

Transparent Overhead Tunneling Data Communication Channel

This chapter provides information about the transparent overhead tunneling data communication channel.

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Transparent Overhead Tunneling Data Communication Channel Overview

SONET or SDH frame provides data communications channel (DCC) bytes for network element operations such as administration, maintenance, and provisioning.

Each SONET or SDH frame includes two DCCs—Section DCC (SDCC or RS-DCC) and Line DCC (LDCC or MS-DCC). The section and line DCCs are used for transporting management messages between Network Elements (NEs) and between NEs and Network Management System (NMS).

Each SONET or SDH frame uses these DCC bytes in overhead of the frame to carry management information for SONET or SDH networks, or Add or Drop multiplexers (ADMs). These DCC bytes traverse through hop-by-hop between ADMs and perform a path discovery and end-to-end provisioning in SONET or SDH network.

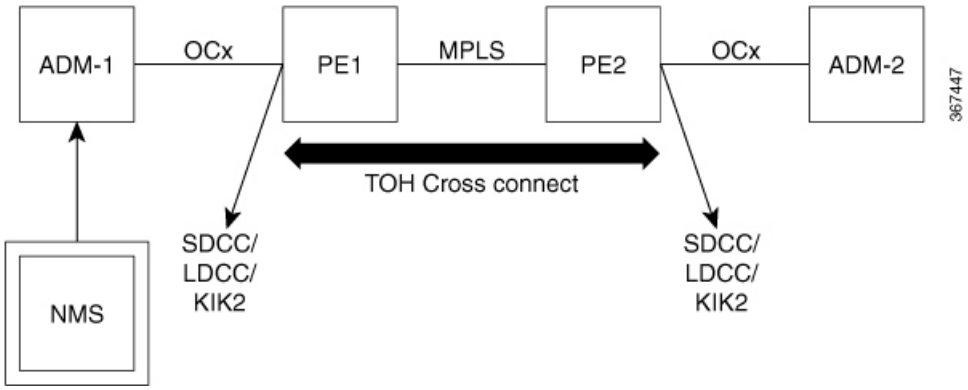
The behavior without DCC tunneling is that the NMS discovers the connected ADM but could not reach the ADM at the remote end of the TDM circuit.

With the introduction of DCC tunneling, the NMS discovers the existing topology and the insertion of ASR nodes are transparent to the DCC bytes. These ASR nodes help to tunnel DCC bytes and the NMS connectivity remains intact.

In the following diagram, the ADM-1 reaches the ADM-2 through transparent overhead (TOH) tunnel that is established between provider edges (PE1 and PE2).

The DCC bytes from ADM-1 reach ADM-2 through the TOH tunnel. Therefore, the NMS could reach the ADM-2 and the topology across ADMs remains intact.

Figure 1: Transparent Overhead Tunneling-SONET



TOH tunneling DCC is supported on the OCx ports for following CEM interface modules:

- 1-port OC-48/STM-16 or 4-port OC-12/OC-3 / STM-1/STM-4 + 12-port T1/E1 + 4-port T3/E3 module
- 1-port OC-192 or 8-port low rate module
- NCS 4200 1-port OC-192 or 8-port low rate CEM 20G bandwidth module

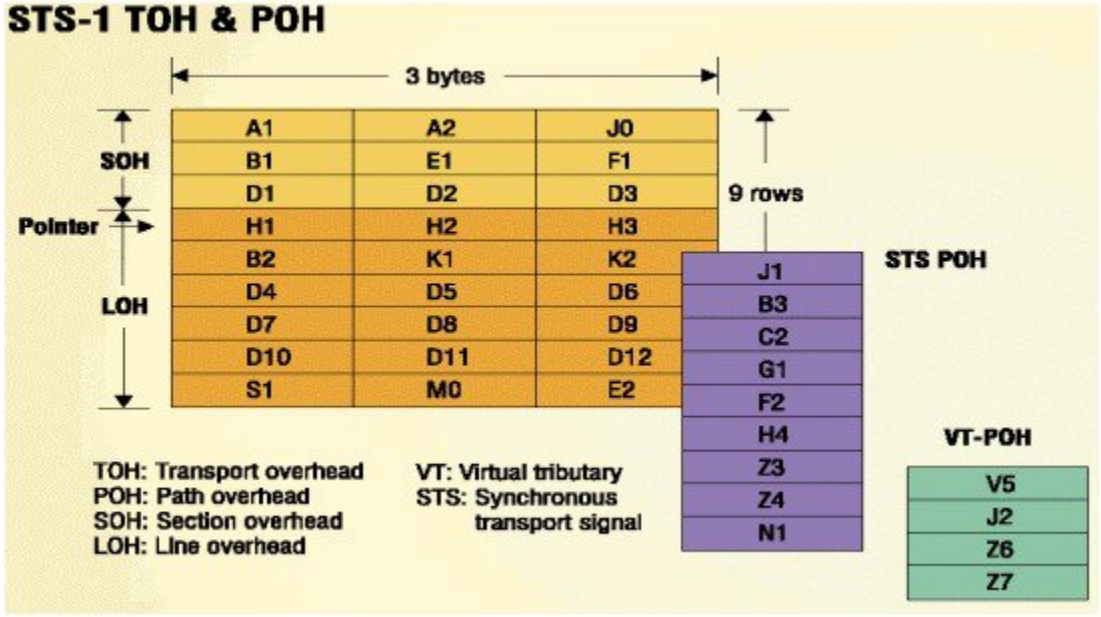
Transparent Overhead Tunnel DCC Types

The transparent overhead tunnel supports the following DCC types that are embedded in the transport overhead of STS-1 frame:

- Section DCC—Supports 3 bytes, D1, D2, and D3 responsible for message-based administration, monitoring, alarm maintenance, and other communication requirements. The section DCC provides a bandwidth of 192 Kbit/s between each pair of SONET section termination equipment. Any SONET equipment that can extract these 3 bytes from the STS-1 frame overhead and process them is considered to support a DCC interface.
- Line DCC—Supports D4 to D12 bytes with bandwidth of 576 Kbit/s.

In the following diagram, STS-1 Transport and Path Overhead are displayed.

Figure 2: STS-1 Frame Structure



The following table describes the transparent overhead tunnel segments with the supported tunnel types and the respective tunnel header bytes.

Table 1: Tunnel Segments with Tunnel Types and Supported Header Bytes

Tunnel Segment	Tunnel Type	Header Bytes
Section Header	SDCC for SONET RS-DCC for SDH	D1, D2, D3
Section Header	SOH	E1, F1, D1, D2, D3
Line Header	K1K2	K1K2
Line Header	LDCC for SONET MS-DCC for SDH	D4 to D12
Line Header	LOH	K1, K2, D4 to D12, E2
Section and Line Header	ALL	E1, F1, D1, D2, D3, K1, K2, D4 to D12, M0, E2

Prerequisites for Transparent Overhead Tunnel

Before creating transparent overhead tunnel, ensure that you perform the following steps:

- Set mode under the STS path for SONET before enabling the overhead tunnel.

  The following example details on how to set STS-1 mode on SONET.

```
platform enable controller MediaType 0/3/2 oc3
controller MediaType 0/3/2
 mode sonet
controller SONET 0/3/2
 rate OC3
 no ais-shut
 alarm-report all
 clock source internal
 !
 sts-1 1
  clock source internal
  mode vt-15
```

- Set mode under the AU-4 path on SDH before enabling the overhead tunnel.

  The following example details on how to set AU-4 mode on SDH.

```
platform enable controller MediaType 0/3/2 stm1
controller MediaType 0/3/2
 mode sdh
controller SDH 0/3/2
 rate STM1
 no ais-shut
 alarm-report all
 clock source internal
 aug mapping au-4
 au-4 1
  clock source internal
  channel-group 0
  mode vc4
```

- Mode and TOH type must be same on both PEs in an end-to-end setup.

  For example, if the PE-1 device has mode that is configured as VT-15 and TOH type as SDCC, then the same mode and TOH type must be configured on the PE-2 device.

  If the mode and TOH type configurations differ, then the TOH tunneling does not work.

Limitations of Transparent Overhead Tunnel

The following limitations apply to the transparent overhead tunnel:

- Ensure that mode is set under the path level of SONET or SDH interface before configuring the tunnel.
- If the DCC interface is configured, then DCC tunneling cannot be configured. You can configure either one of them at a time.
- TOH tunnel configuration is supported only at the port level.
- QoS is not supported for TOH channels.
- Each interface module in IO-FPGA supports only 9 TOH channels.
- When a TOH tunnel is configured with a specific CEM group and CEM identifier on an interface, then to modify the CEM group, you must perform the following steps:
  1. First remove the TOH tunnel that is configured on that interface using the **no overhead tunnel** *tunnel-type cem-group cem-id* command.
  2. Then add with a new CEM group and CEM identifier.

- When DCC tunneling is set, you cannot configure payload and dejitter buffer under the CEM interface.
- The K1 and K2 bytes are not transparent over APS-enabled channels.

How to Configure Transparent Overhead Tunnel

This section provides information about configuring the transparent overhead tunnel.

Configuring Mode for Controller

Configuring Mode for SONET Controller

Before configuring transparent overhead tunnel, ensure that mode for the controller is configured.

To configure mode for the SONET controller, use the following commands:

```
controller sonet interface
sts-1 1
  mode vt-15
end
```

Configuring Mode for SDH Controller

To configure mode for the SDH controller, use the following commands:

```
controller sdh interface
aug mapping au-4
au-4 1
clock source internal
channel-group 0
mode vc4
end
```

Note Any path-level mode can be set for SONET or SDH.

Creating Transparent Overhead Tunnel

To configure a transparent overhead tunnel, specify the tunnel type of the line or section header and CEM group with identifier.

To configure the transparent overhead tunnel on the SONET interface, use the following commands:

```
router(config)#controller sonet interface-name
router(config-controller)#overhead tunnel <All | SDCC | LDCC | K1K2 | LOH | SOH> cem-group
 cem-id unframed
router(config-controller)#end
```

To configure the transparent overhead tunnel on the SDH interface, use the following commands:

```
router(config)#controller sdh interface-name
router(config-controller)#overhead tunnel <All | RS-DCC | MS-DCC | K1K2 | LOH | SOH> cem-group
```

```
 cem-id unframed
router(config-controller)#end
```

Configuring DCC Interface in IP Domain

To configure DCC Interface in IP domain controller, use the following commands:

```
router ospf 100
interface sdcc/ldcc


encapsulation ppp
ip address 10.2.2.1 255.0.0.0
crc <16/32 >
ip ospf 100 area 0
```

Configuring TOH Tunnelling

To configure TOH Tunnelling use the following commands:

```
controller SONET/SDH < >
 no snmp trap link-status
 rate < >
 no ais-shut
 alarm-report all
 clock source internal
 overhead tunnel sdcc/ldcc/k1k2/soh/toh/all/aps_all cem-group 0 unframed
```

Creating Transparent Overhead Tunnel Pseudowire

To configure a transparent overhead tunnel pseudowire, first configure the CEM interface and then perform cross connect to a peer device with a remote IP address and specific virtual circuit identifier using MPLS encapsulation. The pseudowire carry forward specific TOH types as configured.

To configure the transparent overhead tunnel pseudowire, use the following commands:

```
router(config)#interface cem 0/3/4
router(config-if)#cem cem-id
router(config-if)#xconnect  remote-ip-address  virtual-connect-ID  encapsulation MPLS
router(config-controller)#end


router(config)#interface cem 0/3/4
router(config-if)#cem 1
router(config-if)#xconnect   192.168.0.2  2  encapsulation MPLS
router(config-controller)#end
```

Verifying Transparent Overhead Tunnel and Pseudowire Configuration

The following **show cem circuit interface cem** *interface-name* command displays that CEM interface is configured for a transparent overhead tunnel.

```
Router# show cem circuit interface cem 0/7/7
CEM0/7/7, ID: 100, Line: UP, Admin: UP, Ckt: ACTIVE,   TOH Type: LOH
Controller state: up
Idle Pattern: 0xFF, Idle CAS: 0x8
Dejitter: 6 (In use: 0)
```

```
Payload Size: 8
Framing: Unframed
CEM Defects Set
None

Signalling: No CAS
RTP: No RTP

Ingress Pkts:    3001                Dropped:             0
Egress Pkts:     3001                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
```