



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.

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Overview of SONET

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

SONET has a hierarchy of signaling speeds.

Restrictions for SONET

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

Restrictions on Bandwidth

- Total available bandwidth is 10G.

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

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

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

The following table shows the bandwidth used by different rates:

Table 1: Bandwidth Used by Different Rates

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

Restrictions for Clock Source Configuration

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

SONET Switching

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

Modes of CEM:

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

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

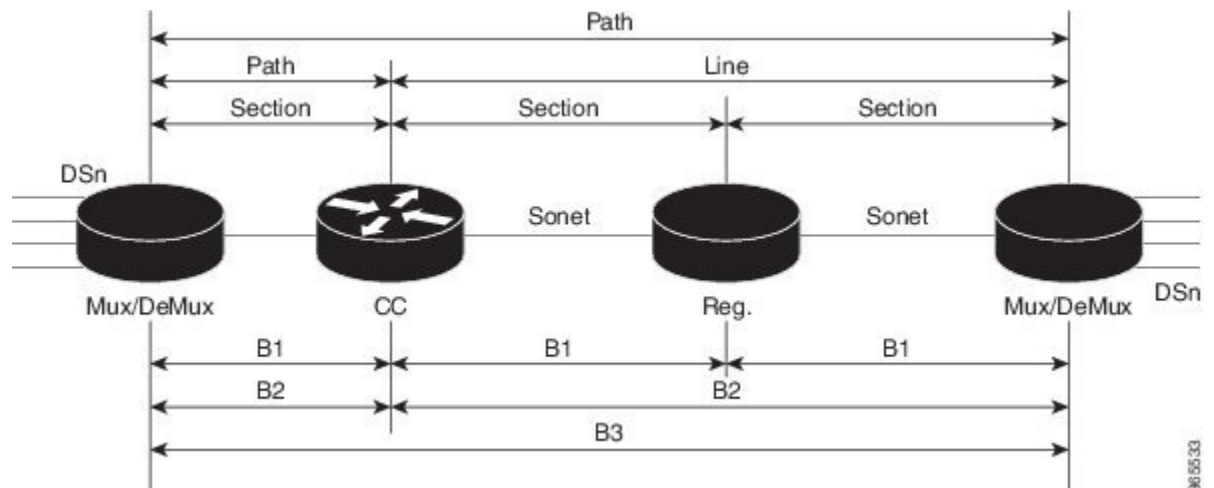
- **Circuit Emulation Service over Packet (CEP)** (RFC 4842) - CEP mode is used to encapsulate SONET payload envelopes (SPEs) like VT1.5 or VT2 or STS-1 or STS-Nc over packet switched networks. In this mode, the bytes from the corresponding SPE are sent out as they arrive on the TDM line. The interface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

Table 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 DS1	SAToP	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

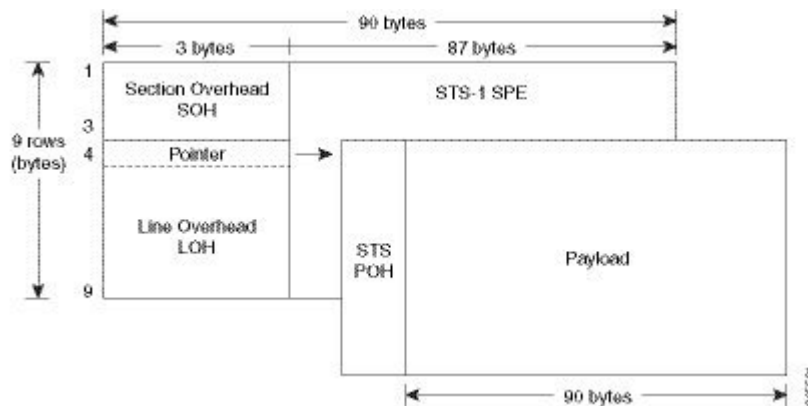
Path-Terminating Equipment (PTE) interfaces non-SONET equipment to the SONET network. At this layer, the payload is mapped and demapped into the SONET frame. For example, an STS PTE can assemble 25 1.544 Mbps DS1 signals and insert path overhead to form an STS-1 signal.

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.

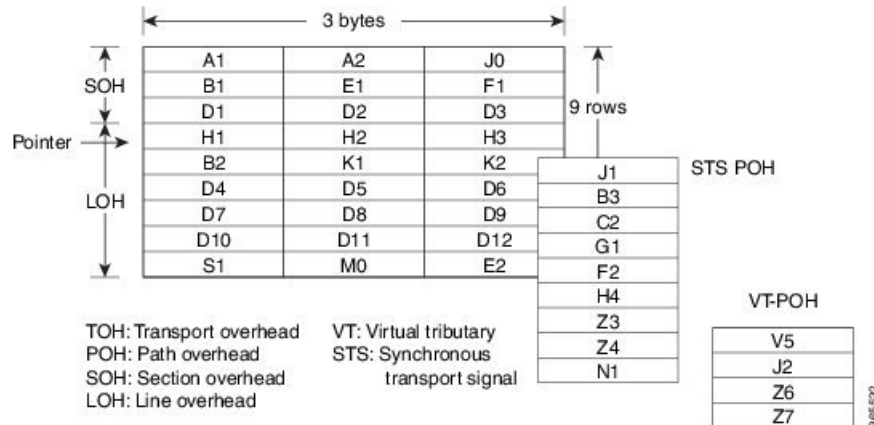
Figure 2: STS-1 Frame Structure



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

BERT

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

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

The supported BERT patterns are 2¹⁵, 2²⁰, 2²³, all 0s.

BERT is supported in the following two directions:

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

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

Modes	Patterns
SONET Path Level	<ul style="list-style-type: none"> • 0s - Repeating pattern of zeros • 2¹⁵ - O.151 - Error and Jitter measurement of 1544, 2048, 6312, 8448, 32064, 44736 kbps • 2²⁰ - O.153 • 2²⁰ - O.151 - Error and Jitter measurement upto 72 kbps • 2²³ - O.151 - Error and Jitter measurement of 34368 kbps and 139264 kbps

Modes	Patterns
SONET T3 or CT3 (T1) or VTG T1 or VT levels	<ul style="list-style-type: none"> • 0s - Repeating pattern of zeros • $2^{11} 2^{11-1}$ test pattern • $2^{15} - 0.151$ - Error and Jitter measurement of 1544, 2048, 6312, 8448, 32064, 44736 kbps • $2^{20} - 0.153$ • $2^{20} - 0.151$ - Error and Jitter measurement upto 72 kbps • $2^{23} - 0.151$ - Error and Jitter measurement of 34368 kbps and 139264 kbps • $2^{31} 2^{31-1}$ test pattern • $2^9 2^9-1$ test pattern

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.

SONET Protection Switching

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 (ADM). 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 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
- UPSR Path Protection at STS Level
- UPSR Path Protection at VT Level

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

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

```

Alarms at SONET Layers

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

SONET Alarm Surveillance

SONET alarm surveillance uses two terms:

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

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

Section Alarms

The following section alarms are supported:

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

Line Alarms

The following line alarms are supported:

- AIS-L — Line AIS
- REI-L — Line Remote Error Indication

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

Path Alarms

The following path alarms are supported:

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

VT Alarms

The following VT alarms are supported:

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

T1 Alarms

The following T1 alarms are supported:

- LOS — DS1 Line loss of Signal
- AIS — DS1 Path Alarm Indication Signal
- AIS-CI — DS1 Path Alarm Indication Signal Customer Installation
- LOF — DS1 Path Loss of Frame

- RDI/RAI — Remote Defect Indication or Remote Alarm Indication
- RAI-CI — Remote Alarm Indication Customer Installation
- TCA for Line and Path DS1

T3 Alarms

The following T3 or path alarms are supported:

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

Alarm Indicators

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

How to Configure SONET

This section describes how to configure SONET.

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

Prerequisites for Configuring SONET

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

You must configure the controller as a SONET port.

Configuring MediaType Controller

To configure MediaType Controller, use the following commands:

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

Configuring SONET Ports

To configure SONET ports, use the following commands:

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

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

Managing and Monitoring SONET Line

This section describes how to manage and monitor SONET.

Configuring Line and Section Overhead

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

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



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

Configuring Line Loopback

To configure loopback, use the following commands:

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



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

Configuring AIS Shut

To configure AIS-Shut, use the following commands:

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



```
ais-shut
end
```



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

Configuring Shut

To configure Shut, use the following commands:

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



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

Configuring Alarm Reporting

To configure alarm reporting, use the following commands:

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



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

Configuring Clock

To configure clock, use the following commands:

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



Note The default mode is internal.



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

Configuring Network-Clock SONET

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

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

Configuring STS-1 Modes

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

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



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

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



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

Configuring DS1/T1 CT3 mode of STS-1

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

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



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

Configuring STS-Nc - Contiguous Concatenation

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

```

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

```



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



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

Configuring APS for SAToP

This section describes the configuration of APS for SAToP.

Configuring Bi-directional ACR (SONET Framing)

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

```

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

```



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

Configuring Unidirectional APS

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

```

enable
configure terminal
controller sonet 0/0/16
clock source internal
aps group acr 1
aps working 1
aps unidirectional
exit
controller sonet 0/0/17
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.



Note Ensure that you use same interface modules for both work and protect links.

Verifying ACR Configurations

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 0/0/16 SONET 0/0/16 SONET 0/0/16
```

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	CEM 0/0/16	CEM 0/0/16	CEM 0/0/16	

```
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 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: Te 0/0/16, 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 0/0/16 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 VT 1.5-T1 Loopback

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

```

enable
configure terminal
controller sonet 0/0/16
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

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

```

enable
configure terminal
controller sonet 0/0/16
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 0/0/16
sts-1 1
overhead c2 10
end

```

J1 Flag

To configure the J1 flag, use the following commands:

```

enable
configure terminal
controller sonet 0/0/16
sts-1 1
overhead j1 expected length
end

```

Configuring Path Threshold

To configure path threshold, use the following commands:

```

enable
configure terminal
controller sonet 0/0/16
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 0/0/16
SONET 0/0/16 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)

```



```

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

```

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

```

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

```

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

SONET Path Tables

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

```

PATH 2:
Clock Source is internal
    
```

```

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

```

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

```

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

```

Expected J1 Length : 64
Expected J1 Trace
52 6F 75 74 65 72 20 30 2F 32 2F 30 2E 32 00 00  Router 0/2/0.2..
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
    
```

```

PATH TRACE BUFFER : UNSTABLE
    
```

```

Rx J1 Length : 0
Rx J1 Trace
    
```

```

SONET Path Tables
    
```

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

PATH 3:
Clock Source is internal

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

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

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

Tx J1 Length : 64
Tx J1 Trace

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

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

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

OC3.STS1 0/0/16 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 3: Field Description

Field	Description
SONET 0/0/16 is up	Shows that the SONET controller is operating. The controller's state can be up, down, or administratively down.
Port configured rate: OC3	Shows the rate configured on the port.
SECTION: LOS = 0 LOF = 0 BIP = 0	Shows the section level alarm counters.
SONET Section Tables: INTERVAL CV ES SES SEFS 05:50-05:58 0 0 0 0	Shows the PMON for the port.
LINE: AIS = 0 RDI = 0 REI = 0 BIP(B2) = 0	Shows the line level alarm counters.
Asserted/Active Alarms: None	Shows the active alarms on the port.

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

Configuring CEM Group for Framed SAToP

To configure a CEM group for Framed SAToP:

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

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

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

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

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

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

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

Configuring CEM APS for Framed SAToP

To configure unidirectional ACR (SONET Framing) for framed SAToP:

```
enable
configure terminal
controller sonet 0/4/16
rate OC3
clock source internal
aps group acr 1
aps working 1
exit
controller sonet 0/4/16
rate OC3
aps group acr 1
aps unidirectional
aps protect 1 10.7.7.7
aps revert 3
aps adm
controller sonet-acr 1
sts-1 1
mode vt-15
vtg 1 t1 1 cem-group 0 framed
end
```

To configure bi-directional ACR (SONET Framing) for Framed SAToP:

```
enable
configure terminal
```

```

controller sonet 0/4/16
rate OC3
clock source internal
aps group acr 1
aps working 1
exit
controller sonet 0/4/16
rate OC3
aps group acr 1
aps protect 1 10.7.7.7
controller sonet-acr 1
sts-1 1
mode vt-15
vtg 1 t1 1 cem-group 0 framed
end

```

Verifying SONET Configuration for Framed SAToP

To verify SONET configuration for Framed SAToP:

```

Router# show running configuration | sec 0/0/16
platform enable controller mediatype 0/0/16 oc3
controller mediatype 0/0/16
mode sonet
controller sonet 0/0/16
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 0/0/16
no ip address
cem 0
!
cem 1
!
cem 2

#Router

```

Provisioning APS 1+1



Note Ensure to follow the steps only in the order provided.

Perform the following generic steps to provision APS 1+1.

- Step 1** Provision a physical controller with mode and rate.
- Step 2** Put controllers into the APS group and define as working or protect.
- Step 3** Setup STS1s on the sonet-acr controller. Cem-group placement is done on the logical port.
- Step 4** Setup ACR or DCR clocking on the physical controllers.
- Step 5** Provision clock recovered configuration under the recovered-clock section.
- Step 6** Apply xconnect under the cem-acr interface.

Deprovisioning APS 1+1



Note Ensure to follow the steps only in the order provided.

Perform the following generic steps to deprovision APS 1+1.

- Step 1** Remove all xconnect under the cem-acr interface.
- Step 2** Remove clock source for all ACR or DCR services under the physical controllers.
- Step 3** Remove the clock recovered lines under the recovered-clock ACR section.
- Step 4** Remove all provisioning under the sonet-acr controller. This includes cem-group information and mode settings.
- Step 5** Shutdown the physical controller setup for Protect, remove aps provisioning and apply no shut controller.
- Step 6** Shutdown the physical controller setup for Working, remove aps provisioning and apply no shut controller.
- Step 7** Remove the *acr XX type* line in the config.
- Step 8** Remove the mode sonet from each physical controller media type to restore the controller to its default setup.

Performance Monitoring Use Cases or Deployment Scenarios

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

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

```
Router# show controller sonet 0/2/0
SONET 0/2/0 is up.
  Hardware is NCS4200-1T8S-10CS
```

```

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 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 20 20 20 20 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 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 20 20 20 20 20 20
20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 00 00 ..
  
```

```

Rx J0 Length : 64
Rx J0 Trace :
  
```

```

01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01
01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01
01 01 01 01 01 01 01 01 01 01 01 01 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	UASF
12:00-12:07	0	0	0	0	0	0	0	389
11:45-12:00	0	1	1	0	0	0	0	900
Total of Data in Current and Previous Intervals								
11:45-12:07	0	1	1	0	0	0	0	1289

PATH 2:

Clock Source is internal

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

Active Defects: None

Detected Alarms: PLOP

Asserted/Active Alarms: PLOP

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

TCA threshold: B3 = 10e-6

Rx: C2 = 00

Tx: C2 = 04

Tx J1 Length : 64

Tx J1 Trace

```

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

```

Expected J1 Length : 64

Expected J1 Trace

```

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

```

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0

Rx J1 Trace

SONET Path Tables

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

PATH 3:

Clock Source is internal

```

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

```

Active Defects: None

Detected Alarms: PLOP LOM

Asserted/Active Alarms: PLOP

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

TCA threshold: B3 = 10e-6

Rx: C2 = 00

Tx: C2 = 02

Tx J1 Length : 64

Tx J1 Trace

```

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

```

Expected J1 Length : 64

Expected J1 Trace

```

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

```

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

PATH TRACE BUFFER : UNSTABLE

Rx J1 Length : 0
Rx J1 Trace

SONET Path Tables

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

SONET 0/2/0.1 T3 is down.
NCS4200-1T8S-10CS

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

FEAC code received: No code is being received
Framing is C-BIT Parity, Cablelength is 224
BER thresholds: SF = 10e-3 SD = 10e-6
Clock Source is internal
Equipment customer loopback
Data in current interval (390 seconds elapsed):

Near End
0 Line Code Violations, 0 P-bit Coding Violations
0 C-bit Coding Violations, 0 P-bit Err Secs
0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
389 Unavailable Secs, 0 Line Errored Secs
0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
0 Severely Errored Line Secs, 0 Path Failures
0 AIS Defect Secs, 0 LOS Defect Secs

Far End
0 Errored Secs, 0 Severely Errored Secs
0 C-bit Unavailable Secs, 0 Path Failures
0 Code Violations, 0 Service Affecting Secs

Data in Interval 1:

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

Far End
0 Errored Secs, 0 Severely Errored Secs
0 C-bit Unavailable Secs, 0 Path Failures
0 Code Violations, 0 Service Affecting Secs

Total Data (last 1 15 minute intervals):

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

```

Far End
  0 Errored Secs, 0 Severely Errored Secs
  0 C-bit Unavailable Secs, 0 Path Failures
  0 Code Violations, 0 Service Affecting Secs

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

SONET 0/2/0.2 T3 is down.
Hardware is 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
Data in current interval (400 seconds elapsed):
  Near End
    0 Line Code Violations, 0 P-bit Coding Violations
    0 C-bit Coding Violations, 0 P-bit Err Secs
    0 P-bit Severely Err Secs, 0 Severely Err Framing Secs

```

```

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

```

```

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

```

ONS Pluggables

A comprehensive range of pluggable optical modules is available. .

Configuring ONS Pluggables

To configure ONS Pluggables, use the following commands:

```

enable
configure terminal

```

```

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

```

Verifying the Supported Pluggables

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

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

```

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

```



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

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

```

show hw-module subslot 0/7 transceiver 6 idprom detail
IDPROM for transceiver SPA-1T8S-10CS_7/6:
  Description                        = SFP or SFP+ optics (type 3)
  Transceiver Type:                  = ONS SE Z1 (406)
  Product Identifier (PID)           = ONS-SE-Z1
  Vendor Revision                     = A
  Serial Number (SN)                 = FNS19251NPM
  Vendor Name                         = CISCO-FINISAR
  Vendor OUI (IEEE company ID)       = 00.90.65 (36965)
  CLEI code                          = WMOTCZPAAA
  Cisco part number                  = 10-1971-04
  Device State                       = Enabled.
  Date code (yy/mm/dd)               = 15/06/19
  Connector type                     = LC.
  Encoding                           = 8B10B
                                     NRZ
                                     Manchester
  Nominal bitrate                    = OC48/STM16 (2500 Mbits/s)
  Minimum bit rate as % of nominal bit rate = not specified
  Maximum bit rate as % of nominal bit rate = not specified
  The transceiver type is 406
  Link reach for 9u fiber (km)       = IR-1(15km) (15)
  Link reach for 50u fiber (m)       = SR(2km) (0)
                                     IR-1(15km) (0)
                                     IR-2(40km) (0)
                                     LR-1(40km) (0)
                                     LR-2(80km) (0)
                                     LR-3(80km) (0)
                                     DX(40KM) (0)
                                     HX(40km) (0)
                                     ZX(80km) (0)
                                     VX(100km) (0)
                                     1xFC, 2xFC-SM(10km) (0)
                                     ESCON-SM(20km) (0)
  Link reach for 62.5u fiber (m)     = SR(2km) (0)
                                     IR-1(15km) (0)

```

```

IR-2 (40km) (0)
LR-1 (40km) (0)
LR-2 (80km) (0)
LR-3 (80km) (0)
DX (40KM) (0)
HX (40km) (0)
ZX (80km) (0)
VX (100km) (0)
1xFC, 2xFC-SM (10km) (0)
ESCON-SM (20km) (0)

Nominal laser wavelength = 1310 nm.
DWDM wavelength fraction = 1310.0 nm.
Supported options = Tx disable
                    Tx fault signal
                    Loss of signal (standard implementation)

Supported enhanced options = Alarms for monitored parameters
                             Software Rx LOS monitoring

Diagnostic monitoring = Digital diagnostics supported
                      Diagnostics are externally calibrated
                      Rx power measured is "Average power"

Transceiver temperature operating range = -40 C to 85 C (industrial)
Minimum operating temperature = -40 C
Maximum operating temperature = 85 C
High temperature alarm threshold = +90.000 C
High temperature warning threshold = +85.000 C
Low temperature warning threshold = -40.000 C
Low temperature alarm threshold = -45.000 C
High voltage alarm threshold = 3630.0 mVolts
High voltage warning threshold = 3470.0 mVolts
Low voltage warning threshold = 3140.0 mVolts
Low voltage alarm threshold = 2971.2 mVolts
High laser bias current alarm threshold = 85.000 mAmps
High laser bias current warning threshold = 65.000 mAmps
Low laser bias current warning threshold = 4.000 mAmps
Low laser bias current alarm threshold = 2.000 mAmps
High transmit power alarm threshold = 4.0 dBm
High transmit power warning threshold = 2.0 dBm
Low transmit power warning threshold = -7.0 dBm
Low transmit power alarm threshold = -9.0 dBm
High receive power alarm threshold = 1.0 dBm
Low receive power alarm threshold = -26.0 dBm
High receive power warning threshold = -1.0 dBm
Low receive power warning threshold = -24.9 dBm
External Calibration: bias current slope = 1.000
External Calibration: bias current offset = 0

```

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

```

sh hw-module subslot 0/7 transceiver 6 idprom brief
IDPROM for transceiver SPA-1T8S-10CS_7/6:
Description = SFP or SFP+ optics (type 3)
Transceiver Type: = ONS SE Z1 (406)
Product Identifier (PID) = ONS-SE-Z1
Vendor Revision = A
Serial Number (SN) = FNS19251N00
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

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 <i>cem-group-number cep</i>	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

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

Loopback Remote on T1 and T3 Interfaces

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

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

Restrictions for Loopback Remote

E1 and E3 loopback remote are not supported.

Configuring Loopback Remote in Sonet

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

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

```
vtg 1 t1 1 loopback remote iboc {fac1 | fac2 | csu}
```

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

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

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

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



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

Verifying the Loopback Remote Configuration

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

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

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

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

Use the following command to check T3 loopback remote configuration:

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

Use the following command to verify T3 loopback remote configuration:

```
Router(config-ctrlr-sts1)# do show controller sonet 0/0/1 | b Path 3
OC3.STS1 0/0/1 Path 3 is up. (Configured for Remotely Looped)
  Currently in Remotely Line Looped
  Hardware is NCS4200-3GMS

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

