serial_pg
```







# CHAPTER 12

## Interworking Multiservice Gateway Access Circuit Redundancy

Interworking Multiservice Gateway Access Circuit Redundancy (iMSG ACR) enables local switching for serial interfaces by creating a virtual serial-ACR interface. All configuration changes made on the virtual serial-ACR interface are applied automatically on both the working and protect interfaces. Switching from working to protect or protect to working interface occurs within 250 milliseconds at different scaled levels with line rate traffic. For more information, see [Serial ACR](#).

- [SONET Supported Modes, on page 195](#)
- [SDH Supported Modes, on page 196](#)
- [Restrictions for iMSG ACR, on page 196](#)
- [How to Configure iMSG ACR, on page 197](#)

### SONET Supported Modes

*Table 12: SONET Supported Modes for iMSG ACR*

Mode	Ports
STS-3C	OC-3, OC-12, OC-48
DS3	OC-3, OC-12, OC-48
DS3-T1	OC-3, OC-12, OC-48
VT 1.5	OC-3, OC-12, OC-48

*Table 13: SONET Supported Modes for iMSG non-ACR*

Mode	Ports
STS-3C	OC-3, OC-12, OC-48
STS-12C	OC-12, OC-48
STS-48C	OC-48

Mode	Ports
DS3	OC-3, OC-12, OC-48
DS3-T1	OC-3, OC-12, OC-48
VT 1.5	OC-3, OC-12, OC-48

## SDH Supported Modes

Table 14: SDH Supported Modes for iMSG ACR

Mode	Ports
VC4	STM1, STM4, STM16
TUG-3-E3	STM1, STM4, STM16
TUG-3-T3	STM1, STM4, STM16
TUG-2-E1	STM1, STM4, STM16
TUG-2-T1	STM1, STM4, STM16

Table 15: SDH Supported Modes for iMSG non-ACR

Mode	Ports
VC4	STM1, STM4, STM16
VC4-4c	STM4, STM16
VC4-16c	STM16

### Modes not supported on SDH for iMSG ACR

- VC4—TUG-3—TUG-2—VC-12
- VC4—TUG-3—TUG-2—VC-11
- (AU-3) VC-3—TUG-2—VC-12
- (AU-3) VC-3—TUG-2—VC11
- SDH—AU3—VC12—E1

## Restrictions for iMSG ACR

- A maximum number of 336 circuits are supported on ACR interface.

- Quality of Service (QoS) and default experimental bits (EXP) marking for MPLS pseudowires is not supported on the iMSG-ACR interface.
- The iMSG ACR is supported only on card.

## How to Configure iMSG ACR

### Creating ACR Group

You can create virtual ACR groups with the following SONET ACR types:

- OC3
- OC12
- OC48

You can create virtual ACR groups with the following SDH ACR types:

- STM1
- STM4
- STM16

To create ACR group, enter the following commands:

```
router(config)#ACR <id> type <type-id>
```

### Configuring ACR Group on APS

You can configure ACR group on APS. The ACR group supported range is from 1 to 96. Any group number exceeding the range is not supported. You can configure the interface as working using the circuit number. The circuit number identifies a particular channel in the APS pair. Since the interface only supports 1 + 1 redundancy, the only valid and the default value for working interface is 1.

The APS group created can be active or inactive:

- Active—The interface that is currently sending and receiving data.
- Inactive—The interface that is currently standing by to take over when the active fails.



**Note** APS is supported in revertive and non-revertive mode and can be configured as unidirectional and bidirectional.

To configure ACR group on APS with SONET interface as a working interface, enter the following commands:

```
configure terminal
controller sonet slot/subslot/port
aps group acr-id
aps working circuit-number
```

```
aps group acr <acr_id>
```

To configure ACR group on APS with SDH interface as a working interface, enter the following commands:

```
configure terminal
controller sdh slot/subslot/port
aps group acr-id
aps working circuit-number
aps group acr <acr_id>
```

You can configure an interface to be protect interface in the APS pair. Because only 1+1 redundancy is supported, the only valid value is 1, and the protect interface defaults to 1.

While specifying ACR ID, you need to specify an IP address for the loopback interface. The protect interface uses this IP address to communicate with the working interface.

To configure ACR group on APS with SONET interface as a protect interface, enter the following commands:

```
configure terminal
controller sonet slot/subslot/port
aps group acr-id
aps protect <acr_id> <any-loopback-ip-address>
aps group acr <acr_id>
```

To configure ACR group on APS with SDH interface as a protect interface, enter the following commands:

```
configure terminal
controller sdh slot/subslot/port
aps group acr-id
aps protect <acr_id> <any-loopback-ip-address>
aps group acr <acr_id>
```

The following example explains how to configure ACR group on APS with SONET interface as working interface:

```
Router# configure terminal
Router (config)# controller sonet 0/1/0
Router(config-controller)# aps group 1
Router (config-controller)# aps working 1
Router (config-controller)# aps group acr 1
```

The following example explains how to configure ACR group on APS with SONET interface as protect interface:

```
Router# configure terminal
Router (config)# controller sonet 0/2/0
Router(config-controller)# aps group 1
Router (config-controller)# aps protect 1 4.1.1.1
Router (config-controller)# aps group acr 1
```

The following example explains how to configure ACR group on APS with SDH interface as working interface:

```
Router# configure terminal
Router (config)# controller sdh 0/3/0
Router(config-controller)# aps group 1
Router (config-controller)# aps working 1
Router (config-controller)# aps group acr 1
```

The following example explains how to configure ACR group on APS with SDH interface as protect interface:

```
Router# configure terminal
Router (config)# controller sdh 0/4/0
Router(config-controller)# aps group 1
Router (config-controller)# aps protect 1 4.1.1.1
Router (config-controller)# aps group acr 1
```

## Creating Serial Interface for SONET ACR

You can create serial interface for SONET ACR on VT 1.5, CT-3, and T3 modes.

### Creating Serial Interface for SONET ACR on VT 1.5 Mode

To create serial interface for SONET ACR on VT 1.5 mode, enter the following commands:

```
controller SONET-ACR <ACR-ID>
sts-1 1
mode vt-15
vtg <vtg_num> t1 <t1_num> channel-group <channel_num> timeslots 1-24
```

The following example describes how to create serial interface on VT 1.5 mode for SONET controller:

```
controller SONET-ACR 100
sts-1 2
mode vt-15
vtg 1 t1 1 channel-group 0 timeslots 1-24
```

### Creating Serial Interface for SONET ACR on CT3 Mode

To create serial interface for SONET ACR on CT-3 mode, enter the following commands:

```
controller SONET-ACR <ACR-ID>
sts-1 1
mode ct3
t3 framing c-bit
t1 <t1_num> channel-group <channel_num> timeslots 1-24
```

The following example describes how to create serial interface on CT-3 mode for SONET controller:

```
controller SONET-ACR 100
sts-1 1
mode ct3
t3 framing c-bit
t1 1 channel-group 0 timeslots 1-24
```

### Creating Serial Interface for SONET ACR on T3 Mode

To create serial interface for SONET ACR on T3 mode, enter the following commands:

```
controller SONET-ACR <ACR-ID>
```

```
sts-1 3
mode t3
t3 framing c-bit
t3 channel-group 0
```

The following example describes how to create serial interface on T3 mode for SONET controller:

```
controller SONET-ACR 100
sts-1 3
mode t3
t3 framing c-bit
t3 channel-group 0
!
```

## Creating Serial Interface for SONET ACR on PoS Mode

To create serial interface for SONET ACR on PoS mode, enter the following commands

```
controller SONET-ACR 50
sts-1 1 - 3 mode sts-3c
channel-group 0
```

## Creating Serial Interface for SONET non-ACR on PoS Mode

To create serial interface for SONET non-ACR on STS-12c mode, enter the following commands:

```
configure terminal
controller SONET <slot>/<subslot>/<port>
rate OC12
sts-1 1 - 12 mode sts-12c
channel-group 0
```

To create serial interface for SONET non-ACR on STS-48c mode, enter the following commands:

```
configure terminal
controller SONET <slot>/<subslot>/<port>
rate OC48
sts-1 1 - 48 mode sts-48c
channel-group 0
```

## Creating Serial Interface for SDH ACR

To create serial interface for SDH ACR on T1, enter the following commands:

```
configure terminal
controller sdh-acr <acr-ID>
aug mapping au-4
au-4 1
mode tug-3
tug-3 1
mode vc1x
Tug-2 1 payload vc12
t1 1 channel-group 0 timeslots 1 - 24
```

To create serial interface for SDH ACR on E1, enter the following commands:

```

enable
configure terminal
controller sdh-acr 200
aug mapping au-4
au-4 1
mode tug-3
tug-3 1
mode vclx
Tug-2 1 payload vcl2
e1 1 channel-group 0 timeslots 1 - 31

```

The following example explains how to create serial interface for SDH ACR on T1:

```

configure terminal
controller sdh-acr 200
aug mapping au-4
au-4 1
mode tug-3
tug-3 1
mode vclx
Tug-2 1 payload vcl2
t1 1 channel-group 0 timeslots 1 - 24

```

The following example explains how to create serial interface for SDH ACR on E1:

```

enable
configure terminal
controller sdh-acr 300
aug mapping au-4
au-4 1
mode tug-3
tug-3 1
mode vclx
Tug-2 1 payload vcl2
e1 1 channel-group 0 timeslots 1 - 31

```

## Creating Serial Interface for SDH ACR on PoS Mode

To create serial interface for SDH ACR on PoS mode, enter the following commands

```

controller SDH-ACR 50
aug mapping au-4
au-4 1
mode vc4
Channel-group 0

```

## Creating Serial Interface for SDH non-ACR on PoS Mode

To create serial interface for SDH non-ACR on VC4-4c Mode, enter following commands under physical controller:

```

configure terminal
controller SDH <slot>/<subslot>/<port>
rate STM

```

```

au-4 1 - 4 mode vc4-4c
channel-group 0

```

To create serial interface for SDH non-ACR on VC4-16c Mode, enter following commands under physical controller:

```

configure terminal
controller SDH <slot>/<subslot>/<port>
rate STM16
au-4 1 - 16 mode vc4-16c
channel-group 0

```

## Modifying Encapsulation to PPP

By default the encapsulation is HDLC, and you can change the encapsulation to PPP.

To modify encapsulation to PPP, enter the following commands:

```

router(config)#interface SERIAL-ACR148.1
router(config-if)#no ip address
router(config-if)# encapsulation ppp

```

## Configuring Pseudowire Class

The following example describes how to configure pseudowire class:

```

pseudowire-class PW_class_name
encapsulation mpls
interworking ip
control-word

```




---

**Note** If the interop node requires control word to be enabled, then you need to use the control word.

---

The following example describes how to configure pseudowire class:

```

pseudowire-class PW_class_name
encapsulation mpls
interworking ip
control-word

```

## Configuring Cross-Connect on Serial Interface

The **xconnect** command binds the attachment circuit to a pseudowire for cross connect service. The identifier creates the binding between a pseudowire that is configured on a PE router and an attachment circuit in a CE device.

To perform cross connection between a pseudowire and attachment circuit, use the following commands:

```

router(config)#interface serial-ACR1.29
router(config-if)#xconnect ip-address vc_num pw-class class-name

```



## Verifying iMSG ACR

### Verifying iMSG ACR with HDLC Encapsulation

Use the following **show aps group** and **show interface SERIAL-ACR** commands to verify iMSG ACR with HDLC encapsulation on the SONET or SDH controller:

```

router# show aps group 100
SONET 0/1/16 APS Group 100: protect channel 0 (Inactive) (HA)
  Working channel 1 at 11.1.1.3 (Enabled) (HA)
  unidirectional, ADM, non-revertive
  PGP timers (extended for HA): hello time=1; hold time=10
    hello fail revert time=120
  SONET framing; SONET APS signalling by default
  Received K1K2: 0x11 0x04
    Do Not Revert (working)
  Transmitted K1K2: 0x00 0x04
    No Request (Null)
  Remote APS configuration: (null)

SONET 0/4/16 APS Group 100: working channel 1 (Active) (HA)
  Protect at 11.1.1.3 (unidirectional, non-revertive)
  PGP timers (from protect): hello time=1; hold time=10
  SONET framing
  Remote APS configuration: (null)

router# show aps group 300
SDH 0/3/0 APS Group 300: protect channel 0 (Inactive) (HA)
  Working channel 1 at 11.1.1.3 (Enabled) (HA)
  unidirectional, ADM, non-revertive
  PGP timers (extended for HA): hello time=1; hold time=10
    hello fail revert time=120
  SDH framing; SDH APS signalling by default
  Received K1K2: 0x11 0x04
    Do Not Revert (working)
  Transmitted K1K2: 0x00 0x04
    No Request (Null)
  Remote APS configuration: (null)

SDH 0/3/1 APS Group 300: working channel 1 (Active) (HA)
  Protect at 11.1.1.3 (unidirectional, non-revertive)
  PGP timers (from protect): hello time=1; hold time=10
  SDH framing
  Remote APS configuration: (null)

router# show interface SERIAL-ACR100.1
SERIAL-ACR100.1 is up, line protocol is up
  Hardware is N/A
  MTU 1500 bytes, BW 1536 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, crc 16, loopback not set
  Keepalive set (10 sec)
  Last input 00:00:05, output 00:00:02, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  30 second input rate 0 bits/sec, 0 packets/sec
  30 second output rate 0 bits/sec, 0 packets/sec
    70 packets input, 10902 bytes, 0 no buffer

```

```

Received 0 broadcasts (0 IP multicasts)
0 runts, 0 giants, 0 throttles
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
57 packets output, 2508 bytes, 0 underruns
0 output errors, 0 collisions, 0 interface resets
20 unknown protocol drops
0 output buffer failures, 0 output buffers swapped out
7 carrier transitions no alarm present
VC 1: timeslot(s): 1-24, Transmitter delay 0, non-inverted data

```

Use the following **show interface SERIAL-ACR** commands to verify HDLC ACR configuration on the SDH controller:

```

router#show int SERIAL-ACR148.1
SERIAL-ACR148.1 is up, line protocol is up
Hardware is N/A
MTU 1500 bytes, BW 44210 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC, crc 16, loopback not set
Keepalive set (10 sec)
Last input 00:00:07, output 00:00:06, output hang never
Last clearing of "show interface" counters 01:16:15
Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
30 second input rate 0 bits/sec, 0 packets/sec
30 second output rate 0 bits/sec, 0 packets/sec
122925 packets input, 16492939 bytes, 0 no buffer
Received 0 broadcasts (0 IP multicasts)
0 runts, 0 giants, 0 throttles
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
744239 packets output, 41162791 bytes, 0 underruns
0 output errors, 0 collisions, 0 interface resets
85 unknown protocol drops
0 output buffer failures, 0 output buffers swapped out
0 carrier transitions alarm present
DSU mode 0, bandwidth 0 Kbit, scramble 0, VC 1, non-inverted data

```

## Verifying iMSG ACR with PPP Encapsulation

Use the following **show interface SERIAL-ACR** command to verify iMSG ACR with PPP encapsulation on the SONET or SDH controller:

```

router#show interface SERIAL-ACR100.1
SERIAL-ACR100.1 is up, line protocol is up
Hardware is N/A
MTU 1500 bytes, BW 1536 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 2/255, rxload 2/255
Encapsulation PPP, LCP Open
Stopped: TAGCP
Open: IPCP, crc 16, loopback not set
Keepalive set (10 sec)
Last input 00:00:00, output 00:00:00, output hang never
Last clearing of "show interface" counters 03:28:29
Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 14000 bits/sec, 1185 packets/sec
5 minute output rate 14000 bits/sec, 1185 packets/sec
14628274 packets input, 25965577 bytes, 0 no buffer
Received 0 broadcasts (0 IP multicasts)

```

```

0 runts, 0 giants, 0 throttles
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
14628402 packets output, 26013374 bytes, 0 underruns
0 output errors, 0 collisions, 1 interface resets
0 unknown protocol drops
0 output buffer failures, 0 output buffers swapped out
2 carrier transitions
PW stats
14625804 input packets ,14625930 output packets,
1872102912 input bytes, 1872119040 output bytes, 0 input packet drop
no alarm present
VC 1: timeslot(s): 1-24, Transmitter delay 0, non-inverted data

```

## Verifying iMSG ACR with HDLC Encapsulation on PoS Mode

Use the following **show interfaces SERIAL-ACR<acr-id>.<path-number>** command to verify iMSG ACR with HDLC encapsulation on PoS mode for SONET or SDH controller.

```

Router#show interfaces serial-acr50.1
SERIAL-ACR50.1 is up, line protocol is up
  Hardware is N/A
  MTU 1500 bytes, BW 155000 Kbit/sec, DLY 100 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, crc 16, loopback not set
  Keepalive set (10 sec)
  Last input 00:00:09, output 00:00:05, output hang never
  Last clearing of "show interface" counters 00:00:27
  Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    102 packets input, 10688 bytes
    Received 0 broadcasts (0 IP multicasts)
    0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    103 packets output, 10732 bytes, 0 underruns
    0 output errors, 0 collisions, 0 interface resets
    0 unknown protocol drops
    0 output buffer failures, 0 output buffers swapped out
    0 carrier transitions
PW stats
100 input packets ,100 output packets,
10000 input bytes, 10000 output bytes, 0 input packet drop
no alarm present
VC:1, Non-inverted data

```

## Verifying iMSG ACR with PPP Encapsulation on PoS Mode

Use the following **show interfaces SERIAL-ACR<acr-id>.<path-number>** command to verify iMSG ACR with PPP encapsulation on PoS mode for SONET or SDH controller.

```

Router#show interfaces serial-acr50.85
SERIAL-ACR50.85 is up, line protocol is up
  Hardware is N/A
  MTU 1500 bytes, BW 155000 Kbit/sec, DLY 100 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Open
  Stopped: TAGCP

```

```
Open: IPCP, crc 16, loopback not set
Keepalive set (10 sec)
Last input 00:00:01, output 00:00:01, output hang never
Last clearing of "show interface" counters 00:00:11
Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  104 packets input, 10776 bytes
  Received 0 broadcasts (0 IP multicasts)
  0 runts, 0 giants, 0 throttles
  0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
  104 packets output, 10776 bytes, 0 underruns
  0 output errors, 0 collisions, 0 interface resets
  0 unknown protocol drops
  0 output buffer failures, 0 output buffers swapped out
  0 carrier transitions
PW stats
100 input packets ,100 output packets,
10000 input bytes, 10000 output bytes, 0 input packet drop
no alarm present
  VC:85, Non-inverted data
```



# CHAPTER 13

## Serial Interfaces

You can create the serial interface on T1 or E1, T3 or E3, SDH, or SONET interface. Each serial interface configuration differs based on the interface mode.

The channel identifier configuration differs based on the interface mode. For more information, refer serial interface supported modes.

- [Serial Interface Supported Modes, on page 207](#)
- [Creating T1 or E1 Serial Interfaces on T1 or E1 Ports, on page 211](#)
- [Creating T3 or E3 Serial Interfaces on T3 or E3 Ports, on page 212](#)
- [Creating Serial Interfaces on SDH, on page 213](#)
- [Creating Serial Interfaces on SONET, on page 216](#)
- [Modifying Encapsulation to PPP, on page 217](#)
- [IPv4 Interworking Pseudowire over HDLC or PPP, on page 217](#)
- [IPv4 Layer 3 Termination on HDLC or PPP Serial Interfaces, on page 222](#)

## Serial Interface Supported Modes

The serial interface name is specified as **interface serial0/bay/port**. The zero specifies the slot number, bay specifies the bay number in the slot, and port specifies the port number in the bay.

The channel identifier varies depending on port type and supported port modes.

The following table details the values for the channel ID depending on the port modes:

**Table 16: Channel Identifier Supported on T1 or E1 Interface**

Mode	Interface	Serial Interface with supported Channel Identifier
T1 or E1	T1 or E1	Serial0/bay/port.1 The port value ranges from 0 to 11.

Table 17: Channel Identifier Supported on T3 or E3 Interface

Mode	Interface	Serial Interface with supported Channel Identifier
T3 or E3	T3 or E3	Serial0/bay/port.1 The port value ranges from 12 to 15.
CT3 or CE3	Channelized T3 or E3	Serial0/bay/port.<t1 number> Serial0/bay/port.<e1 number> T1 or E1 number specifies the VTG number with TUG number and T1 channels. The T1 or E1 number that is supported are as follows: <ul style="list-style-type: none"> <li>• VTG 1/TUG2 1: T1 {1,8,15,22}</li> <li>• VTG 2/TUG2 2: T1 {2,9,16,23}</li> <li>• VTG 3/TUG2 3: T1 {3,10,17,24}</li> <li>• VTG 4/TUG2 4: T1 {4,11,18,25}</li> <li>• VTG 5/TUG2 5: T1 {5,12,19,26}</li> <li>• VTG 6/TUG2 6: T1 {6,13,20,27}</li> <li>• VTG 7/TUG2 7: T1 {7,14,21,28}</li> </ul>

Table 18: Channel Identifier Supported on SDH or SONET Interface

Mode	Interface Mode	Serial Interface with supported Channel Identifier
SONET or SDH	STS-3c or VC-4	<p>Serial0/bay/port.&lt;channel-id&gt;</p> <p>For SONET, the &lt;channel-id&gt; is calculated based on the following formula:</p> $\text{Channel-id} = (\text{start\_sts\_number} - 1) \times 28 + 1$ <p>For SDH, the &lt;channel-id&gt; is calculated based on the following formula:</p> $\text{Channel-id} = (\text{start\_aug4} - 1) \times 28 \times 3 + 1$
SONET or SDH	T3 or E3	<p>Serial0/bay/port.&lt;channel-id&gt;</p> <p>For SONET, the &lt;channel-id&gt; is calculated based on the following formula:</p> $\text{Channel-id} = (\text{start\_sts\_number} - 1) \times 28 + 1$ <p>For SDH AU-4 mapping in TUG3 mode, the &lt;channel-id&gt; is calculated based on the following formula:</p> $\text{Channel-id} = (\text{AUG } 4 - 1) \times 28 \times 3 + (\text{TUG } 3 - 1) \times 28 + (\text{e1} - 1) \times 7 + \text{TUG } 2$ <p>For SDH AU-3 mapping, the &lt;channel-id&gt; is calculated based on the following formula:</p> $\text{Channel-id} = (\text{AUG } 3 - 1) \times 28 + (\text{e1} - 1) \times 7 + \text{TUG } 2$

Mode	Interface Mode	Serial Interface with supported Channel Identifier
SONET or SDH	Concatenated Mode	<p>For SONET, the &lt;channel-id&gt; is calculated based on the following formula:</p> $\text{Channel-id} = (\text{start\_sts\_number} - 1) \times 28 + 1$ <p>For SDH, the &lt;channel-id&gt; is calculated based on the following formula:</p> $\text{Channel-id} = (\text{start\_aug4} - 1) \times 28 \times 3 + 1$
SONET	VT1.5	<p>Serial0/bay/port.&lt;channel-id&gt;</p> <p>&lt;channel-id&gt; is the channel ID calculated based on the following formula:</p> $\text{Channel-id} = (\text{sts\_number} - 1) \times 28 + (\text{T1/E1} - 1) \times 7 + \text{VTG}$ <p>The following example describes how the channel ID is calculated for a given configuration.</p> <pre>sts-1 2 mode vt-15 vtg 2 t1 3 channel-group 0 timeslots 1-24</pre> <p>Inter serial interface channel-id = <math>(2 - 1) \times 28 + (3 - 1) \times 7 + 2 = 44</math></p> <ul style="list-style-type: none"> <li>• VTG 1 1: T1 {1,8,15,22}</li> <li>• VTG 2 2: T1 {2,9,16,23}</li> <li>• VTG 3 3: T1 {3,10,17,24}</li> <li>• VTG 4 4: T1 {4,11,18,25}</li> <li>• VTG 5 5: T1 {5,12,19,26}</li> <li>• VTG 6 6: T1 {6,13,20,27}</li> <li>• VTG 7 7: T1 {7,14,21,28}</li> </ul>



Mode	Interface Mode	Serial Interface with supported Channel Identifier
SDH	Vc11 and Vc12	<p>T1 number with Vc11 supported:</p> <ul style="list-style-type: none"> <li>• TUG2 1: T1 {1,8,15,22}</li> <li>• TUG2 2: T1 {2,9,16,23}</li> <li>• TUG2 3: T1 {3,10,17,24}</li> <li>• TUG2 4: T1 {4,11,18,25}</li> <li>• TUG2 5: T1 {5,12,19,26}</li> <li>• TUG2 6: T1 {6,13,20,27}</li> <li>• TUG2 7: T1 {7,14,21,28}</li> </ul> <p>E1 number with Vc12 supported:</p> <ul style="list-style-type: none"> <li>• TUG2 1: E1 {1,8,15}</li> <li>• TUG2 2: E1 {2,9,16}</li> <li>• TUG2 3: E1 {3,10,17}</li> <li>• TUG2 4: E1 {4,11,18}</li> <li>• TUG2 5: E1 {5,12,19}</li> <li>• TUG2 6: E1 {6,13,20}</li> <li>• TUG2 7: E1 {7,14,21}</li> </ul> <p><b>Note</b> Depending on the mode selected, the number of E1 changes.</p>

## Creating T1 or E1 Serial Interfaces on T1 or E1 Ports

### Creating T1 Serial Interface

To create a channel group on a T1 interface, use the following commands:

```
router(config)#controller t1 0/2/0
router(config-controller)#channel-group 0 timeslots 1-24
```



**Note** For T1, the channel-group ID ranges from 0 to 23.

### Creating E1 Serial Interface

To create a channel group on an E1 interface, use the following commands:

```
router(config)#controller e1 0/2/0
router(config-controller)#channel-group 0 timeslots 1-31
```




---

**Note** For E1, the channel-group ID ranges from 0 to 30.

---

The following example explains a channel group of number 2 with time slot 1-24 is configured on the T1 interface of the controller. The default encapsulation of HDLC is used.

```
router(config)#controller t1 0/2/0
router(config-controller)#channel-group 2 timeslots 1-24
router(config-controller)#end
```




---

**Note** While specifying time slot, use the complete range, for example, 1-24 for T1 and 1-31 for E1.

---

The following example explains a channel group of number 10 with time slot 1-31 is configured on the E1 interface of the controller. The default encapsulation of HDLC is used.

```
router(config)#controller e1 0/3/2
router(config-controller)#channel-group 2 timeslots 1-31
router(config-controller)#end
```

## Creating T3 or E3 Serial Interfaces on T3 or E3 Ports

### Configuring Mode to T3 or E3

To configure T3 mode, use the following commands:

```
router(config)#controller mediatype 0/2/12
router(config-controller)#mode t3
router(config-controller)#exit
```

To configure E3 mode, use the following commands:

```
router(config)#controller mediatype 0/2/12
router(config-controller)#mode e3
router(config-controller)#exit
```

### Creating T3 Serial Interface

To create a T3 interface, use the following commands:

```
router(config)#controller t3 0/2/12
router(config-controller)#no channelized
router(config-controller)#channel-group 0
router(config-controller)#exit
```



**Note** Use **no channel group** command to clear configured T3 channels.

### Creating E3 Serial Interface

To create an E3 interface, use the following commands:

```
router(config)#controller e3 0/2/12
router(config-controller)#no channelized
router(config-controller)#channel-group 0
router(config-controller)#exit
```

### Creating CT3 Serial Interface

To create a CT3 interface, use the following commands:

```
router(config)#controller t3 0/2/12
router(config-controller)#channelized
router(config-controller)#T1 1 channel-group 0 timeslots 1-24
router(config-controller)#T1 2 channel-group 0 timeslots 1-24
router(config-controller)#exit
```



**Note** While specifying time slot, ensure that you provide the complete time slot, for example 1-24 for T1 interface.

The following example explains a channel group of 0 is configured on the E3 interface of the controller. The default encapsulation of HDLC is used.

```
router(config)#controller e3 0/2/12
router(config-controller)#no channelized
router(config-controller)#channel-group 0
router(config-controller)#end
```

The following example explains a channel group of number 0 is configured on the CT3 interface of the controller. The default encapsulation of HDLC is used.

```
router(config)#controller t3 0/2/12
router(config-controller)#no channelized
router(config-controller)#channel-group 0
router(config-controller)#end
```

## Creating Serial Interfaces on SDH

### Configuring Mode to SDH

To enter into SDH mode, use the following commands:

```
router(config)#controller mediatype 0/bay/port
router(config-controller)#mode sdh
router(config-controller)#exit
```

### Creating SDH T3 Interface

To create an SDH T3 interface, use the following commands:

```
router(config)#controller sdh 0/bay/port
router(config-controller)#rate {stm1 | stm4 | stm16}
router(config-controller)#aug mapping au-4
router(config-controller)#au-4 1
router(config-ctrlr-au4)#mode tug-3
router(config-ctrlr-au4)#tug-3 1
router(config-ctrlr-tug3)#[no]mode t3
router(config-ctrlr-tug3)#[no]t3 channel-group 0
router(config-ctrlr-tug3)#exit
```

### Creating SDH E3 Interface

To create an SDH E3 interface, use the following commands:

```
router(config)#controller sdh 0/bay/port
router(config-controller)#rate {stm1 | stm4 | stm16}
router(config-controller)#aug mapping au-4
router(config-controller)#au-4 1
router(config-ctrlr-au4)#mode tug-3
router(config-ctrlr-au4)#tug-3 1
router(config-ctrlr-tug3)#[no]mode e3
router(config-ctrlr-tug3)#[no]e3 channel-group 0
router(config-ctrlr-tug3)#exit
```

### Creating SDH VC11 Interface

To create an SDH VC11 interface, use the following commands:

```
router(config)#controller sdh 0/bay/port
router(config-controller)#rate {stm1 | stm4 | stm16}
router(config-controller)#aug mapping au-4
router(config-controller)#au-4 1
router(config-ctrlr-au4)#[no]mode tug-3
router(config-ctrlr-au4)#tug-3 1
router(config-ctrlr-tug3)#[no]mode vc1x
router(config-ctrlr-tug3)#tug-2 1 payload vc11
router(config-ctrlr-tug2-vcx)#[no]t1 1 channel-group 0 timeslots 1-24
router(config-ctrlr-tug3)#exit
```

### Creating SDH VC12 Interface

To create an SDH VC12 interface, use the following commands:

```
router(config)#controller sdh 0/bay/port
router(config-controller)#rate {stm1 | stm4 | stm16}
router(config-controller)#aug mapping au-4
router(config-controller)#au-4 1
router(config-ctrlr-au4)#[no]mode tug-3
router(config-ctrlr-au4)#tug-3 1
router(config-ctrlr-tug3)#[no]mode vc1x
router(config-ctrlr-tug3)#tug-2 1 payload vc12
router(config-ctrlr-tug2-vcx)#[no]e1 1 channel-group 0 timeslots 1-31
router(config-ctrlr-tug3)#exit
```

### Creating SDH VC4-nc Interface

To create an SDH VC4-nc concatenated interface, use the following commands:

```

router(config)#controller sdh 0/bay/port
router(config-controller)#rate {stm1 | stm4 | stm16}
router(config-controller)#aug mapping au-4
router(config-controller)#au-4 1
router(config-ctrlr-au4)#[no]mode vc4
router(config-ctrlr-au4)#[no]channel-group 0
router(config-ctrlr-tug3)#exit

```

### Creating SDH T3 Interface with AUG-3 Mapping

To create an SDH T3 interface with AUG-3 AUG mapping, use the following commands:

```

router(config)#controller sdh 0/bay/port
router(config-controller)#aug mapping au-3
router(config-controller)#au-3 1
router(config-ctrlr-au3)#[no]mode t3
router(config-ctrlr-au3)#[no]t3 channel-group 0
router(config-ctrlr-au3)#exit

```

### Creating SDH VC11 Interface with AUG-3 Mapping

To create an SDH VC11 interface with AUG-3 AUG mapping, use the following commands:

```

router(config)#controller sdh 0/bay/port
router(config-controller)#au-3 1
router(config-ctrlr-au3)#[no]mode vclx
router(config-ctrlr-au3)#tug-2 1 payload vc11
router(config-ctrlr-tug2-vcx)#[no] t1 1 channel-group 0 timeslots 1-24
router(config-ctrlr-tug3)#exit

```

### Creating SDH VC12 Interface with AUG-3 Mapping

To create an SDH VC12 interface with AUG-3 AUG mapping, use the following commands:

```

router(config)#controller sdh 0/bay/port
router(config-controller)#au-3 1
router(config-ctrlr-au3)#[no]mode vclx
router(config-ctrlr-au3)#tug-2 1 payload vc12
router(config-ctrlr-tug2-vcx)#[no]e1 1 channel-group 0 timeslots 1-31
router(config-ctrlr-tug3)#exit

```

The following example explains SDH serial interface is configured with rate STM1 with AU-4 mapping and TUG-3 and T3 mode:

```

router(config)#controller sdh 0/3/4
router(config-controller)#rate stm1
router(config-controller)#aug mapping au-4
router(config-controller)#au-4 1
router(config-ctrlr-au4)#mode tug-3
router(config-ctrlr-au4)#tug-3 1
router(config-ctrlr-tug3)#mode t3
router(config-ctrlr-tug3)#t3 channel-group 0
router(config-ctrlr-tug3)#exit

```

# Creating Serial Interfaces on SONET

## Setting Controller Mode to SONET

To enter into SONET mode, use the following commands:

```
router(config)#controller mediatype 0/bay/port
router(config-controller)#mode sonet
router(config-controller)#exit
```

## Creating T3 Serial Interface

To create a channel group on the T3 interface, use the following commands:

```
router(config)#controller sonet 0/bay/port
router(config-controller)#rate {oc3 | oc12 | oc48}
router(config-controller)#sts-1 1
router(config-controller)#[no]mode t3
router(config-controller)#[no]t3 channel-group 0
router(config-controller)#exit
```

## Creating VT1.5 Serial Interface

To create a channel group on the VT1.5 interface, use the following commands:

```
router(config)#controller sonet 0/bay/port
router(config-controller)#rate oc3
router(config-controller)#sts-1 1
router(config-controller)#[no]mode vt-15
router(config-controller)#[no]vtg 1 t1 1 channel-group 0 timeslots 1-24
router(config-controller)#exit
```

## Creating CT3 Serial Interface

To create a channel group on the CT3 interface, use the following commands:

```
router(config)#controller sonet 0/bay/port
router(config-controller)#rate oc3
router(config-controller)#sts-1 1
router(config-controller)#[no]mode ct3
router(config-controller)#[no]t1 1 channel-group 0 timeslots 1-24
router(config-controller)#exit
```




---

**Note** While specifying time slot, ensure that you specify the complete time slot.

---

## Creating Concatenated Mode Serial Interface

To create a channel group on the concatenated mode serial interface, use the following commands:

```
router(config)#controller sonet 0/bay/port
router(config-controller)#rate oc3
router(config-controller)#sts-1 1 - 3 mode sts-3c
router(config-controller)#channel-group 0
router(config-controller)#exit
```

The following example explains SONET interface that is configured with OC-3 rate, STS-1 as 1, and mode as T3. The serial interface is modified for PPP encapsulation.

```
router(config)#controller sonet 0/3/4
router(config-controller)#rate oc3
router(config-controller)#sts-1 1
router(config-controller)#mode t3
router(config-controller)#t3 channel-group 0
router(config-controller)#end
router(config)#interface serial 0/3/4 .1
router(config-if)#no ip address
router(config-if)# encapsulation ppp
```

## Modifying Encapsulation to PPP

By default, HDLC is used for encapsulation. You can modify encapsulation to PPP on a serial interface using the **encapsulation ppp** command.

The **channel-id** varies based on the mode set and the circuit type. For more information, see the Serial Interface Supported Modes section.

To modify encapsulation on the serial interface, use the following commands:

```
router(config)#interface serial 0/bay/port.channel-id
router(config-if)#no ip address
router(config-if)# encapsulation ppp
```

## IPv4 Interworking Pseudowire over HDLC or PPP

### L2VPN Interworking

Layer 2 transport over MPLS and IP already exists for like-to-like attachment circuits, such as Ethernet-to-Ethernet or PPP-to-PPP. Layer 2 Virtual Private Network (L2VPN) Interworking builds on this functionality by allowing disparate attachment circuits to be connected. An interworking function facilitates the translation between the different Layer 2 encapsulations.

- [L2VPN Interworking Mode, on page 217](#)
- [IPv4 Interworking Pseudowire Supported Modes, on page 218](#)

### L2VPN Interworking Mode

L2VPN Interworking works in IP (routed) mode that facilitates transport of IPv4 payload in HDLC or PPP frames to Ethernet, over an MPLS network. The configuration is supported on . You specify the mode by issuing the **interworking ip** command in pseudowire-class configuration mode.

The interworking command causes the attachment circuits to be terminated locally. The **ip** keyword causes IP packets to be extracted from the attachment circuit and sent over the pseudowire. Packets with IPv4 payload only are transported over pseudowire.

## IP Interworking Mode

The CE routers encapsulate the IP on the link between the CE router and PE router. A new VC type is used to signal the IP pseudowire in MPLS. Translation between the L2 and IP encapsulations across the pseudowire is required. Special consideration is given to the address resolution and routing protocol operation, because these operations are handled differently on different L2 encapsulations.

In routed interworking, IP packets that are extracted from the ACs are sent over the pseudowire. The pseudowire works in the IP Layer 2 transport (VC type 0x000B) like-to-like mode. The interworking function at the network service provider's (NSP) end performs the required adaptation that is based on the AC technology. Non-IPv4 packets are not forwarded on pseudowire. Only packets with the IPv4 payload are transported over the pseudowire.

The following table details on the packets that are terminated locally:

**Table 19: List of Packets Locally Terminated**

Protocol	Packets (Locally Terminated)	PID Number
Cisco HDLC	SLARP, LCP, or RARP	0x8035
Cisco HDLC	NCP or ARP	0x0806
PPP	LCP	0xCxxx to 0xFxxx
PPP	NCP	0x8xxx to 0xBxxx

## HDLC or PPP to Ethernet IPv4 Interworking Pseudowire

Starting with Cisco IOS XE 16.9.1 release, the L2VPN interworking allows you to connect disparate attachment circuits, for example, TDM and Ethernet attachment circuits. The L2VPN interworking operates in IP (routed) mode that facilitates transport of IPv4 payload in HDLC or PPP frames to Ethernet, over MPLS network translation.

For pseudowires operated in the IP (routed) mode, the IP packets are extracted from the attachment circuit and sent over the pseudowire.

Once IPv4 interworking is configured, create a serial interface with specific channel identifier.

When a serial interface is UP, an internal label is allocated and LDP negotiation with a peer is performed for a remote label. A pseudowire is created and bound to HDLC or PPP channel. Based on the pseudowire configuration, you can permit IPv4 payload traffic with an allocated internal MPLS label.

The default encapsulation for all serial interfaces is HDLC. You can change the encapsulation to PPP. You can cross connect the attachment circuit segment with specific VC identifier and the pseudowire segment.

## IPv4 Interworking Pseudowire Supported Modes

IPv4 interworking pseudowire is supported on the following modes:

- T1 or E1
- T3 or E3
- Channelized T3 or E3 (channelized to T1 or E1)



- SDH
- SONET

## Limitations of IPv4 Interworking Pseudowire on HDLC or PPP Serial Interfaces

The following limitations apply to IPv4 interworking pseudowire on HDLC or PPP serial interfaces:

- IPv4 interworking pseudowire with HDLC or PPP attachment circuit is supported only on the .
- IPv4 interworking is supported only for HDLC or PPP to Ethernet and not supported on MLPPP.
- L3 termination, bridging, and local switching on serial interfaces are not supported.
- Access circuit redundancy, Unidirectional Path Switched Ring (UPSR), and card protection with serial interfaces are not supported.
- IPv4 over HDLC or PPP is not supported on Nx DS0 serial interfaces.
- T1 framing SF is not supported.
- HDLC or PPP is not supported for STS-12C or VC4-4C, and STS48C or VC4-16C modes.
- HDLC or PPP is not supported for CE3 modes.

## How to Configure IPv4 Interworking Pseudowire on HDLC or PPP Interface

This section provides the following information about configuring an IPv4 interworking pseudowire on an HDLC or PPP interface:

- [Configuring L2VPN Interworking, on page 219](#)
- [Configuring Cross-Connect Under Attachment Circuit, on page 220](#)

### Configuring L2VPN Interworking

To configure L2VPN interworking, create a pseudowire class with the tunneling encapsulation as MPLS. The **interworking** command specifies the type of payload traffic that flows across the pseudowire tunnel. Configure pseudowire class only once on a device.

You can also configure **control-word** as an optional command.

To configure L2VPN interworking, use the following commands:

```
router>enable
router#configure terminal
router(config)#pseudowire-class pw-class-name
router(config-pw)#encapsulation mpls
router(config-pw)# interworking ip
router(config-pw)# control-word
```

## Configuring Cross-Connect Under Attachment Circuit

The **xconnect** command binds the attachment circuit to an L2VPN pseudowire for cross connect service. The virtual circuit identifier creates the binding between a pseudowire that is configured on a PE router and an attachment circuit in a CE device.

To perform cross connection between an AToM routed pseudowire and attachment circuit, use the following commands:

```
router(config)#interface serial 0/bay/port.channel-id
router(config-if)#xconnect ip-address vc-id pw-class atom-iw-routed
```

## Verifying IPv4 Interworking Pseudowire over HDLC or PPP Configuration

The following **show interface serial 0/bay/port.vc-number** command displays information about encapsulation and statistics of a serial interface.

To display configuration information on the serial interface, use the **show interface serial** command:

```
Router# show interface serial 0/5/19.8
Serial0/5/19.8 is up, line protocol is up
  Hardware is
  MTU 1500 bytes, BW 1536 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Open
  Stopped: TAGCP
  Open: IPCP, crc 16, loopback not set
  Keepalive set (10 sec)
  Last input 00:00:04, output 00:00:04, output hang never
  Last clearing of "show interface" counters 23:52:46
  Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    16201 packets input, 712844 bytes, 0 no buffer
    Received 0 broadcasts (0 IP multicasts)
    0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    16205 packets output, 696835 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
    0 unknown protocol drops
    0 output buffer failures, 0 output buffers swapped out
    1 carrier transitions
  PW stats
    0 input packets ,0 output packets,
    0 input bytes, 0 output bytes, 0 input packet drop
    no alarm present
    VC 2: timeslot(s): 1-24, Transmitter delay 0, non-inverted data
```

The **show platform software tdm-combo vc info** command helps you to identify the bay, port, STS path, T1, and channel group associated with a serial interface:

```
router#show platform software tdm-combo vc info
BAY  PORT PATH  T1      CHANNEL      VC          HWIDB
spa in bay:0 is NULL
spa in bay:1 is NULL
5    19   1      1       0           Serial0/5/19.1 1
5    19   1      8       0           Serial0/5/19.8 2
TOTAL ENTRIES :2
```

The **show running-config interface serial 0/5/19.8** command provides information on cross connect status, and local or remote label bindings:

```
router#show running-config interface serial 0/5/19.8
Building configuration...

Current configuration : 147 bytes
!
interface Serial0/5/19.8
 no ip address
 encapsulation ppp
 ppp authentication chap
 xconnect 192.0.2.6 207 encapsulation mpls pw-class ip-iw
end

BYOS-RSP3#sh 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 ac Se0/5/19.8(PPP)  UP mpls 192.0.2.6:207  UP
```

The **show mpls l2transport vc 207 detail** command provides information on pseudowire corresponding to VC ID 207:

```
Local interface: Se0/5/19.8 up, line protocol up, PPP up
 Interworking type is IP
 Destination address: 192.0.2.6, VC ID: 207, VC status: up
  Output interface: Gi0/3/7, imposed label stack {16}
  Preferred path: not configured
  Default path: active
  Next hop: 40.40.40.1
 Create time: 23:31:56, last status change time: 23:31:54
  Last label FSM state change time: 23:31:56
 Signaling protocol: LDP, peer 192.0.2.6:0 up
  Targeted Hello: 192.0.2.10(LDP Id) -> 192.0.2.6, 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 512, remote 16
 Group ID: local n/a, remote 0
 MTU: local 1500, remote 1500
 Remote interface description:
 Sequencing: receive disabled, send disabled
 Control Word: On
 SSO Descriptor: 192.0.2.6/207, local label: 512
 Dataplane:
  SSM segment/switch IDs: 8219/8218 (used), PWID: 1
 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
```

## IPv4 Layer 3 Termination on HDLC or PPP Serial Interfaces

### IPv4 Layer 3 Termination on HDLC or PPP Serial Interfaces

Starting with Cisco IOS XE 16.11.x release, you can perform IPv4 Layer 3 termination on HDLC or PPP serial interfaces on the Cisco ASR 920 Series 4-Port OC3/STM-1 or 1-Port OC12/STM-4 Module.

IPv4 routing can be performed using standard routing protocols such as OSPF, BGP, IS-IS, EIGRP, and RIP.

A maximum of 1020 serial interfaces are supported on the Cisco RSP3 module.

This feature supports MPLS IP.

### Restrictions for IP4 Layer 3 Termination on HDLC or PPP Serial Interfaces

- IPv6 routing is not supported.
- ACR or UPSR protection on serial interfaces is not supported.
- Multicast and QoS features are not supported.
- Frame-relay or MLPPP is not supported.
- BFD is not supported on serial interfaces.

## How to Configure IP4 Layer 3 Termination on HDLC or PPP Serial Interfaces

### Configuring Protocols

#### Configuring Routing Protocol

You should configure routing protocols such as OSPF, BGP, IS-IS, EIGRP, and RIP.

For more information on configuring IP Routing protocols, refer the respective Guides:

<https://www.cisco.com/c/en/us/support/ios-nx-os-software/ios-xe-3s/products-installation-and-configuration-guides-list.html>

#### Configuring L3 VPN

To configure L3 VPN, refer the MPLS Virtual Private Networks chapter in the [MPLS: Layer 3 VPNs Configuration Guide](#).

### Configuring VRF

Before configuring IPv4 Layer 3 flow on a serial interface, ensure that you have configured VRF forwarding. For more information, refer [Configuring VRF](#).

VRF-lite is a feature that enables a service provider to support two or more VPNs, where IP addresses can be overlapped among the VPNs. VRF-lite uses input interfaces to distinguish routes for different VPNs and forms virtual packet-forwarding tables by associating one or more Layer 3 interfaces with each VRF.

With the VRF-lite feature, the router supports multiple VPN routing or forwarding instances in customer edge devices. VRF-lite allows a service provider to support two or more VPNs with overlapping IP addresses using one interface.

To configure VRF, enter the following commands:

```
router#configure terminal
router(config)#vrf definition vrf_test
router(config-vrf)#rd 1:1
router(config-vrf)#address-family ipv4
```

Once VRF is configured, ensure that you specify the Layer 3 interface to be associated with the VRF and then associate the VRF with the Layer 3 interface using the **vrf forwarding vrf-name** command. The interface can be a routed port or SVI.

To configure VRF forwarding, enter the following commands:

```
router#configure terminal
router (config-vrf)# interface interface-id
router (config-if)#vrf forwarding vrf-name
```

## Configuring IPv4 Unicast Layer 3 Termination on HDLC or PPP Interfaces

You can enable or disable IPv4 Layer 3 flow on HDLC or PPP serial interfaces. You can use the **vrf forwarding <vrf name>** command optionally on the serial interface.

You can also modify the default MTU 1500 bytes optionally using the **mtu** command.

To enable IPv4 Layer 3 flow on a serial interface, enter the following commands:

```
router(config)#interface serial x/y/z.channel-id
router(config-if)#vrf forwarding <vrf name> (optional)
router(config-if)#ip address <ipv4 address> <mask>
router(config-if)#mtu <bytes>
```

To disable IPv4 Layer 3 flow on a serial interface, enter the no form of the command:

```
router(config)#interface serial x/y/z.channel-id
router(config-if)#vrf forwarding <vrf name>
router(config-if)#no ip address <ipv4 address> <mask>

router(config)#interface serial x/y/z.channel-id
router(config-if)#no vrf forwarding <vrf name>
```

## Verifying IPv4 Layer 3 Termination on HDLC or PPP

The following **show interface serial 0/bay/port.vc-number** command displays information about PPP encapsulation and statistics of a serial interface.

To display configuration information on the serial interface, use the **show interface serial** command:

```
Router# show interface serial 0/5/16.1
Serial0/5/16.1 is up, line protocol is up
Hardware is
Internet address is 41.41.41.1/24
MTU 1500 bytes, BW 44210 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC, crc 16, loopback not set
Keepalive set (10 sec)
Last input 00:00:03, output 00:00:02, output hang never
Last clearing of "show interface" counters never
Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 76000 bits/sec, 298 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  99332 packets input, 983489 bytes, 0 no buffer
    Received 0 broadcasts (0 IP multicasts)
      0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
  62 packets output, 4832 bytes, 0 underruns
    0 output errors, 0 collisions, 3 interface resets
    0 unknown protocol drops
    0 output buffer failures, 0 output buffers swapped out
    0 carrier transitions
no alarm present
DSU mode 0, bandwidth 0 Kbit, scramble 0, VC 3, non-inverted data
```