

Automatic Protection Switching

Table 1: 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.
CEM and IP IW Feature Parity for A900-IMA1Z8S-CXMS and A900-IMA3G-IMSG Interface Modules	Cisco IOS XE Bengaluru 17.4.1	Support for APS and non-APS on SDH and SONET for iMSG IPv6 interworking on A900-IMA1Z8S-CXMS and A900-IMA3G-IMSG 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 partially comply with Telcordia—GR-253-CORE standard. 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
- UPSR Path Protection at STS Level
- UPSR Path Protection at VT Level

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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.

Restrictions for APS

- APS group number of 255 and UPSR group ID of 1 can't be configured on the same router.
- For the releases earlier to Cisco IOS XE Cupertino 17.9.1, when there's a Line Remote Defect Indicator (LRDI) or Line Alarm Indication Signal (LAIS) alarm detected on the protect port, then the received K2 byte stays zero.

  For the releases later than Cisco IOS XE Cupertino 17.9.1, when there's an LRDI alarm on the protect channel, the received K2 reflects the LRDI alarm. Whereas for the LAIS alarm on the protect channel, due to all 1s in the SONET or SDH frame rx K1 or K2 becomes invalid, and the router displays the last received best value.
- The **aps exercise** command is not supported with A900-IMA1Z8S-CXMS and A900-IMA3G-IMSG interface modules.
- The APS switch commands are autocleared on reload and controller-shut operations.
- When APS is configured as the revertive mode, then **aps revert** must be enabled from both the ends.
- During *Wait-to-Restore (working)*, when you configure **no aps revert**, then it takes into effect only after the current wait to restore operation completes.
- On the RSP3 module, it takes a long time (for example, more than half an hour) to copy scale configuration (8064 VT CEP) from boot flash to the running configuration. As a workaround, you can copy the individual configuration one after the other from the CLI.
- You can perform a force switchover to overcome the following limitations:
  - An interface module OIR, either through physical or software causes the APS switchover time to be higher (500-600ms).
  - Shut or no shut of the port may lead to higher APS switchover time.
  - Removal of the active working or protect interface may lead to higher APS switchover time.

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 0/4/17
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 0/4/17
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.

Procedure

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.

Procedure

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 step includes cem-group information and mode settings.

Step 5 Shut down the physical controller setup for Protect, remove APS provisioning, and apply no shut controller.

Step 6 Shut down the physical controller setup for Working, remove APS provisioning and apply no shut controller.

Step 7 Remove the *acr XX type* line in the configuration.

Step 8 Remove the mode SONET from each physical controller media type to restore the controller to its default setup.

Step 9 Remove ACR completely from the SONET or SDH interfaces. Ensure that you remove ACR from the virtual SONET and SDH controllers.

SONET Controller

```
config terminal
no controller sonet-acr <group-id>
end
```

The following example shows how to remove ACR completely from the SONET controller:

```
config terminal
no controller sonet-acr 100
end
```

SDH Controller

```
config terminal
no controller sdh-acr <group-id>
end
```

The following example shows how to remove ACR completely from the SDH controller:

```
config terminal
no controller sdh-acr 100
end
```

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 0/0/17
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 0/0/17      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 172.16.0.1 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: 0, Line: UP, Admin: UP, Ckt: ACTIVE
Path Mode : VT15, STS: 1, VTG: 1, T1: 1, CEM Mode: T1-SAToP
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: 10.2.2.2, 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: 192.168.1.2
  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 10.2.2.2:0 up
    Targeted Hello: 10.1.1.1(LDP Id) -> 10.2.2.2, 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: 10.2.2.2/1, 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 10.1.1.1 (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 10.1.1.1
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
```

Monitoring Protection Switching Count for Protected SONET Interface

Table 2: Table 1. Feature History

Feature Name	Release Information	Feature Description
Protection Switching Count for Protected SONET Interface	Cisco IOS XE 17.15.1	In SONET networks with redundancy, Automatic Protection Switching (APS) seamlessly transitions traffic between working and standby protection links, typically due to circuit failures or other disruptions. Each switching event is tracked using the Protection Switching Count (PSC) parameter. This parameter allows network operators to monitor and analyze the frequency of these switches in real-time. By examining the PSC count, users can diagnose the network to identify the root causes of frequent switching events and implement necessary corrective actions. This advanced capability significantly enhances network reliability and performance, offering users a robust and efficient solution for maintaining optimal service quality.

In addition to SONET alarms, the Protection Switching Count (PSC) parameter records the number of times that a SONET traffic is switched between working and protection SONET circuits automatically. The switching count can be monitored and tracked as part of performance monitoring at 15-minute and 24-hour intervals. A higher PSC value serves as an alert, prompting administrators to investigate the SONET network for failures and implement corrective actions to restore optimal performance.

Supported Interface Module for PSC Monitoring

PSC monitoring is supported on these interface modules:

- A900-IMA3G-IMSG
- A900-IMA1Z8S-CXMS

Viewing the PSC Parameter

You can view the PSC parameter under the **SONET Section Tables** area of the **show controller sonet** and **show controller sonet tabular** commands.

In the show output example where the performance monitoring is set for a period of 15-minutes, you can view the PSC value of 2. This indicates that switching occurred twice every 15 minutes, with a total switching count of 4 on the SONET interface.

```
Router#show controller sonet 0/3/1
SONET 0/3/1 is up.(Configured for Locally Looped)
  Currently in Locally Looped
  Alarm-profile: telcordia
  Sec-admin-state: maintenance, Soak-time: NA,
  soak-Time-left: NA, AINS-state: OOS-MA,LPBK & MT
  Hardware is A900-IMA1Z8S-CXMS

 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 = 1          LOF = 0                           BIP(B1) = 0

SONET Section Tables
  INTERVAL       CV    ES   SES  SEFS    PSC
  20:46-20:53     0    170  170   170    2 (Invalid)
  20:31-20:46     0    559  559   559    2 (Invalid)
Total of Data in Current and Previous Intervals
                  0    729  729  729     4 (Invalid)

LINE:
  AIS = 0          RDI = 0          REI = 12         BIP(B2) = 36
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 :

  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 00 00                    ..

Rx J0 Length : 64
Rx J0 Trace :

  52 6F 75 74 65 72 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 0D 00                    ..

SONET Line Tables
  INTERVAL       CV    ES   SES   UAS  CVFE  ESFE  SESFE  UASFE
  02:35-02:47     0     5     5     0     0     0      0      0  (NE, FE Invalid)


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 = 00
Tx: C2 = 00

Tx J1 Length : 64
Tx J1 Trace

  52 6F 75 74 65 72 20 30 2F 33 2F 31 2E 31 00 00     Router 0/3/1.1..
  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 33 2F 31 2E 31 00 00     Router 0/3/1.1..
  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 : 0
Rx J1 Trace


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

  52 6F 75 74 65 72 20 30 2F 33 2F 31 2E 32 00 00     Router 0/3/1.2..
  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 33 2F 31 2E 32 00 00     Router 0/3/1.2..
  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


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

  52 6F 75 74 65 72 20 30 2F 33 2F 31 2E 33 00 00     Router 0/3/1.3..
  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 33 2F 31 2E 33 00 00     Router 0/3/1.3..
  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
```

Viewing the PSC Parameter from the Detailed Show Output

The **show controller sonet tabular** command displays a detailed output of the SONET configuration along with the PSC value that can be viewed under the **SONET Section Tables** area.

In the show output example where the performance monitoring is set for a period of 15-minutes, you can view the PSC value of 1. This indicates that switching occurred once every 15 minutes, with a total switching count of 2 on the SONET interface.

```
Router#show controller sonet 0/3/1 tabular
SONET 0/3/1 is up.(Configured for Locally Looped)
  Currently in Locally Looped
  Hardware is A900-IMA3G-IMSG

 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 = 1          LOF = 0                          BIP(B1) = 0

SONET Section Tables
  INTERVAL       CV-S    ES-S   SES-S  SEFS-S    PSC
  12:15-12:29       0       0       0       0      0
  12:00-12:15       0       0       0       0      0
  11:45-12:00       0       0       0       0      0
  11:30-11:45       0     404     404     404      1
  11:15-11:30       0     619     619     619      1
  11:00-11:15       0       0       0       0      0
  10:45-11:00       0     711     711     711      0
  10:30-10:45       0     656     656     656      0  (Invalid)
Total of Data in Current and Previous Intervals
                    0    2390    2390    2390      2  (Invalid)

LINE:
  AIS = 0          RDI = 0          REI = 12         BIP(B2) = 36
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 :

  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 :

  52 6F 75 74 65 72 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 0D 00                    ..

SONET Line Tables
  INTERVAL     CV-L  ES-L  SES-L  UAS-L  CV-LFE  ES-LFE  SES-LFE  UAS-LFE
  02:35-02:48     0     5      5      0       0       0        0        0  (NE, FE Invalid)



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 = 00
Tx: C2 = 00

Tx J1 Length : 64
Tx J1 Trace

  52 6F 75 74 65 72 20 30 2F 33 2F 31 2E 31 00 00     Router 0/3/1.1..
  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 33 2F 31 2E 31 00 00     Router 0/3/1.1..
  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 : 0
Rx J1 Trace


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

  52 6F 75 74 65 72 20 30 2F 33 2F 31 2E 32 00 00     Router 0/3/1.2..
  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 33 2F 31 2E 32 00 00     Router 0/3/1.2..
  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


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

  52 6F 75 74 65 72 20 30 2F 33 2F 31 2E 33 00 00     Router 0/3/1.3..
  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 33 2F 31 2E 33 00 00     Router 0/3/1.3..
  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
```