Overview of Circuit Emulation

Circuit Emulation (CEM) is a technology that provides a protocol-independent transport over IP/MPLS networks. It enables proprietary or legacy applications to be carried transparently to the destination, similar to a leased line.

CEM provides a bridge between a Time-Division Multiplexing (TDM) network and Multiprotocol Label Switching (MPLS) network. The chassis encapsulates the TDM data in the MPLS packets and sends the data over a CEM pseudowire to the remote Provider Edge (PE) chassis. As a result, CEM functions as a physical communication link across the packet network.

The chassis supports the pseudowire type that utilizes CEM transport: Structure-Agnostic TDM over Packet (SAToP).

L2VPN over IP/MPLS is also supported on the interface modules.

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Configuring Pseudowire

Cisco Pseudowire Emulation Edge-to-Edge (PWE3) allows you to transport traffic by using traditional services such as T1/E1 over a packet-based backhaul technology such as MPLS or IP. A pseudowire (PW) consists of a connection between two provider edge (PE) chassis that connects two attachment circuits (ACs), such as T1/E1 or T3/E3 links.

Information About Pseudowire

The following sections describe how to configure pseudowire on the interface module of the chassis.

Overview of Pseudowire

Pseudowires manage encapsulation, timing, order, and other operations in order to make it transparent to users. The pseudowire tunnel acts as an unshared link or circuit of the emulated service.
How to Configure Pseudowire

The following sections describe how to configure pseudowire.

Structure-Agnostic TDM over Packet

Structure-Agnostic TDM over Packet (SAToP) encapsulates Time Division Multiplexing (TDM) bit-streams as pseudowires over public switched networks. It disregards any structure that may be imposed on streams, in particular the structure imposed by the standard TDM framing.

The protocol used for emulation of these services does not depend on the method in which attachment circuits are delivered to the Provider Edge (PE) chassis. For example, a T1 attachment circuit is treated the same way for all delivery methods, including copper, multiplex in a T3 circuit, a virtual tributary of a SONET circuit, or unstructured Circuit Emulation Service (CES).

In SAToP 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 out transparently as a part of a bit stream.

Configuring CEM for SAToP

This section provides information about how to configure CEM. CEM provides a bridge between a Time Division Multiplexing (TDM) network and a packet network, MPLS. The chassis encapsulates the TDM data in the MPLS packets and sends the data over a CEM pseudowire to the remote Provider Edge (PE) chassis.

The following sections describe how to configure CEM.

Configuring CEM Restriction

- Not all combinations of payload size and dejitter buffer size are supported. If you apply an incompatible payload size or dejitter buffer size configuration, the chassis rejects it and reverts to the previous configuration.
- The dummy-pattern command is not supported.

Note: CEM interface does not support idle-cas parameter.

Configuring CEM Group for SAToP for T1 Interfaces

The following section describes how to configure a CEM group for SAToP.

```
enable
cfgterminal
controller tl 0/4/0
cem-group 0 unframed
end
```

Note: You need metroaggrservice license to configure CEM group on the Interface Module.
Configuring CEM Classes

A CEM class allows you to create a single configuration template for multiple CEM pseudowires. Follow these steps to configure a CEM class:

- The CEM parameters can be configured either by using CEM class or on CEM interface directly.
- The CEM parameters at the local and remote ends of a CEM circuit must match; otherwise, the pseudowire between the local and remote PE chassis does not come up.

```
enable
configure terminal
class cem mycemclass
payload-size 512
dejitter-buffer 12
exit
interface cem 0/0/1
cem 0
cem class mycemclass
xconnect 10.10.10.10 200 encapsulation mpls
exit
```

Configuring CEM Parameters

The following sections describe the parameters you can configure for CEM circuits.

Configuring Payload Size

To specify the number of bytes encapsulated into a single IP packet, use the `payload-size` command. The size argument specifies the number of bytes in the payload of each packet. The range is from 32 to 1312 bytes.

Default payload sizes for an unstructured CEM channel are as follows:

- T1 = 192 bytes
- E1 = 256 bytes
- DS0 = 32 bytes

Default payload sizes for a structured CEM channel depend on the number of time slots that constitute the channel. Payload size (L in bytes), number of time slots (N), and packetization delay (D in milliseconds) have the following relationship: \( L = 8 \times N \times D \). The default payload size is selected in such a way that the packetization delay is always 1 millisecond. For example, a structured CEM channel of 16xDS0 has a default payload size of 128 bytes.

- Both payload-size and dejitter-buffer must be configured simultaneously.

Setting the Dejitter Buffer Size

To specify the size of the dejitter-buffer used to compensate for the network filter, use the `dejitter-buffer` command. The configured dejitter-buffer size is converted from milliseconds to packets and rounded up to the next integral number of packets. Use the size argument to specify the size of the buffer, in milliseconds. The range is from 1 to 32; the default is 5.

Shutting Down a CEM Channel

Overview of Circuit Emulation

How to Configure Pseudowire
To shut down a CEM channel, use the `shutdown` command in CEM configuration mode. The `shutdown` command is supported only under CEM mode and not under the CEM class.

Configuring CEM Parameter on CEM Interface

The CEM parameters can be configured directly on CEM interface. Follow these steps to configure CEM parameters:

```
enable
configure terminal
interface cem 0/0/1

cem 0
payload-size 512 dejitter-buffer 12
xconnect 10.10.10.10 200 encapsulation mpls
exit
```

Verifying CEM Statistics for SAToP

Use the following commands to verify the pseudowire configuration for SAToP:

- `show cem circuit` — Displays information about the circuit state, administrative state, the CEM ID of the circuit, and the interface on which it is configured. If cross connect is configured under the circuit, the command output also includes information about the attachment circuit status.

```
Router# show cem circuit

CEM Int. ID Line Admin Circuit AC
--------------------
CEM0/1/0 1 UP UP ACTIVE --/--
CEM0/1/0 2 UP UP ACTIVE --/--
CEM0/1/0 3 UP UP ACTIVE --/--
CEM0/1/0 4 UP UP ACTIVE --/--
CEM0/1/0 5 UP UP ACTIVE --/--
```

- `show cem circuit cem-id` — Displays the detailed information about that particular circuit.

```
Router# show cem circuit 0

CEM0/1/2, ID: 0, Line: UP, Admin: UP, Ckt: ACTIVE
Controller state: up, T1/E1 state: up
Idle Pattern: 0xFF, Idle CAS: 0x8
Dejitter: 5 (In use: 0)
Payload Size: 192
Framing: Unframed
CEM Defects Set
None

Signalling: No CAS
RTP: No RTP

Ingress Pkts: 11060 Dropped: 0
Egress Pkts: 11061 Dropped: 0

CEM Counter Details
Input Errors: 0
Pts Missing: 0
Misorder Drops: 0
Error Sec: 0
```
Overview of Circuit Emulation

How to Configure Pseudowire

- show cem circuit summary — Displays the number of circuits which are up or down per interface basis.

Router# show cem circuit summary

<table>
<thead>
<tr>
<th>CEM Int.</th>
<th>Total Active</th>
<th>Inactive</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEM0/1/0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Circuit Emulation Service over Packet-Switched Network

CESoPSN is a method for encapsulating structured (NxDS0) TDM signals as pseudowires over packet switching networks.

Restrictions for CESoPSN on T1 Interface

- The maximum number of CEM interface supported is 192.
- The DS0 loopback is not supported on the T1 interface.
- The alarm forwarding is not supported on the T1 interface.
- The card protection is not supported on the T1 interface.

Configuring CEM Group for CESoPSN on T1 Interface

The following section describes how to configure a CEM group for CESoPSN.

To configure xconnect over MPLS, use the following commands:

```
enable
cfgure terminal
trol t1 0/4/32
cem-group 0 timeslots 1-10

Configure xconnect:

enable
cfgure terminal
nterface cem 0/4/32
cem 0
xconnect 2.2.2.2 10 encapsulation mpls
```

Perform a similar configuration on the other end of the pseudowire.

```
sh running-config | sec 0/8/16
troller T1 0/8/16
raming esf
linecode b8zs
blelength short 110
cem-group 0 timeslots 1-10
terface CEM0/8/16
ip address
cem 0
xconnect 2.2.2.2 10 encapsulation mpls
```
Check for xconnect configuration using the following command:

PE1#sh xconnect all | i 0/4/32
UP pri ac CE0/4/32:0(CESoPSN Basic) UP mpls 2.2.2.2:10 UP

PE1#sh controllers t1 0/4/32
T1 0/4/32 is up
Applique type is NCS4200-48T1E1-CE
Cablelength is short 110
No alarms detected.
Alarm-trigger is not set
Soaking time: 3, Clearance time: 10
AIS State:Clear LOS State:Clear LOF State:Clear
Framing is ESF, Line Code is B8ZS, Clock Source is Line.

Verifying CEM for CESoPSN on T1 Interface

Use the following commands to verify the pseudowire configuration for CESoPSN:

- show cem circuit—Displays information about the circuit state, administrative state, the CEM ID of the circuit, and the interface on which it is configured. If cross connect is configured under the circuit, the command output also includes information about the attachment circuit status.

- show mpls l2 vc—Displays information about the MPLS VC.

- show mpls l2 vc detail—Displays detailed information about the MPLS VC.

PE1#show mpls l2 vc 10

<table>
<thead>
<tr>
<th>Local intf</th>
<th>Local circuit</th>
<th>Dest address</th>
<th>VC ID</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE0/4/32</td>
<td>CESoPSN Basic 0</td>
<td>2.2.2.2</td>
<td>10</td>
<td>UP</td>
</tr>
</tbody>
</table>

PE1#show mpls l2 vc 10 det
PE1#show mpls l2 vc 10 detail
Local interface: CE0/4/32 up, line protocol up, CESoPSN Basic 0 up
Destination address: 2.2.2.2, VC ID: 10, VC status: up
Output interface: Te0/0/0, imposed label stack {650}
Preferred path: not configured
Default path: active
Next hop: 123.123.123.2
Create time: 00:21:25, last status change time: 00:21:25
Last label FSM state change time: 00:21:25
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: configured and not enabled
Non stop routing: not configured and not 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: No fault
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 fault
Last remote LDP TLV status rcvd: No fault
Last remote LDP ADJ status rcvd: No fault
MPLS VC labels: local 577, remote 650
Group ID: local 238, remote 276
MTU: local 0, remote 0
Remote interface description:
Sequencing: receive disabled, send disabled
Control Word: On (configured: autosense)
SSO Descriptor: 2.2.2.2/10, local label: 577
Dataplane:
  SSM segment/switch IDs: 6893171/4140658 (used), PWID: 674
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

Router# show cem circuit int cem 0/4/32
CEM0/4/32, ID: 0, Line: UP, Admin: UP, Ckt: ACTIVE
Mode :T1, CEM Mode: T1-CESoP
Controller state: up, T1/E1 state: up
Idle Pattern: 0xFF, Idle CAS: 0x8
Dejitter: 5 (In use: 0)
Payload Size: 80
Framing: Framed (DS0 channels: 1-10)
CEM Defects Set
  None
Signalling: No CAS
RTP: No RTP

<table>
<thead>
<tr>
<th>Ingress Pkts: 203997</th>
<th>Dropped: 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egress Pkts: 203999</td>
<td>Dropped: 0</td>
</tr>
</tbody>
</table>

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
  Generated Mbits: 0
  Received Mbits: 0

Configuring DS1 Local Connec
The following section describes how to configure first segment for DS1 local connection:

enable
configure terminal
controller T1 0/5/0
framing unframed
clock source internal
linenode b8zs
cablelength short 110
cem-group 0 unframed
description TO_CE1_0/1/0

The following section describes how to configure second segment for DS1 local connection:

enable
configure terminal
controller T1 0/5/3
framing unframed
clock source recovered 0
linenode b8zs
cablelength short 110
cem-group 0 unframed
description TO_CE1_0/1/1

The following section describes how to create a DS1 local connection:

enable
configure terminal
connect dsl_connect CEM0/5/0 0 CEM0/5/3 0
Verifying DS1 Local Connect

Use the following commands to verify the DS1 local connection:

- show connection name—Displays information about the connection state and segment state.

```
Router#show connection name ds1_connect
Connection: 673 - ds1_connect
Current State: UP
Segment 1: CEM0/5/0 SATOP T1 0 up
Segment 2: CEM0/5/3 SATOP T1 0 up
```

Associated Commands

The following commands are used to configure pseudowire:

<table>
<thead>
<tr>
<th>Commands</th>
<th>URL</th>
</tr>
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Additional References for Configuring Pseudowire

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
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<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
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### Standards and RFCs

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<tr>
<th>Standard/RFC</th>
<th>Title</th>
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<tbody>
<tr>
<td>—</td>
<td>There are no standards and RFCs for this feature.</td>
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</tbody>
</table>

### MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>—</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
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### Technical Assistance

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<tr>
<th>Description</th>
<th>Link</th>
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</thead>
<tbody>
<tr>
<td>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
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