



# Transparent SONET or SDH over Packet (TSoP) Protocol

**Table 1: Feature History**

Feature Name	Release Information	Description
SFP-TS-OC3STM1-I and SFP-TS-OC12STM4-I Optics Support	Cisco IOS XE 17.13.1	<p>SFP-TS-OC3STM1-I and SFP-TS-OC12STM4-I Optics Support is extended to the following chassis:</p> <ul style="list-style-type: none"> <li>• NCS 4201</li> <li>• NCS 4202</li> </ul> <p>These TSOP smart SFPs can operate in the low latency mode and is used for rail signaling.</p> <p><b>Note</b> The support for the ONS-SC-155-TSOP and ONS-SC-622-TSOP are deprecated and are replaced with the new TSoPs SFP-TS-OC3STM1-I and SFP-TS-OC12STM4-I optics, respectively. The software functionalities of the new TSoPs remain the same as the earlier TSoPs.</p>

The Transparent SONET or SDH over Packet (TSoP) protocol converts SONET or SDH TDM traffic to a packet stream. Operators can now transport SONET or SDH traffic across a packet network by simply adding

the TSoP Smart SFP to any router or packet switch. With TSoP the SONET or SDH signal is forwarded transparently, maintaining its embedded payload structure, protection protocols and synchronization. This simplifies the configuration and service turn-up of SONET or SDH connections across the packet network.

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## Prerequisites for TSoP

- Single mode optical fiber must be used to connect TSoP Smart SFP with the OC-3 port.
- The TSoP smart SFP pseudowire endpoints must use the same configuration parameters.

## Restrictions for TSoP

- The TSoP smart SFP payload size is *not* configurable. The byte size is fixed at 810 bytes.
- The router *cannot* be synced with the TSoP Smart SFP clock.
- Only untagged encapsulation is supported.
- CFM (connectivity fault management) is *not* supported.
- Only QoS Default Experimental marking is supported.
- SSO is not supported on TSoP for STM-4 or OC-12 SFP due to hardware restriction.
- TSoP is not supported on the 10G ports.

## Information About TSoP Smart SFP

TSoP Smart SFP is a special type of optical transceiver which provides solution to transparently encapsulate SDH or SONET bit streams into packet format, suitable for pseudowire transport over an ethernet network. The TSoP pseudowires is manually configured or setup using PWE3 control protocol [RFC4447].

TSoP provides packetization, de-packetization, and clock recovery that translates the TDM bit stream to fixed size data blocks (810 octets), and vice versa.

TSoP follows the SAToP method described in [RFC4553] for pseudowire transport of E1/DS1, over a packet switched network. With TSoP, the entire OC-3 or STM-1 is encapsulated in a single circuit emulating pseudowire traffic, and is transported it to a single destination across the ethernet network.



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- Note** The TSoP smart SFP is used on any of the front panel ports of the 8-port Gigabit Ethernet SFP Interface Module (8X1GE).
- The Smart SFP transceivers is compatible with the Small Form Factor Pluggable 20-pin Multi-Source Agreement (MSA).
  - TSoP Smart SFP (PN: ONS-SC-155-TSOP) transports upto 155 Mbps, on a L1.1 (40km) optical data link.
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## Guidelines for TSoP Smart SFP

TSoP is compatible with the below SFPs supported on the OC-3 interface module. We recommend you use the specified attenuator:

- ONS-SI-155-I1—For 15km cable length, use 2 dB attenuator; short distance use 8 dB attenuator to avoid receiver overload.
- ONS-SI-155-L1—For 40km cable length, no attenuator; short distance use 10 dB attenuator to avoid receiver overload.
- ONS-SI-155-L2—For 40km cable length, use 2 dB attenuator; short distance use 10 dB attenuator to avoid receiver overload.



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- Note** Multimode SFP is not supported with TSoP.
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STM-4 TSoP is compatible with the below SFPs supported on the OC-12 interface module:

- ONS-SI-622-L2—For 40km cable length, use 2 dB attenuator; short distance use 10 dB attenuator to avoid receiver overload.
- ONS-SI-622-L1—For 40km cable length, no attenuator; short distance use 10 dB attenuator to avoid receiver overload.
- ONS-SI-622-I1—For 15km cable length, use 2 dB attenuator; short distance use 8 dB attenuator to avoid receiver overload.



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- Note** The OC-12 Smart SFP (PN: ONS-SC-622-TSOP) is *not* supported in Cisco IOS XE Release 3.14S.
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- Note** Effective Cisco IOS XE Release 3.18, STM-4 TSoP is supported on .
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# Configuring the Reference Clock

The reference clock for the TSoP is extracted from the network. You can extract the clock reference from either of the following:

- Ethernet physical interface
- Incoming TDM physical interface



**Note** If TDM reference clock is configured, and you want to return to the Ethernet reference clock (default), use the `ssfpd tsop clock-source ethernet` command. Additionally, you can also use the `no ssfpd tsop clock-source` command to return the Ethernet reference clock (default).

## Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b> <b>Example:</b> Router> <code>enable</code>	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> Router# <code>configure terminal</code>	Enters global configuration mode.
<b>Step 3</b>	<b>interface <i>type number</i></b> <b>Example:</b> Device(config)# <code>interface gigabitethernet 0/0/0</code>	Specifies the Gigabit Ethernet interface for configuration and enters interface configuration mode.
<b>Step 4</b>	<b>ssfpd tsop clock-source {ethernet   tdm}</b> <b>Example:</b> Device(config)# <code>ssfpd tsop clock-source ethernet</code>	Configures the reference clock on the interface. <ul style="list-style-type: none"> <li>• <b>ethernet</b>—Specifies the ethernet interface as clock source. Default is ethernet.</li> <li>• <b>tdm</b>—Specifies the TDM interface as clock source.</li> </ul> <p><b>Note</b> If Ethernet interface is selected as clock source, the TSoP Smart SFP is synchronized with the Ethernet interface's clock (where smart SFP is installed), which in turn is synchronized with the network clock (that is already chosen through PTP or SYNC-E).</p>

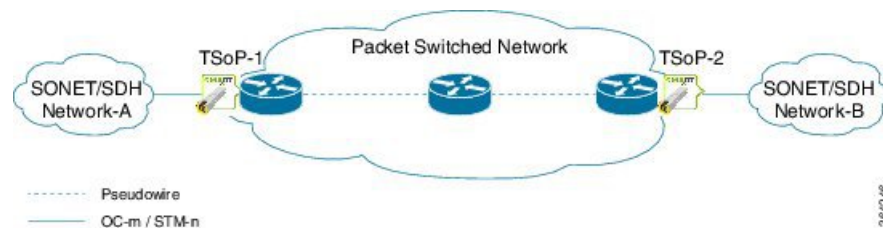
	Command or Action	Purpose
<b>Step 5</b>	<b>end</b> <b>Example:</b> Device(config)# end	Exists configuration and enters privileged EXEC mode

## Configuration Examples for TSoP

### Sample Configuration

For configuring SONET or SDH controller as in the figure (network A and B), see [Configuring Optical Interface Modules](#).

**Figure 1: TSoP in Packet Switched Network**



TSoP Smart SFP inserted in the PE's, CE (SONET or SDH) can be configured as

- SDH or SONET framing for T1 and E1 mode.
- Serial interface in SDH or SONET mode. The scale for OC-3 IM is as supported—63 for E1 and 84 for T1 interfaces. The scale supported for OC-12 IM is 252 E1 and 336 T1 interfaces.
- Multilink interface with minimum of 1 member link and maximum of 16 member link.
- POS interface in SDH or SONET mode.
- ATM Layer3 interfaces in SDH or SONET mode.



**Note** ATM Layer 3 interface is not supported on CE for OC-12 IM.

- In OC-12 mode, if OC-12 IM is used on CE, only port 0 (ZERO) of the IM is used. Use the card-type command to operate the OC-12 IM.

For configuring the pseudowire using service instances, see [Ethernet Virtual Connections Configuration on the Cisco ASR 903 Router](#).



**Note** Only untagged encapsulation is supported.

- The following example shows a sample configuration on the CE:

```

!
controller SONET 0/2/3
 framing sdh
 clock source line
 aug mapping au-3
!
!
au-3 1
 overhead j1 length 64
 mode c-11
 tug-2 1 t1 1 channel-group 0 timeslots 1

!

```

- The following example shows a sample configuration of the Gigabit Ethernet interface with TSoP smart SFP installed:

```

!
interface GigabitEthernet0/0/0
 no ip address
 negotiation auto
 no keepalive
 service instance 1 ethernet
 encapsulation untagged
 xconnect 2.2.2.2 1 encapsulation mpls

!

```

## Verification Examples

### Verifying TSoP Smart SFP

- Use the **show inventory** command to display all TSoP Smart SFPs installed on the router.

```

Router# show inventory
NAME: "subslot 0/0 transceiver 7", DESCR: "TSoP OC-3/STM-1"
PID: ONS-SC-155-TSOP , VID: 01.0, SN: OES18100028

```

- Use the **show platform software ssfp db** command to display all TSoP Smart SFPs recognized by the router.

```

Router# show platform software ssfp db
=== Smart SFP info ===
dpidx: 14
mac : 00:19:3a:00:2f:18
port: 7
bay: 0
ssfp upgrade data store id: -1
ssfp is device upgrade safe: -1
upgrade percentage complete: 0
ssfp upgrade in progress: 0

```

- Use the **show platform software ssfp db** command with slot, bay and port to display specific TSoP Smart SFPs recognized by the router.

```

Router# show platform software ssfp slot 0 bay 0 port 7 ssfp-d

```

```

port 7 sspf-db
dpidx: 14
mac : 00:19:3a:00:2f:18
port: 7
bay: 0
ssfp upgrade data store id: -1
ssfp device upgrade safe: -1
Upgrade percentage_complete: 0
ssfp upgrade in progress: 0

```

- Use the **show hw-module subslot** command to view information about TSoP Smart SFP.

```

Router# show hw-module subslot 0/0 transceiver 7 idprom
IDPROM for transceiver GigabitEthernet0/0/7:
Description = SFP or SFP+ optics (type 3)
Transceiver Type: = TSoP OC-3/STM-1 (291)
Product Identifier (PID) = ONS-SC-155-TSOP
Vendor Revision = 01.0
Serial Number (SN) = OES18100028
Vendor Name = CISCO-OES
Vendor OUI (IEEE company ID) = 00.19.3A (6458)
CLEI code = WOTRDBZBAA
Cisco part number = 10-2949-01
Device State = Enabled.
Date code (yy/mm/dd) = 14/03/07
Connector type = LC.
Encoding = 8B10B
NRZ
Nominal bitrate = OC3/STM1 (200 Mbits/s)

```

The following example shows the configuration of STM-4 TSoP:

```

NAME: "subslot 0/5 transceiver 2", DESCR: "TSoP OC-12/STM-4"
PID: ONS-SC-622-TSOP , VID: 01.0, SN: OES17420029

```

The following example shows the configuration of ASR-920-12CZ-D:

```

router#show platform
Chassis type: ASR-920-12CZ-D

```

Slot	Type	State	Insert time (ago)
0/0	12xGE-2x10GE-FIXED	ok	7w2d
R0	ASR-920-12CZ-D	ok, active	7w2d
F0		ok, active	7w2d
P0	ASR920-PSU0	ps, fail	never
P1	ASR920-PSU1	ok	never
P2	ASR920-FAN	ok	never

Slot	CPLD Version	Firmware Version
R0	20051844	15.6(53r)S
F0	20051844	15.6(53r)S

## Verifying Clock Source

- Use the **show platform software sspf** command to display the configured clock source. In the following example, rtpClockSource value for Ethernet clock source is displayed as 0. For TDM clock source the rtpClockSource value is displayed as 1.

```
Router# show platform software ssfpd slot 0 bay 0 port 7 encap-params
sdId: 14
channel: 0
iwfEncapOutputEnable: 1
ecid: 0
gAisTriggerActive: 0
gAisIncludeLosTrigger: 1
gAisIncludeLofTrigger: 1
insertRtpHeader: 1
rtpClockSource: 0
rtpFrequency: 0
rtpPayloadType: 0
rtpSsrc: 0
```