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

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 0-1, 2-3, 4-5, 6-7 and 8. A maximum rate of 4XOC-48 is supported on ports 0-7.

  4XOC-48 can be configured in any one port of a port-group and other port is not used.

- Only 16 BERT Patterns can be configured at a time on 1-Port OC192/STM-64 or 8-Port OC3/12/48/STM-1/-4/-16 Module.

- 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 for 1-Port OC192/STM-64 or 8-Port OC3/12/48/STM-1/-4/-16 Module 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 1: Bandwidth Used by Different Rates

Rate	Bandwidth
OC-3	155.52 Mbps
OC-12	622.08 Mbps
OC-48	2.4 Gbps
OC-192	9.6 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/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 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 2: 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 1.5	CESoPSN	OC-3, OC-12, OC-48, OC-192
CT3-T1	CESoPSN	OC-3, OC-12, OC-48, OC-192

SONET Hierarchy

Figure 1: A SONET Link
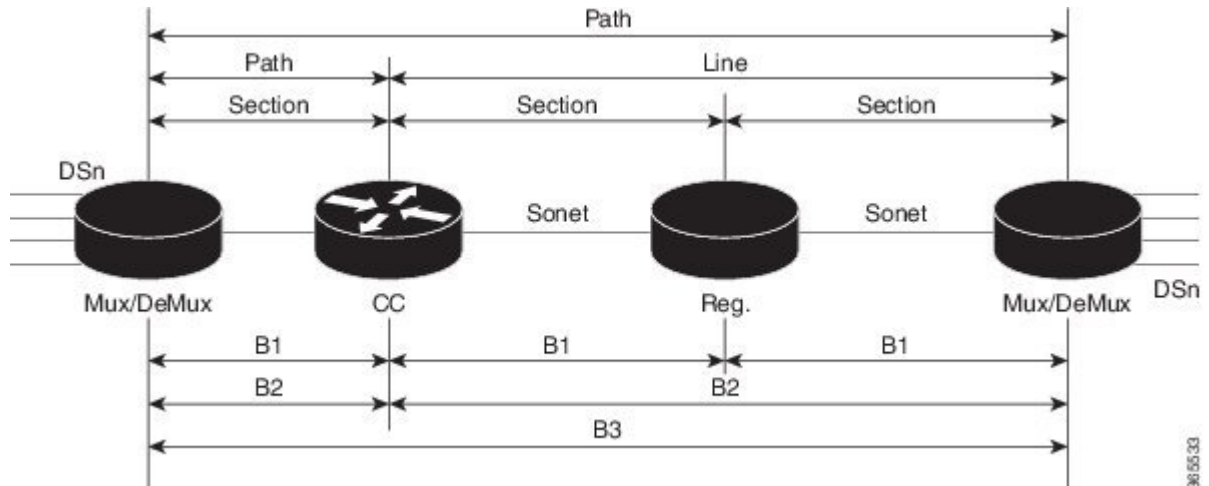
Each level of the SONET hierarchy terminates its corresponding fields in the SONET payload, as follows:

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 2: STS-1 Frame Structure
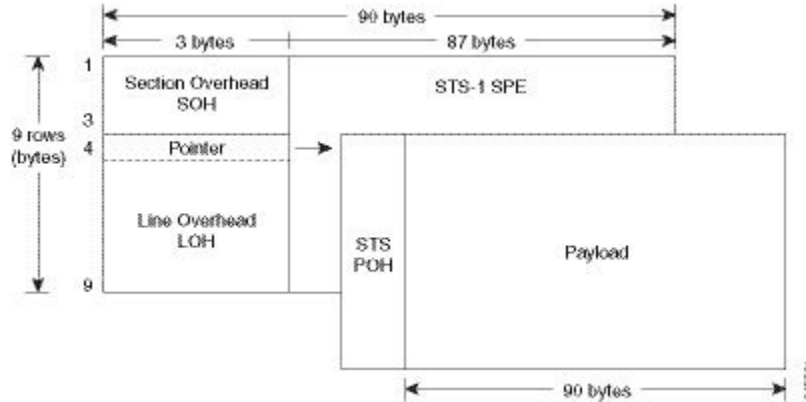
There is one column of bytes in the payload that represents the STS path overhead. This column frequently "floats" throughout the frame. Its location in the frame is determined by a pointer in the Section and Line overhead.

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

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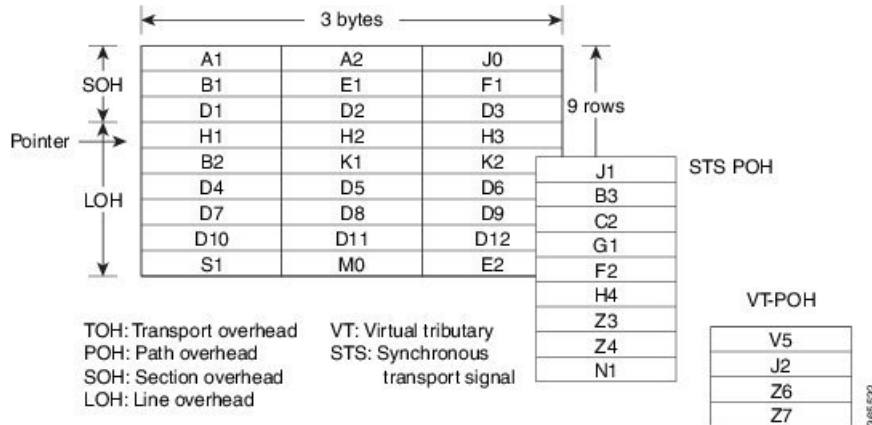
For STS-1, a single SONET frame is transmitted in 125 microseconds, or 8000 frames per second. 8000 fps * 810 B/frame = 51.84 Mbs, of which the payload is roughly 49.5 Mbs, enough to encapsulate 28 DS-1s, a full DS-3, or 21 CEPT-1s.

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.

    - **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.

    - **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.

BERT is supported in the following two directions:

- Line—Supports BERT in TDM direction.

- System—Supports BERT in PSN direction.

BERT Patterns on 1-Port OC-192 or 8-Port Low Rate CEM Interface Module

Table 3: Feature History

Feature Name	Release Information	Description
Support for all 0s and 1s BERT Patterns	Cisco IOS XE Bengaluru 17.4.1	Support for all 0s and 1s BERT patterns for SONET and SDH.

The BERT patterns on the 1-Port OC-192 or 8-Port Low Rate CEM interface module are:

Table 4: BERT Pattern Descriptions

Keyword	Description
All 0s	Pseudo-random binary test pattern consisting of all 0's that is used for test line coding.
All 1s [1]	Pseudo-random binary test pattern consisting of all 1's that is used to test alternating line volt and repeaters.
2^15-1 O.151	Pseudo-random O.151 test pattern consisting of a maximum of 14 consecutive zeros and 15 consecutive ones. The length of this pattern is 32,768 bits.
2^20-O.151	Pseudo-random O.151 test pattern consisting of a maximum of 19 consecutive zeros and 20 consecutive ones. The length of this pattern is 1,048,575 bits.
2^20-O.153	Pseudo-random O.153 test pattern consisting of a maximum of 19 consecutive zeros and 20 consecutive ones. The length of this pattern is 1,048,575 bits.

Keyword	Description
2^23-1 O.151	Pseudo-random 0.151 test pattern consisting of a maximum of 22 consecutive zeros and 23 consecutive ones. The length of this pattern is 8,388,607 bits.
2^9-1 [2]	Pseudo-random binary test pattern consisting of a maximum of eight consecutive zeros and nine consecutive ones. The length of this pattern is 511 bits.
2^11-1 [3]	Pseudo-random binary test pattern consisting of a maximum of ten consecutive zeros and eleven consecutive ones. The length of this pattern is 2048 bits.

[1]   All 1s are supported only on SONET CT3, SDH AU-3 - CT3/CE3 - T1/E1, and SDH AU-3 - VC3. Starting with Cisco IOS XE Bengaluru 17.4.1, All Is are supported on all modes.

[2]   Starting with Cisco IOS XE Bengaluru 17.4.1, 2^9 mode is supported.

2^9 is not supported on the following modes:

- SONET—Unframed, STS-3c, STS-12c, and STS-48c.

- SDH AU-4—VC4, TUG-3-VC3, TUG-3-E3, TUG-3-T3, and TUG-3 - VC1x.

- SDH AU-3—VC3, VC4-4c, VC4-16c, and VC1x.

[3]   Starting with Cisco IOS XE Bengaluru 17.4.1, 2^11 mode is supported.

2^11 is not supported on the following modes:

- SONET—Unframed, STS-3c, STS-12c, and STS-48c.

- SDH AU-4—VC4 and TUG-3-VC3.

- SDH AU-3—VC3, VC4-4c, and VC4-16c.

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.

Automatic Protection Switching

Table 5: Feature History

Feature Name	Release Information	Feature Description
IMA3G 1+1 OC3/12 Single Card APS Support	Cisco IOS XE Amsterdam 17.3.1	Automatic protection switching (APS) is a protection mechanism for SONET networks that enables SONET connections to switch to another SONET circuit when a circuit failure occurs. This protection schemes allows a pair of SONET lines or paths to be configured for line or path redundancy. In the event of a fiber cut, the active line or path switches automatically to the standby line or path. In the 1+1 architecture, there is one working interface (circuit) and one protection interface, and the same payload from the transmitting end is sent to both the receiving ends. The receiving end decides which interface to use.

Feature Name	Release Information	Feature Description
CEM and IP IW Feature Parity for Interface Modules	Cisco IOS XE Bengaluru 17.4.1	Support for APS and non-APS on SDH and SONET for iMSG IPv6 interworking on Interface Module.

Automatic protection switching (APS) is a protection mechanism for SONET networks that enables SONET connections to switch to another SONET circuit when a circuit failure occurs. A protection interface serves as the backup interface for the working interface. When the working interface fails, the protection interface quickly assumes its traffic load.

The SONET protection schemes comply with GR-253 and ITU-T G.783. It allows Optical Interface Module to work seamlessly as SONET Add or Drop Multiplexers (ADMs). The implementation of the above protection schemes allows a pair of SONET lines or paths to be configured for line or path redundancy. In the event of a fiber cut, the active line or path switches automatically to the standby line or path in up to 60 milliseconds (2/5/10 millisecond for holdover and 50 millisecond switchovers).

Optical Interface Module supports the following SONET protection switching schemes:

- Linear Bidirectional 1+1 APS

- Linear Unidirectional 1+1 APS

1+1 APS

In the 1+1 architecture, there is one working interface (circuit) and one protection interface, and the same payload from the transmitting end is sent to both the receiving ends. The receiving end decides which interface to use. The line overhead (LOH) bytes (K1 and K2) in the SONET frame indicate both status and action.

The protection interfaces need to be configured with an IP address of the chassis that has the working interface, using APS commands. The APS Protect Group Protocol, which runs on top of UDP, provides communication between the process controlling the working interface and the process controlling the protection interface. Using this protocol, interfaces can be switched because of a chassis failure, degradation or loss of channel signal, or manual intervention. In bidirectional mode, the receive and transmit channels are switched as a pair.

Two SONET connections are required to support APS.

The following option is available for linear bidirectional 1+1 APS:

- Revertive option — For any failure on working line, the software switches to protection line and when the working line recovers, it waits based on the revertive timer and reverts back to working line as active link.
- Non-revertive option — When the signal fails, the software switches to the protection line and does not automatically revert back to the working line. This is the default option.

The following features are supported on 1+1 APS:

- SONET PW (SAToP or CEP)

- SONET local connect

Benefits of APS

The following lists the benefits of APS:

• APS performs switchovers with minimal loss of data and time-consuming reroutes are avoided.

• There is no visibility that a failure has occurred beyond the network element in which it is residing; other nodes are not affected by the failure.

• Implementation of APS guards a network against complex restarts and resynchronizations since failures are isolated to a local device.

• With APS, the effect of a failure is greatly minimized and a fast switchover guarantees minimal effect on the network.

APS 1+1 for SONET Layer 1 traffic

SONET linear APS 1+1 provides protection against both fiber cuts and front card or back card failures. APS 1+1 requires a redundant protection line for every working line. The traffic is simultaneously carried by the working and the protection lines. Hence, the receiver that terminates the APS 1+1 should select the traffic from one of the lines and continue to forward the traffic. APS 1+1 provides protection in unidirectional and bi-directional modes:

• **Uni-directional Protection**: The receiving end can switch from working to protection line without any coordination at the transmit end since both lines transmit the same information.

• **Bi-directional Protection**: The receiving end switches from working to protection line by coordinating at the transmit end.

Scenario for Bidirectional APS 1+1

In the above figure, two are connected to provide APS 1+1 bi-directional protection. The highlighted one is the working line and the other is the protection line. The traffic is transmitted on both working and protection lines and received only on one line.

In a scenario where you encounter a fiber cut,

1. There is a cable cut in the working line. So, the receives a Loss of Signal (LOS) on working line.

2. starts generating K2 byte and sends it to the over the protection line.

3. receives the K2 byte and reacts on the receiving K2 byte.

4. starts sending K1 byte to the on the protection line.

5. starts sending K2 byte to on the protection line.

6. receives the K1/K2 byte and starts receiving the data from protection line. The protection line now acts as the active line.

7. sends K2 byte over the new active line to . receives this signal and starts accepting the data from this new active line.

Scenario for Unidirectional APS 1+1

In the above figure, two are connected to provide APS 1+1 unidirectional protection. The figure shows a working line and a protection line. The traffic is transmitted on both working and protection line and received only on one line.

In a scenario where you encounter a fiber cut,

1. receives a LOS on RX working line.

2. detects LOS and starts receiving the data from the protection line. The protection line now becomes the active line.

3. receives the K2 byte and knows about switching event on device 2.

UPSR Path Protection

Table 6: Feature History

Feature Name	Release Information	Feature Description
CEM and IP IW Feature Parity for Interface Modules	Cisco IOS XE Bengaluru 17.4.1	Support for UPSR IPv6 on Interface Module.

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 same signal flows through both rings, one clockwise and the other counterclockwise. It is called UPSR because monitoring is done 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. If part of a ring between two ADMs fails, the other ring still can guarantee the continuation of data flow. UPSR, like the one-plus-one scheme, has fast failure recovery.

Once a signal fail condition or a signal degrade condition is detected, the hardware initiates an interrupt to software that switches from the working path to the protection path. Nonrevertive options are valid for UPSR path protection.

Note 1X OC-192 and 8X OC-48 interface modules only supports the nonrevertive option. The nonrevertive option is the default mode.

Note When an active link of UPSR and APS is configured on the same interface module and the interface module reloads, the convergence number for UPSR circuits to switch to backup is high ranging 100–200 ms. When each circuit is configured separately, the convergence time is always under 50 ms.

The below table gives the maximum number of path level circuits that are supported in each mode.

Modes	Supported Scale
VT 1.5	84
STS-1	48
STS 3c	16
STS 12c	4
STS 48c	1

The UPSR path protection supports the following feature:

- SONET local connect and cross connect are supported at VT-15 CEP, STS-1c, STS-3c, STS-12c, and STS-48c levels. UPSR is also supported on TDM endpoints that are mapped to a pseudowire. T1 SAToP,

T3 SAToP, and CT3 are supported on an UPSR ring only with local connect mode. Cross connect of T1, T3, and CT3 circuits to UPSR are not supported until Cisco IOS XE Fuji 16.8.x.

Starting with Cisco IOS XE Fuji 16.9.x, the cross connect of T1, T3, and CT3 circuits to UPSR is supported. For xconnect with the CT3 mode, the CEM protection group interface only supports the VT-15 mode. For cross-connect configuration, see *Configuring UPSR*.

Configuring UPSR

Protection Group Configuration

```
enable
configure terminal
protection-group 401 type STS48c
controller protection-group 401
type STS48c
cem-group 19001 cep
end
```

Cross-connect Configuration with the CT3 mode

For cross connect with the CT3 mode, the CEM protection group interface supports only the VT-15 mode.

```
protection-group 2 type vt1.5
controller protection-group 2
type vt1.5
cem-group 16002 unframed

controller sonet 0/4/0
sts-1 1
mode vt-15
vtg 1 t1 2 protection-group 2 working

controller sonet 0/5/0
sts-1 1
mode vt-15
vtg 1 t1 2 protection-group 2 protect
```

Configuring UPSR Work and Protection Path Configuration

UPSR Work Path Configuration:

```
enable
configure terminal
controller MediaType 0/3/6
mode sonet
controller sonet 0/3/6
rate oc48
sts-1 1 - 48 mode sts-48c
protection-group 401 working
end
```

UPSR Protect Path Configuration:

```
enable
configure terminal
controller MediaType 0/12/6
mode sonet
controller sonet 0/12/6
rate oc48
sts-1 1 - 48 mode sts-48c
```

```
protection-group 401 protect
end
```

Verifying UPSR Configuration

Use the **show protection-group** command to verify UPSR configuration:

```
show protection-group
PGN    Type     Working I/f                Protect I/f              Active Status
-------------------------------------------------------------------------------
401    STS48C   SONET0/3/6.1-48            SONET0/12/6.1-48           W        A
-------------------------------------------------------------------------------
Status legend:D=Deleted FO=Force SF=SignalFailure SD=SignalDegrade
                         FL=Fail M=Manual L=Lockout C=Clear A=Auto
 (W)=working, (P)=protect
```

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 0/5/0
mode sonet
end
```

Configuring SONET Ports

To configure SONET ports, use the following commands:

```
enable
configure terminal
controller MediaType 0/5/0
mode sonet
controller sonet 0/5/0
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 0/5/0
mode sonet
controller sonet 0/5/0
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 and Section Threshold

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

```
enable
configure terminal
controller sonet 0/5/0
threshold b2-tca 3
end
```

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

```
enable
configure terminal
controller sonet 0/5/0
threshold b2-tca 3
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 0/5/0
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 0/5/0
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 0/5/0
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 0/5/0
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 0/5/0
mode sonet
controller sonet 0/5/0
```

```
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 0/5/0
end
```

Configuring STS-1 Modes

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

```
enable
configure terminal
controller sonet 0/5/0
sts-1 1
mode vt-15
end
```

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

   - mode vt-15

   - mode ct3

   - mode cte-e1

   - mode t3

   - mode unframed

   - mode vt-2

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 0/5/0
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 0/5/0
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.

Configuring CEM Group for Sonet Mode VT1.5-T1 in CESoPSN

To configure CEM group in VT 1.5 mode of STS-1 for CESoPSN, use the following commands:

```
enable
configure terminal
controller sonet 0/5/0
sts-1 2
mode vt-15
vtg 1 t1 1 cem-group 56 timeslots 1 - 8
end
```

Configuring CEM Group for Sonet Mode CT3-T1 in CESoPSN

To configure CEM group in CT3 mode of STS-1 for CESoPSN, use the following commands:

```
enable
configure terminal
controller sonet 0/5/0
sts-1 1
mode ct3
t1 3 cem-group 28 timeslots 1 - 7
end
```

Configuring APS for SAToP

This section describes the configuration of APS for SAToP.

Configuring Bi-directional ACR (SONET Framing) for SAToP

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

```
enable
configure terminal
controller sonet 0/5/0
clock source internal
aps group acr 1
aps working 1
exit
controller sonet 0/4/0
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 Unidirectional APS for SAToP

> **Note** When the **aps adm** command is not used, the LOS is detected on active port and the L-AIS is transmitted to the remote-end to force APS switchover. This is similar to bi-directional APS mode.
>
> 'When the **aps adm** command is used, the ports are in strict unidirectional mode. When the LOS is detected on active port, the L-AIS is suppressed and behaves in a strict uni-directional mode.

Ensure that the configuration is performed under the protected interface.

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

```
enable
configure terminal
controller sonet 0/5/0
clock source internal
aps group acr 1
aps working 1
aps unidirectional
exit
controller sonet 0/4/0
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.

Verifying ACR Configurations for SAToP

This section includes show commands for ACR: The following example shows the ACR groups that have been configured or deleted:

```
Router# show acr group

ACR Group Working I/f Protect I/f Currently Active Status

--------------------------------------------------------------------------

1 SONET 4/1/0 SONET 3/1/0 SONET 4/1/0
```

The following example shows the configured working and protect CEM interfaces under the ACR controller:

```
Router# show acr group 1 detail cem
ACR Group       Working I/f     Protect I/f     Currently Active    Status
--------------------------------------------------------------------------
CE1             CEM0/3/0        CEM0/12/1       CEM0/3/0

CEM CKT Details
Cktid  State on Working    State on Protect
1         Enable Success      Enable Success
```

The following example shows the configuration under the ACR controller:

```
Router##show running-config | sec ACR
controller SONET-ACR 1
framing sonet
!
sts-1 1
  mode vt-15
  vtg 1 vt 1 cem-group 1 cep
!
sts-1 2
 !
sts-1 3
interface CEM-ACR1
no ip address
cem 1
!
```

The following example shows the loopback IP address for the router:

```
Router# show ip interface brief | i Loopback

Loopback0 22.22.22.22 YES NVRAM up up
```

The following example shows the CEM-ACR circuit status:

```
Router# show cem circuit

CEM Int. ID Ctrlr Admin Circuit AC
-------------------------------------------------------------
CEM-ACR1 1 UP UP Active UP
CEM-ACR1 2 UP UP Active UP
CEM-ACR1 3 UP UP Active UP
CEM-ACR1 4 UP UP Active UP
CEM-ACR1 5 UP UP Active UP
CEM-ACR1 6 UP UP Active UP
CEM-ACR1 7 UP UP Active UP
CEM-ACR1 8 UP UP Active UP
```

The following example shows the CEM-ACR circuit details for CEM group 0 under the CEM-ACR interface:

```
Router# #show cem circuit interface cem-acr 1 1

CEM-ACR1, ID: 1, Line: UP, Admin: UP, Ckt: ACTIVE
Controller state: up, T1/E1 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: Configured, RTP-HDR Compression: Disabled

Ingress Pkts:    8186065            Dropped:            0
Egress Pkts:     8186065            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
```

The following example shows the MPLS L2 transport vc details for the specified vc. In this case it is the vc with vc-id = 1001:

```
Router# sh mpls l2 vc 1 det
Local interface: CE1 up, line protocol up, SATOP T1 1 up
  Destination address: 2.2.2.2, VC ID: 1, VC status: up
    Output interface: Te0/8/0, imposed label stack {100}
    Preferred path: not configured
    Default path: active
    Next hop: 31.1.1.2
  Create time: 02:48:15, last status change time: 02:47:26
    Last label FSM state change time: 02:47:26
  Signaling protocol: LDP, peer 2.2.2.2:0 up
    Targeted Hello: 1.1.1.1(LDP Id) -> 2.2.2.2, LDP is UP
    Graceful restart: not configured and not enabled
    Non stop routing: configured and 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 status
      Last remote LDP TLV    status rcvd: No fault
      Last remote LDP ADJ    status rcvd: No fault
    MPLS VC labels: local 16, remote 100
    Group ID: local 38, remote 36
    MTU: local 0, remote 0
    Remote interface description:
  Sequencing: receive disabled, send disabled
  Control Word: On (configured: autosense)
  SSO Descriptor: 2.2.2.2/1, local label: 16
  Dataplane:
    SSM segment/switch IDs: 274581/4096 (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
```

The following example shows the currently configured APS groups on the router:

```
Router# show aps

SONET 0/5/2 APS Group 25: protect channel 0 (Inactive) (HA)
Working channel 1 at 1.1.1.1 (Enabled) (HA)
bidirectional, non-revertive
PGP timers (extended for HA): hello time=1; hold time=10
hello fail revert time=120
Received K1K2: 0x00 0x05
No Request (Null)
Transmitted K1K2: 0x00 0x00
No Request (Null)
Remote APS configuration: (null)
SONET 0/0/2 APS Group 25: working channel 1 (Active) (HA)
Protect at 1.1.1.1
PGP timers (from protect): hello time=1; hold time=10
Remote APS configuration: (null)
```

Configuring APS for CESoPSN

This section describes the configuration of APS for CESoPSN.

Configuring CEM Group for APS CT3-T1 in CESoPSN

To configure CEM group in CT3 mode of STS-1 for CESoPSN, use the following commands:

```
enable
configure terminal
controller sonet-acr 200
sts-1 1
mode ct3
t1 1 cem-group 0 timeslots 1 - 2
end
```

To configure internal clock source for the working controller, use the following commands:

```
enable
configure terminal
controller sonet 0/3/6
sts-1 3
t1 1 clock source internal
t1 1 framing esf
end
```

To configure internal clock source for the protect controller, use the following commands:

```
enable
configure terminal
controller sonet 0/4/6
sts-1 3
vtg 1 t1 1 clock source internal
vtg 1 t1 1 framing esf
end
```

Configuring CEM Group for APS VT1.5-T1 in CESoPSN

To configure CEM group in VT 1.5 mode of STS-1 for CESoPSN, use the following commands:

```
enable
configure terminal
```

```
controller sonet-acr 200
sts-1 3
mode vt-15
vtg 1 t1 1 cem-group 37 timeslots 1 - 5
end
```

To configure internal clock source for the working controller, use the following commands:

```
enable
configure terminal
controller sonet 0/3/6
sts-1 3
vtg 1 t1 1 clock source internal
vtg 1 t1 1 framing esf
end
```

To configure internal clock source for the protect controller, use the following commands:

```
enable
configure terminal
controller sonet 0/4/6
sts-1 3
vtg 1 t1 1 clock source internal
vtg 1 t1 1 framing esf
end
```

Configuring VT 1.5-T1 Loopback for SAToP

To configure VT 1.5-T1 loopback for SAToP, use the following commands:

```
enable
configure terminal
controller sonet 0/5/0
rate oc3
no ais shut
alarm- report all
framing sonet
clock source internal
sts-1 1
clock source internal
mode vt-15
vtg 1 t1 1 loopback local
end
```

Configuring VT 1.5-T1 BERT on SONET for SAToP

To configure VT 1.5-T1 BERT on SONET for SAToP, use the following commands:

```
enable
configure terminal
controller sonet 0/5/0
rate oc3
no ais shut
alarm- report all
framing sonet
clock source internal
sts-1 1
clock source internal
mode vt-15
vtg 1 t1 1 bert pattern 2^11 interval 10
end
```

Configuring Path Overhead

This section describes the configuration of path overhead.

C2 Flag

To configure the C2 flag, use the following commands:

```
enable
configure terminal
controller sonet 0/5/0
sts-1 1
overhead c2 10
end
```

J1 Flag

To configure the J1 flag, use the following commands:

```
enable
configure terminal
controller sonet 0/5/0
sts-1 1
overhead j1 expected length
end
```

Configuring Path Threshold

To configure path threshold, use the following commands:

```
enable
configure terminal
controller sonet 0/5/0
sts-1 1
threshold b3-tca 3
end
```

Verification of SONET Configuration

The following sample output shows the verification of SONET configuration:

```
Router# show controllers sonet 0/3/3
SONET 0/3/3 is up.                              ======> this is the controller/port
status.
  Hardware is

 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/SDH Section Tables
  INTERVAL        CV    ES    SES   SEFS
  05:50-05:58     0     0     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


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: PLOP 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
   05:58-05:58    0     0      0      0

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: None
Alarm reporting enabled for: PLOP LOM B3-TCA

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

PATH TRACE BUFFER : UNSTABLE
```

```
     00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00     ................
     00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00     ................
     00 00 00 00 00 00 00 00 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/SDH Path Tables
    INTERVAL        CV    ES    SES   UAS
    05:58-05:58      0     0     0     0


OC3.STS1 0/3/3.1 is up.    ======> present status of the path
   Hardware is

 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 7: Field Description

Field	Description
SONET 0/3/3 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.

Performance Monitoring Use Cases or Deployment Scenarios

To view the performance monitoring result that includes statistics or error count, 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 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   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
```

To view the performance monitoring results in a table format, use the **show controller sonet tabular** command:

```
Router# show controllers sonet 0/2/0 tabular
SONET 0/2/0 is down.
  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 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 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    409      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   1309      0      0       0       0

SONET 0/2/0.2 T3 is down.
  Hardware is NCS4200-1T8S-10CS

  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
  Near End Data
  INTERVAL      LCV   PCV   CCV   PES   PSES   SEFS    UAS   LES   CES   CSES   LSES   PFC   PAIS
  LLOS
  12:00-12:07     0     0     0     0      0      0    419     0     0      0      0      0
0     0
  11:45-12:00     0     0     0     0      0      0    910     0     0      0      0      1
0     0
  Total           0     0     0     0      0      0    910     0     0      0      0      1
0     0
  Far End Data

  INTERVAL      PES   PSES   PUAS   PFC   PCV   PSASC

  12:00-12:07     0     0      0     0     0      0

  11:45-12:00     0     0      0     0     0      0

  Total           0     0      0     0     0      0


  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
     INTERVAL     LCV    PCV   CSS  SELS   LES    DM    ES   BES   SES   UAS    SS
     12:00-12:07    0      0     0     0     0     0     0     0     0   419     0
     11:45-12:00    0      0     0     0     0     0     0     0     0   900     0
     Total          0      0     0     0     0     0     0     0     0   900     0
     Far End Data
     INTERVAL     LCV    PCV   CSS  SELS   LES    DM    ES   BES   SES   UAS
     12:00-12:07    0      0     0     0     0     0     0     0     0     0
     11:45-12:00    0      0     0     0     0     0     0     0     0     0
     Total          0      0     0     0     0     0     0     0     0     0

   STS-1 2, T1 2 (CT3 2-2) is down
    timeslots:

Router# sh controller sonet 0/2/0.3/1/1
SONET 0/2/0 is up.
 Path mode VT15

 STS-1 3, VTG 1, VT 1 (VT1.5 3/1/1) is down
 VT Receiver has LP-AIS.
  cep is configured: FALSE cem_id  (0)
  fwd_alarm_ais :0     fwd_alarm_rai :0
  Framing is ESF, Clock Source is Internal
  BIP2-tca:6, BIP2-sf:3, BIP2-sd:6
  Tx V5:1
  Rx V5:7
  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: 0x5F ERROR

  5B F4 5E 94 E4 93 F0 18 F7 A7 7C 71 D5 C2 F2 00      [.^.......|q....

 Data in curerent interval (420 seconds elapsed)
   Near End
    0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 419 Unavailable Secs
   Far End
    0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 0 Unavailable Secs
 Data in Interval 1:
   Near End
    0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 893 Unavailable Secs
   Far End
    0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 0 Unavailable Secs
 Total Data (last 1 fifteen minute intervals):
   Near End
    0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 893 Unavailable Secs
   Far End
    0 CodeViolations, 0 ErrorSecs, 0 Severly Err Secs, 0 Unavailable Secs
```

```
   STS-1 3, VTG 1, T1 1 (VT1.5 3/1/1) 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 (430 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
       429 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
       893 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
       893 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
Router# sh controller sonet 0/2/0.3/1/1 tabular
SONET 0/2/0 is up.
 Path mode VT15

 STS-1 3, VTG 1, VT 1 (VT1.5 3/1/1) is down
 VT Receiver has LP-AIS.
  cep is configured: FALSE cem_id  (0)
  fwd_alarm_ais :0    fwd_alarm_rai :0
  Framing is ESF, Clock Source is Internal
  BIP2-tca:6, BIP2-sf:3, BIP2-sd:6
  Tx V5:1
  Rx V5:7
  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: 0x5F ERROR

   5B F4 5E 94 E4 93 F0 18 F7 A7 7C 71 D5 C2 F2 00     [.^.......|q....
```

INTERVAL	CV	ES	SES	UAS	CVFE	ESFE	SESFE	UASFE
12:00-12:08	0	0	0	429	0	0	0	0
11:45-12:00	0	0	0	893	0	0	0	0
Total	0	0	0	893	0	0	0	0

```
 STS-1 3, VTG 1, T1 1 (VT1.5 3/1/1) is down
 timeslots:
 FDL per ANSI T1.403 and AT&T 54016 spec.
 Receiver is getting AIS.
 Framing is ESF, Clock Source is Internal
```

INTERVAL	LCV	PCV	CSS	SELS	LES	DM	ES	BES	SES	UAS	SS
12:00-12:08	0	0	0	0	0	0	0	0	0	429	0
11:45-12:00	0	0	0	0	0	0	0	0	0	893	0
Total	0	0	0	0	0	0	0	0	0	893	0

Far End Data

INTERVAL	LCV	PCV	CSS	SELS	LES	DM	ES	BES	SES	UAS
12:00-12:08	0	0	0	0	0	0	0	0	0	0
11:45-12:00	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0

Table 8: Feature History Table

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

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

```
Router#show controllers t1 0/2/0 tabular
T1 0/6/0 is up
  Applique type is
  Cablelength is short 110
  No alarms detected.
  alarm-trigger is not set
  Soaking time: 3, Clearance time: 10
  Framing is ESF, Line Code is B8ZS, Clock Source is Line.
  BER thresholds:  SF = 10e-3  SD = 10e-6
  Near End Data
  INTERVAL      CV-L     ES-L     CV-P     ES-P     SES-P    CSS-P    SAS-P    UAS-P    FC-P
  09:49-10:01    0        0        0        0        0        0        0        0        0
  Far End Data
  INTERVAL      ES-LFE   ES-PFE   SES-PFE  SEFS-PFE   CSS-PFE   UAS-PFE   FC-PFE
  09:49-10:01     0        0        0         0          0         0         0
```

To view the performance monitoring details on the T3 interface, use the **show controller t3 tabular** command:

```
Router#show controllers t3 0/2/0 tabular
T3 0/2/0 is up.
  Hardware is

  Applique type is Subrate T3
  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-3  SD = 10e-6
    Clock Source is internal
    Equipment customer loopback
    Near End Data
    INTERVAL       CV-L  ES-L  SES-L LOSS-L  CVP-P CVCP-P  ESP-P ESCP-P SESP-P SESCP-P  SAS-P
  AISS-P  FC-P UASP-P UASCP-P
    19:03-19:11       0     0     0      0      0      0      0      0      0       0      0
        0     0     0      0
    18:48-19:03       0     0     0      0      0      0      0      0      0       0      0
        0     0     0      0
    Total             0     0     0      0      0      0      0      0      0       0      0
        0     0     0      0
    Far End Data
    INTERVAL       CVCP-PFE  ESCP-PFE  SESCP-PFE  UASCP-PFE  FCCP-PFE  SASCP-PFE
    19:03-19:11           0         0         0          0         0          0
    18:48-19:03           0         0         0          0         0          0
    Total                 0         0         0          0         0          0
```

To view the performance monitoring details on the channelized T3-T1 interface, use the **show controller t3 tabular** command:

```
Router#show controllers t3 0/2/4 tabular
T3 0/2/4 is down.
  Hardware is

  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-3  SD = 10e-6
  Clock Source is internal
  Equipment customer loopback
  Near End Data
  INTERVAL       CV-L  ES-L  SES-L LOSS-L  CVP-P CVCP-P  ESP-P ESCP-P SESP-P SESCP-P  SAS-P
AISS-P  FC-P UASP-P UASCP-P
  19:02-19:09       0   459   459    459      0      0      0      0      0       0      0
      0     1   459    459
  Far End Data
  INTERVAL       CVCP-PFE  ESCP-PFE  SESCP-PFE  UASCP-PFE  FCCP-PFE  SASCP-PFE
  19:02-19:09           0         0         0          0         0          0

  T3 0/2/4.1 T1 is down
  timeslots:
  FDL per AT&T 54016 spec.
  Receiver is getting AIS.
  Framing is ESF, Clock Source is Internal
  Near End Data
  INTERVAL      CV-L   ES-L   CV-P   ES-P  SES-P  CSS-P  SAS-P  UAS-P   FC-P
  19:02-19:09      0      0      0      0      0      0      0      0      1
  Far End Data
  INTERVAL      ES-LFE  ES-PFE  SES-PFE  SEFS-PFE  CSS-PFE  UAS-PFE  FC-PFE
  19:02-19:09        0       0        0         0         0        0       0
```

To view the performance monitoring details on SONET, use the **show controller sonet tabular** command:

```
Router#show controllers sonet 0/9/7 tabular

SONET 0/9/7 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-S    ES-S    SES-S   SEFS-S
  10:16-10:23       0       0       0       0
  10:01-10:16       0       0       0       0
Total of Data in Current and Previous Intervals
  10:01-10:23       0       0       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 = NA
    K1 = 00,   K2 = 00
    J0 = 00

    RX S1 = 00

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

Tx J0 Length : 64
Tx J0 Trace :

  50 45 32 20 20 20 20 20 20 20 20 20 20 20 20 20      PE2
  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 :

  50 45 32 20 20 20 20 20 20 20 20 20 20 20 20 20      PE2
  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 :

  50 45 32 20 20 20 20 20 20 20 20 20 20 20 20 20      PE2
  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 0D 00                        ..

SONET Line Tables
  INTERVAL        CV-L  ES-L  SES-L  UAS-L  CV-LFE  ES-LFE  SES-LFE  UAS-LFE
  10:16-10:23       0     0     0      0       0       0       0        0
  10:01-10:16       0     0     0      0       0       0       0        0
Total of Data in Current and Previous Intervals
```

```
   10:01-10:23      0       0       0       0       0       0       0       0

APS
  BERSF = 0          BERSD = 0
  Active Alarms: None


PATH 1:
Clock Source is internal

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

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

BER threshold:  SF = 10e-3  SD = 10e-6
TCA threshold:  B3 = 10e-6
Rx: C2 = 04
Tx: C2 = 04

Tx J1 Length : 64
Tx J1 Trace

  50 45 32 20 30 2F 39 2F 37 2E 31 00 00 00 00 00     PE2 0/9/7.1.....
  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

  50 45 32 20 30 2F 39 2F 37 2E 31 00 00 00 00 00     PE2 0/9/7.1.....
  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     ................

Rx J1 Length : 64
Rx J1 Trace

  50 45 32 20 30 2F 37 2F 31 39 2E 31 00 00 00 00     PE2 0/7/19.1....
  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-P   ES-P   SES-P   UAS-P   CV-PFE   ES-PFE   SES-PFE   UAS-PFE
  10:16-10:23      0      0       0       0       0        0        0         0
  10:01-10:16      0      0       0       0       0        0        0         0
Total of Data in Current and Previous Intervals
  10:01-10:23      0      0       0       0       0        0        0         0

PATH 2:
Clock Source is internal

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

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

```
BER threshold:  SF = 10e-3   SD = 10e-6
TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 64
Tx J1 Trace

  50 45 32 20 30 2F 39 2F 37 2E 32 00 00 00 00 00    PE2 0/9/7.2.....
  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

  50 45 32 20 30 2F 39 2F 37 2E 32 00 00 00 00 00    PE2 0/9/7.2.....
  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    ................

Rx J1 Length : 0
Rx J1 Trace


SONET Path Tables
  INTERVAL       CV-P   ES-P   SES-P  UAS-P   CV-PFE   ES-PFE   SES-PFE   UAS-PFE
  10:23-10:23      0      0       0      0        0        0         0         0

PATH 3:
Clock Source is internal

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

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

BER threshold:  SF = 10e-3   SD = 10e-6
TCA threshold:  B3 = 10e-6
Rx: C2 = 00
Tx: C2 = 00

Tx J1 Length : 64
Tx J1 Trace

  50 45 32 20 30 2F 39 2F 37 2E 33 00 00 00 00 00    PE2 0/9/7.3.....
  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

  50 45 32 20 30 2F 39 2F 37 2E 33 00 00 00 00 00    PE2 0/9/7.3.....
  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    ................

Rx J1 Length : 0
Rx J1 Trace
```

```
SONET Path Tables
  INTERVAL      CV-P  ES-P  SES-P  UAS-P  CV-PFE  ES-PFE  SES-PFE  UAS-PFE
  10:23-10:23    0     0     0      0       0       0        0        0


SONET 0/9/7.1 T3 is up.
  Hardware is NCS4200-1T8S-20CS

  Applique type is T3
  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
  Near End Data
  INTERVAL      CV-L  ES-L  SES-L LOSS-L  CVP-P CVCP-P  ESP-P ESCP-P SESP-P SESCP-P  SAS-P
AISS-P  FC-P UASP-P UASCP-P
  10:16-10:23    0     0     0      0       0     0       0     0      0      0       0
      0     0     0       0
  10:01-10:16    0     0     0      0       0     0       0     0      0      0       0
      0     0     0       0
  Total          0     0     0      0       0     0       0     0      0      0       0
      0     0     0       0
  Far End Data
  INTERVAL      CVCP-PFE  ESCP-PFE  SESCP-PFE  UASCP-PFE  FCCP-PFE  SASCP-PFE
  10:16-10:23      0         0         0          0         0         0
  10:01-10:16      0         0         0          0         0         0
  Total            0         0         0          0         0         0
PE2#
```

Configuring Port Rate and Verifying Pluggables

A comprehensive range of pluggable optical modules is available. For more information, see .

Configuring ONS Pluggables

To configure ONS Pluggables, use the following commands:

```
enable
configure terminal
controller mediatype 0/12/0
mode sonet
exit
controller sonet 0/12/0
rate oc3
```

Verifying the Pluggables

Before you configure the 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
```

Configuring BERT in Sonet for CESoPSN

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.

BERT is supported in the following two directions:

- Line—Supports BERT in TDM direction.

- System—Supports BERT in PSN direction.

BERT is supported in following controllers:

- T1—NxDS0, DS1

- T3—NxDS0, DS1 (channelised), clear channel DS3.

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

Configuring VT1.5-T1 BERT for CESoPSN

To configure VT 1.5-T1 BERT, use the following commands:

```
enable
configure terminal
controller sonet 0/5/0
rate oc3
no ais shut
alarm- report all
clock source internal
sts-1 1
clock source internal
mode vt-15
vtg 1 t1 1 bert timeslots 1 pattern 2^11 interval 10
end
```

Verifying VT1.5-T1 BERT Configuration for CESoPSN

Use **show controller sonet** command to verify BERT configuration in mode VT 1.5:

```
Router# show controller sonet 0/5/0.2/2/3 | sec BERT

  BERT running on timeslots 1,2,3,4,5,6,7,8,
  BERT test result (running)
     Test Pattern : 2^11, Status : Sync, Sync Detected : 1
     Interval : 1 minute(s), Time Remain : 00:00:43
     Bit Errors (since BERT started): 0 bits,
     Bits Received (since BERT started): 8 Mbits
     Bit Errors (since last sync): 0 bits
     Bits Received (since last sync): 8 Mbits
     Direction   : Line
```

Configuring CT3-T1 mode BERT for CESoPSN

To configure T1 CT3 mode BERT, use the following commands:

```
controller mediatype 0/5/0
mode sonet
controller sonet 0/5/0
rate oc3
```

```
sts-1 1
mode ct3
t1 4 bert timeslots 1 pattern 2^15 interval 1 direction
```

Verifying CT3-T1 mode BERT for CESoPSN

Use **show controller sonet** command to verify BERT configuration in mode CT3:

```
Router# show controller sonet 0/5/0.1/4 | sec BERT
  BERT running on timeslots 1,
  BERT test result (running)
     Test Pattern : 2^15, Status : Sync, Sync Detected : 1
     Interval : 1 minute(s), Time Remain : 00:00:43
     Bit Errors (since BERT started): 0 bits,
     Bits Received (since BERT started): 1 Mbits
     Bit Errors (since last sync): 0 bits
     Bits Received (since last sync): 1 Mbits
     Direction   : Line
```

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 until Cisco IOS XE Fuji 16.9.4 release. Starting from Cisco IOS XE Fuji 16.9.5 release, E1 and E3 loopback remote are supported.

- IBOC loopcode configuration is not supported when CESoP or SATOP (framed or unframed) is configured.

- ESF loopcode configuration is not supported when SAToP is configured.

Configuring Loopback Remote 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
```

Clock Recovery System in CESoPSN

The Clock Recovery System is able to recover the service clock using two methods, the Adaptive Clock Recovery and Differential Clock Recovery.

Adaptive Clock Recovery in CESoPSN

When emulating TDM over PSNs, the physical layer clock is sometimes not available to both ends. Adaptive Clock Recovery (ACR) is a technique where the clock from the TDM domain is mapped through the packet domain. The sending Inter Working Function (IWF) processes outgoing packets with an internal free-running clock, and the receiving IWF creates a clock based on packet arrival. The service clock frequency is adjusted depending on fill level of the jitter buffer.

- When sending TDM digital signal over PSN, the TDM data is inserted into packets in the primary IWF and sent to the desired destination (subordinate IWF).

- The rate at which the packets are transmitted to the PSN is constant. Due to the nature of the PSN, the packets might arrive to the destination in bursts and with varying rate.

- The long-term average of this rate is equal to the insertion rate at the primary IWF. Moreover, the packets in the PSN might switch their order and even be lost.

- The IWF at the far end of the PSN (subordinate IWF) recovers the service clock (E1/T1) used by the primary IWF.

- The recovered clock is used by the subordinate IWF for the transmission of the data back into the TDM lines.

- The primary IWF aggregates the TDM data and creates the PWE packets; these packets are transmitted to the PSN.

- The packets are received by the subordinate IWF and stored in a jitter buffer designed to absorb the packet delay variation (PDV).

- The packets are extracted from the jitter buffer and the clock recovery algorithm updates the service clock based on the timing information available.
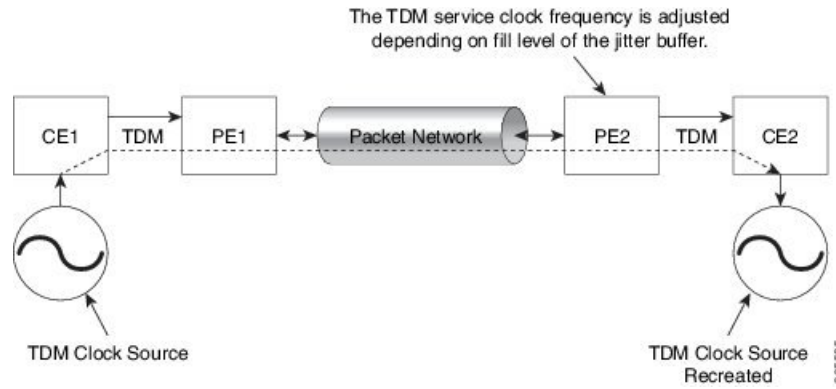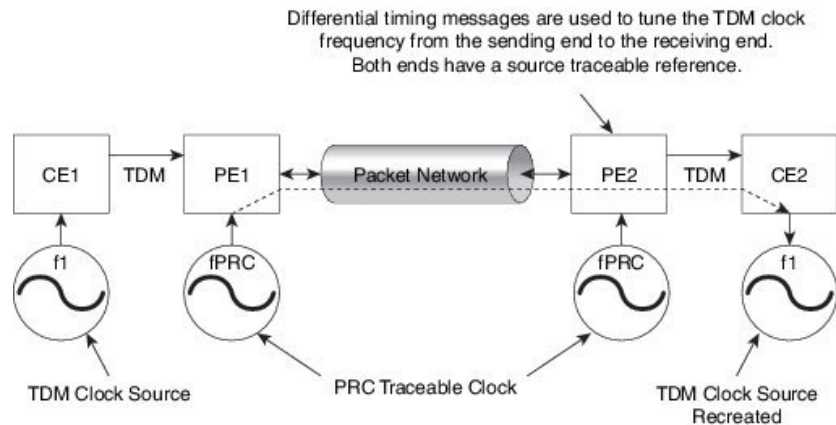

Differential Clock Recovery in CESoPSN

DCR (Differential Clock Recovery) is another technique used for Circuit Emulation (CEM) to recover clocks based on the difference between PE clocks. The clock from the TDM domain is mapped through the packet domain. It differs from ACR in that a PRC traceable clock is used at each end. Differential timing messages are used to tune the TDM clock frequency from the sending end to the receiving end. Both ends have a source traceable reference. Because of this, the recovered clock is not affected by PDV when using DCR.

In contrast with DCR, a PRC traceable clock source is available at each end. ACR is used when a traceable source is not available at both ends of the PSN link.

The recreated service clock accuracy is dependent on the accuracy between the sending and receiving PRC frequencies.

Benefits of Clock Recovery

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

- In CESoPSN, a slave clock is supported for clock redundancy.

Scaling Information

IM Card	Pseudowires Supported (Number of Clocks Derived)
48-Port T1/E1 CEM Interface Module	48

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.

- When ACR or DCR is configured and loopback network is applied on the same PDH (T1/E1), then the ACR or DCR mode configuration is removed to enable the loopback. The ACR or DCR should be configured again after the loopback maintenance activity.

Scale Restrictions

- For the Cisco IOS XE Amsterdam 17.3.x release, a maximum of **5376** ACR and DCR session scale is supported on the Cisco 1-port OC-192 Interface module or 8-port Low Rate Interface Module (8-port SFP GE and 1-port 10GE IM with CEM, 10G). For releases before the Cisco IOS XE Amsterdam 17.3.1 release, only 2000 session are supported.

Configuring ACR in VT 1.5-T1 mode for CESoPSN

To configure the CEM group in the SONET controller:

```
configure terminal
controller sonet <bay>/<slot>/<port>
rate OC3
sts-1 <num>
mode vt-15
vtg <vtg_no> t1 <t1_num> clock source recovered <clock-id>
vtg <vtg_no> t1 <t1_num> cem-group <cem-group-no> timeslots <1-24>
```

To configure the CEM interface for CESoPSN:

```
interface cem <bay>/<slot>/<port>
```

```
cem <cem-group-no>
```

To configure recovered clock for CESoPSN:

```
recovered-clock <bay> <slot>
clock recovered <clock-id> adaptive cem <port-no> <cem-group-no> priority <priority no>
```

Verifying ACR in VT 1.5-T1 mode for CESoPSN

Use the **show recovered-clock** command to verify the ACR for CEM groups 58 and 61 configured in VT 1.5 mode on T1 interface:

```
Router#show recovered clock
Recovered clock status for subslot 0/5
---------------------------------------
Clock   Type    Mode     CEM    Status   Frequency Offset(ppb)  Circuit-No
        Priority
19      OCx-T1  ADAPTIVE   58   ACQUIRING  n/a                    0/2/1/1
(Port/path/vtg/t1)     2
20      OCx-T1  ADAPTIVE   61   ACQUIRING  n/a                    0/2/1/2
(Port/path/vtg/t1)     2
```

Configuring DCR in VT 1.5-T1 mode for CESoPSN

To configure the CEM group in the SONET controller:

```
configure terminal
controller sonet <bay>/<slot>/<port>
rate OC3
sts-1 <num>
mode vt-15
vtg <vtg_no> t1 <t1_num> clock source recovered <clock-id>
vtg <vtg_no> t1 <t1_num> cem-group <cem-group-no> timeslots <1-24>
```

To configure the CEM interface for CESoPSN:

```
interface cem <bay>/<slot>/<port>
cem <cem-group-no>
rtp-present
```

To configure recovered clock for CESoPSN:

```
recovered-clock <bay> <slot>
clock recovered <clock-id> differential cem <port-no> <cem-group-no> priority <priority no>
```

Verifying DCR in VT 1.5-T1 mode for CESoPSN

Use the **show recovered-clock** command to verify the DCR for CEM groups 59 and 60 configured in VT 1.5 mode on T1 interface:

```
Router#show recovered clock
Recovered clock status for subslot 0/5
------------------------------------
Clock    Type     Mode          CEM    Status     Frequency Offset(ppb)  Circuit-No
         Priority
11       OCx-T1   DIFFERENTIAL   59    ACQUIRING  n/a                    0/2/1/1
(Port/path/vtg/t1)     2
12       OCx-T1   DIFFERENTIAL   60    ACQUIRING  n/a                    0/2/1/2
(Port/path/vtg/t1)     2
```

Configuring ACR in CT3-T1 mode for CESoPSN

To configure the CEM group in the SONET controller:

```
configure terminal
controller sonet <bay>/<slot>/<port>
rate OC3
sts-1 <num>
mode ct3
t1 <t1_num> clock source recovered <clock-id>
t1 <t1_num> cem-group <cem-group-no> timeslots <1-24>
```

To configure recovered clock for CESoPSN:

```
recovered-clock <bay> <slot>
clock recovered <clock-id> adaptive cem <port-no> <cem-group-no> priority <priority no>
```

Verifying ACR in CT3-T1 mode for CESoPSN

Use the **show recovered-clock** command to verify the ACR for CEM groups 30 and 34 configured in CT3 mode on T1 interface:

```
Router#show recovered clock
Recovered clock status for subslot 0/5
------------------------------------
Clock    Type     Mode          CEM    Status     Frequency Offset(ppb)  Circuit-No
  Priority
17       OCx-T1   ADAPTIVE       30    ACQUIRING  n/a                    0/1/3 (Port/t3/t1)
  2
18       OCx-T1   ADAPTIVE       34    ACQUIRED   n/a                    0/1/4 (Port/t3/t1)
  2
```

Configuring DCR in CT3-T1 mode for CESoPSN

To configure the CEM group in the SONET controller:

```
configure terminal
controller sonet <bay>/<slot>/<port>
rate OC3
sts-1 <num>
mode ct3
t1 <t1_num> clock source recovered <clock-id>
```

```
t1 <t1_num> cem-group <cem-group-no> timeslots <1-24>
interface cem <bay>/<slot>/<port>
cem < cem-group-no>
rtp-present
```

To configure recovered clock for CESoPSN:

```
recovered-clock <bay> <slot>
clock recovered <clock-id> differential cem <port-no> <cem-group-no> priority <priority no>
```

Verifying DCR in CT3-T1 mode for CESoPSN

Use the **show recovered-clock** command to verify the DCR for CEM groups 31 and 32 configured in CT3 mode on T1 interface:

```
Router#show recovered clock
Recovered clock status for subslot 0/5
---------------------------------------
Clock   Type    Mode          CEM  Status   Frequency Offset(ppb)  Circuit-No
     Priority
17      OCx-T1  DIFFERENTIAL   31  ACQUIRING n/a                    0/1/3 (Port/t3/t1)
     2
18      OCx-T1  DIFFERENTIAL   32  ACQUIRED  n/a                    0/1/4 (Port/t3/t1)
     2
```

Configuring Clocking for ACR and DCR on APS for CESoPSN

Configuring Clocking for ACR on APS CT3-T1 in CESoPSN

For clocking, you need to configure Sonet controllers with prriority.

To configure clock source in CT3 mode of STS-1 for CESoPSN, use the following commands:

```
enable
configure terminal
controller mediatype 0/5/0
mode sonet
controller sonet 0/5/0
rate oc3
sts-1 1
mode ct3
t1 1 clock source recovered 1
end
```

To configure the recovered clock with priority 1, use the following commands:

```
enable
configure terminal
recovered-clock acr 200
clock recovered 1 adaptive cem 1 priority 1
end
```

To configure clock source in CT3 mode of STS-1 for CESoPSN, use the following commands:

```
enable
configure terminal
controller sonet 0/4/6
sts-1 1
mode ct3
t1 1 clock source recovered 1
end
```

To configure the recovered clock with priority 2, use the following commands:

```
enable
configure terminal
recovered-clock acr 200
clock recovered 1 adaptive cem 2 priority 2
end
```

Verifying Clocking for ACR on APS CT3-T1 in CESoPSN

Use the **show recovered-clock** command to verify the ACR on APS in CT3 mode for CESoPSN:

```
Router#show recovered clock

Recovered clock status for SONET-ACR 200
------------------------------------
Clock   Type    Mode      CEM   Status      Circuit-No              Working    Protect
   Priority
1    OCx-T1   ADAPTIVE    1    ACQUIRED    200/1/1(acr/t3/t1)        ACQUIRED   ACQUIRED
   1
4    OCx-T1   ADAPTIVE    38   ACQUIRING   200/3/1/1(acr/path/vtg/t1)  ACQUIRIN  ACQUIRING
   1
```

Configuring Clocking for DCR on APS CT3-T1 in CESoPSN

For clocking, you need to configure Sonet controllers with prriority.

To configure clock source in CT3 mode of STS-1 for CESoPSN, use the following commands:

```
enable
configure terminal
controller mediatype 0/3/6
mode sonet
rate oc3
sts-1 1
mode ct3
t1 1 clock source recovered 1
end
```

To configure CEM interface, use the following commands:

```
interface cem <bay>/<slot>/<port>
cem <cem-group-no>
rtp-present
```

To configure the recovered clock with priority 1, use the following commands:

```
enable
```

```
configure terminal
recovered-clock dcr 200
clock recovered 1 differential cem 1 priority 1
end
```

To configure clock source in CT3 mode of STS-1 for CESoPSN, use the following commands:

```
enable
configure terminal
controller sonet 0/4/6
sts-1 1
mode ct3
t1 1 clock source recovered 1
end
```

To configure CEM interface, use the following commands:

```
interface cem <bay>/<slot>/<port>
cem <cem-group-no>
rtp-present
```

To configure the recovered clock with priority 2, use the following commands:

```
enable
configure terminal
recovered-clock dcr 200
clock recovered 1 differential cem 2 priority 2
end
```

Verifying Clocking for DCR on APS CT3-T1 in CESoPSN

Use the **show recovered-clock** command to verify the DCR on APS in CT3 mode for CESoPSN:

```
Router#show recovered clock

Recovered clock status for SONET-DCR 200
----------------------------------------
Clock   Type    Mode      CEM   Status      Circuit-No          Working    Protect
   Priority
2    OCx-T1   DIFFERENTIAL  13   ACQUIRED     200/2/1(dcr/t3/t1)       ACQUIRED  ACQUIRED
  1
5    OCx-T1   DIFFERENTIAL  44   ACQUIRING    200/4/1/1(dcr/path/vtg/t1) ACQUIRIN  ACQUIRING
  1
```

Configuring Clocking for ACR on APS VT 1.5-T1 in CESoPSN

For clocking, you need to configure Sonet controllers with prriority.

To configure clock source in VT 1.5 mode of STS-1 for CESoPSN, use the following commands:

```
enable
configure terminal
controller sonet 0/3/6
sts-1 1
mode vt-15
vtg 1 t1 1 clock source recovered 4
end
```

To configure the recovered clock with priority 1, use the following commands:

```
enable
configure terminal
recovered-clock acr 200
clock recovered 4 adaptive cem 38 priority 1
end
```

To configure clock source in VT1.5 mode of STS-1 for CESoPSN, use the following commands:

```
enable
configure terminal
controller sonet 0/4/6
sts-1 1
mode vt-15
vtg 1 t1 1 clock source recovered 4
end
```

To configure the recovered clock with priority 2, use the following commands:

```
enable
configure terminal
recovered-clock acr 200
clock recovered 4 adaptive cem 39 priority 2
end
```

Verifying Clocking for ACR on APS VT 1.5-T1 in CESoPSN

Use the **show recovered-clock** command to verify the ACR on APS in VT 1.5 mode for CESoPSN:

```
Router#show recovered clock
Recovered clock status for SONET-ACR/SDH-ACR 200
---------------------------------------
Clock    Type    Mode       CEM    Status       Circuit-No           Working    Protect
   Priority
4    OCx-T1    ADAPTIVE    38    ACQUIRING  200/3/1/1(acr/path/vtg/t1) ACQUIRIN  ACQUIRING
   1
```

Configuring Clocking for DCR on APS VT 1.5-T1 in CESoPSN

For clocking, you need to configure Sonet controllers with prriority.

To configure clock source in VT 1.5 mode of STS-1 for CESoPSN, use the following commands:

```
enable
configure terminal
controller sonet 0/3/6
sts-1 1
mode vt-15
vtg 1 t1 1 clock source recovered 4
end
```

To configure CEM interface, use the following commands:

```
interface cem <bay>/<slot>/<port>
cem <cem-group-no>
rtp-present
```

To configure the recovered clock with priority 1, use the following commands:

```
enable
configure terminal
recovered-clock acr 200
clock recovered 4 differential cem 38 priority 1
end
```

To configure clock source in VT1.5 mode of STS-1 for CESoPSN, use the following commands:

```
enable
configure terminal
controller sonet 0/4/6
sts-1 1
mode vt-15
vtg 1 t1 1 clock source recovered 4
end
```

To configure CEM interface, use the following commands:

```
interface cem <bay>/<slot>/<port>
cem <cem-group-no>
rtp-present
```

To configure the recovered clock with priority 2, use the following commands:

```
enable
configure terminal
recovered-clock acr 200
clock recovered 4 differential cem 39 priority 2
end
```

Verifying Clocking for DCR on APS VT 1.5-T1 in CESoPSN

Use the **show recovered-clock** command to verify the DCR on APS in VT 1.5 mode for CESoPSN:

```
Router#show recovered clock
Recovered clock status for SONET-ACR 200
---------------------------------------
Clock    Type    Mode      CEM    Status      Circuit-No        Working    Protect
   Priority
5    OCx-T1   DIFFERENTIAL  44   ACQUIRING  200/4/1/1(acr/path/vtg/t1) ACQUIRIN  ACQUIRING
  1
```

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 0/5/0
mode sonet
controller sonet 0/5/0
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 CT3 Framed SAToP mode:

```
enable
configure terminal
controller MediaType 0/5/0
mode sonet
controller sonet 0/5/0
rate oc3
sts-1 2
mode ct3
t3 framing c-bit
t1 1 cem-group 1 framed
end
```

Verifying SONET Configuration for Framed SAToP

To verify SONET configuration for Framed SAToP:

```
Router# show running configuration | sec 0/5/0
platform enable controller mediatype 0/5/0 oc3
controller mediatype 0/5/0
mode sonet
controller sonet 0/5/0
rate oc3
no ais-shut
alarm-report all
clock source internal
!
sts-1 1
clock source internal
mode vt-15
vtg 1 t1 1 cem-group 0 framed
!
sts-1 2
clock source internal
mode ct3
t3 framing c-bit
t3 clock source internal
t1 1 cem-group 1 framed
!
sts-1 3
clock source internal
mode ct3-e1
t3 framing c-bit
t3 clock source internal
e1 1 cem-group 2 framed
interface cem 0/5/0
no ip address
cem 0
!
cem 1
!
cem 2
```

```
#Router
```

Associated Commands

The following table shows the Associated Commands for SONET configuration:

Commands	Links
ais-shut	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp7654966010
alarm-report	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp2800999060
aps adm	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp8015117230
aps group	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp1674734739
aps protect	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp2073867702
aps revert	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp4063780600
aps unidirectional	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp5340799170
aps working	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-a1.html#wp8949584630
cem-group *cem-group-number* **cep**	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600
controller mediatype	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1201337639
controller protection-group	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-03.html
controller sonet	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp2020468554

Commands	Links
clock source	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp3604380959
loopback	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp2735045490
mode sonet	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp2327088950
mode sts-nc	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp1791424945
mode vt-15	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp1137973905
overhead c2	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp1973678817
overhead j0	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp4338698890
overhead j1	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp1987243836
overhead s1s0	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp2779929239
protection-group	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-10.html
protection-group [**working** | **protect**]	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-10.html
rate [**OC3** | **OC12** | **OC48** | **OC192**]	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp4442889730
shutdown	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s6.html#wp3364503641
show controllers sonet	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp1341372847

Configuring SONET

Additional References for Configuring SONET on 1-Port OC192/STM-64 or 8-Port OC3/12/48/STM-1/-4/-16 Interface Module

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

Additional References for Configuring SONET on 1-Port OC192/STM-64 or 8-Port OC3/12/48/STM-1/-4/-16 Interface Module

Related Documents

Related Topic	Document Title
Cisco IOS commands	http://www.cisco.com/en/US/docs/ios/mcl/allreleasemcl/all_book.html

Standards

Standards	Title
—	There are no standards for this feature.

Configuring SONET

Additional References for Configuring SONET on 1-Port OC192/STM-64 or 8-Port OC3/12/48/STM-1/-4/-16 Interface Module

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: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
—	There are no RFCs for this feature.

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. 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. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html