



## Configuring CEM

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This module describes how to configure Circuit Emulation (CEM).

- [Circuit Emulation, on page 1](#)
- [How to Configure CEM, on page 2](#)
- [Overview of DS3 CEP, on page 6](#)
- [Associated Commands, on page 11](#)
- [Additional References for Configuring CEM, on page 12](#)

## 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 a Multiprotocol Label Switching (MPLS) network. The router encapsulates the TDM data in the MPLS packets and sends the data over a CEM pseudowire to the remote Provider Edge (PE) router. As a result, CEM functions as a physical communication link across the packet network.

The router supports the pseudowire type that utilizes CEM transport: Structure-Agnostic TDM over Packet (SAToP) and Circuit Emulation Service over Packet-Switched Network (CESoPSN).

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



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**Note** We recommend that you configure the controller in the administratively up mode. Configuration under the administratively down mode is not recommended and it might cause configuration errors.

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**Note** The default behaviour of the CEM pseudowire is always UP irrespective of the controller alarms.

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## 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.

## CEM pseudowire Scale

Effective from the 16.12.1 release,

- 21504 CEM pseudowires without protection (with SONET)
- 10752 CEM pseudowires with protection

is supported on the router.

Currently the Cisco A900-IMA3G-IMSG support a maximum of 1344 CEM pseudowires.




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**Note** The 21K CEM pseudowire's can be achieved on the router by using the combination of the Cisco A900-IMA1Z8S-CX and A900-IMA3G-IMSG interface modules in multiple slot combinations.

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### Restrictions for pseudowire Scale Increase

- CEM pseudowire scale is supported **only** on the SONET mode.
- When configured for scale beyond 21504 CEM pseudowire, a syslog is printed as:
 

```
Cannot allocate CEM group, maximum CEM group exceeded, but the configurations will not be rejected. For example, when a 215xxth CEM pseudowire is configured, the configuration fails even though the CLI is not rejected with the mentioned syslog notification.
```
- While performing ISSU with 21504 CEM pseudowire, sufficient delay must be provided for each interface module.
- After SSO and successful bulk sync, run the **show platform software tdm-combo cem ha-stray-entries** command. If the output of this command displays no entries, then the next SSO can be performed. You must wait until **show platform software tdm-combo cem ha-stray-entries** has no entries.

## How to Configure CEM

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.

## 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:



### Note

- 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 0/4/0
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 (Optional)

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

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:  $L = 8 * N * D$ . The default payload size is selected in such a way that the packetization delay is always 1 millisecond.

The payload size must be an integer of the multiple of the number of time slots for structured CEM channels.

### Setting the Dejitteer Buffer Size

Dejitteer Buffer is a buffering mechanism to account for a delay variation in the CEM packet stream. The buffer size is the amount of time you allocate to compensate for the network filter. The configured dejitter-buffer size is converted from milliseconds to packets and rounded up to the next integral number of packets. To set the size of the dejitter-buffer (in milliseconds), use the **dejitter-buffer value** command. The value range is from 1 to 32; the default is 5.

## Shutting Down a CEM Channel

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 DS1 CT3 SAToP Mode on OCx Ports

To configure DS1 CT3 SAToP mode on OCx ports, use the following commands:

```
enable
configure terminal
controller MediaType 0/4/16
mode sonet
controller sonet 0/4/16
rate oc12
sts-1 1
mode ct3
t1 1 cem-group 100 unframed
t1 1 framing unframed
interface cem 0/4/16
cem 100
xconnect 10.2.2.2 10 encapsulation mpls
end
```

## Configuring VT DS1 SAToP Mode

To configure VT DS1 SAToP mode, use the following commands:

```
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 framing unframed
vtg 1 t1 1 cem-group 0 unframed
end
```

## Configuring STS-Nc CEP

To configure STS-Nc CEP, use the following commands:

```
enable
configure terminal
controller MediaType 0/4/16
mode sonet
controller sonet 0/4/16
rate oc12
sts-1 1 - 3 mode sts-3c
cem-group 100 cep
interface cem 0/4/16
cem 100
xconnect 10.2.2.2 10 encapsulation mpls
end
```

## Configuring CEP

To configure CEP, use the following commands:

```

enable
configure terminal
controller MediaType 0/4/16
mode sonet
controller sonet 0/4/16
sts-1 1
mode unframed
cem-group 100 cep
end

```

## Configuring VT-15 CEP

To configure VT-15 CEP, use the following commands:

```

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 vt 1 cem-group 100 cep
end

```

## Configuring DS3 SAToP

To configure DS3 SAToP, the STS-1 needs to be configured in mode T3::

```

enable
configure terminal
controller MediaType 0/4/16
mode sonet
controller sonet 0/4/16
rate oc12
sts-1 1
mode t3
cem-group 100 unframed
interface cem 0/4/16
cem 100
xconnect 10.2.2.2 10 encapsulation mpls
end

```

## Configuring Unidirectional APS

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

```

enable
configure terminal
controller sonet 0/4/16
clock source internal
aps group acr 1
aps working 1
aps unidirectional
exit
controller sonet 0/4/16
aps group acr 1
aps protect 1 10.7.7.7
aps revert 3
aps adm
end

```




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

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

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### Configuring Bi-directional ACR (SONET Framing)

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

```
enable
configure terminal
controller sonet 0/4/16
clock source internal
aps group acr 1
aps working 1
exit
controller sonet 0/4/16
aps group acr 1
aps protect 1 10.7.7.7
end
```




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

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### Configuring CEM APS

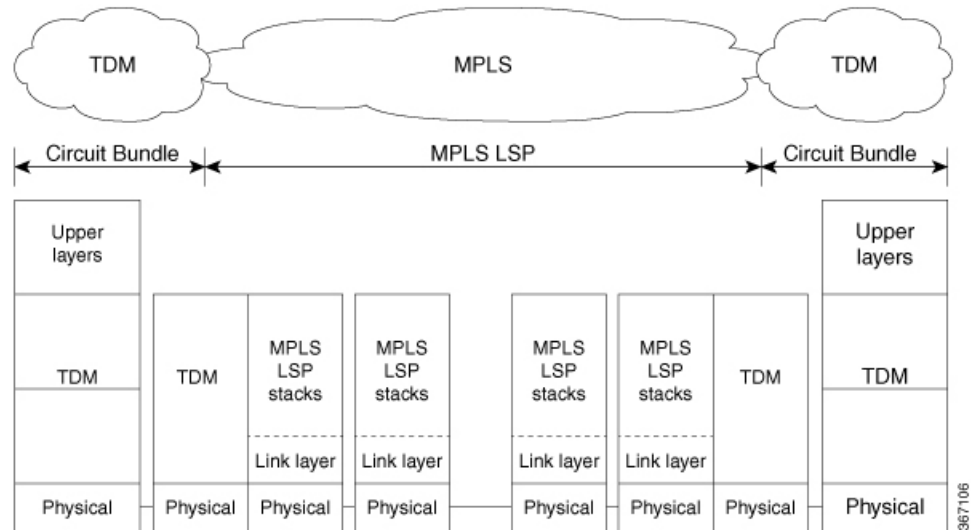
To configure CEM APS:

```
enable
configure terminal
controller MediaType 0/4/16
mode sonet
controller sonet 0/4/16
controller sonet-acr acr_no
sts-1 1
vtg 1 t1 1 cem-group 100 unframed
end
```

## Overview of DS3 CEP

Effective Cisco IOS XE Fuji 16.8.1, DS3 CEP feature is introduced to achieve CEP configuration on DS3 ports of the interface module. Here, T3 or E3 is mapped to STS-1 or VC4 that is emulated on a packet network.

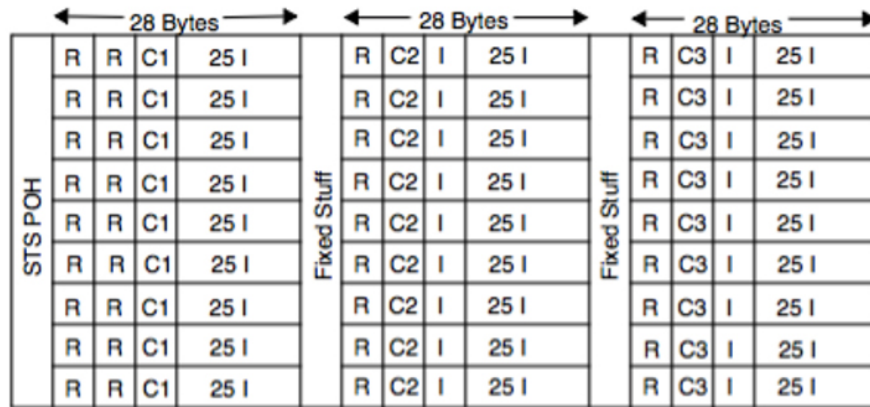
Figure 1: Network Reference Model and Protocol Layers for TDM-MPLS User Plane Interworking



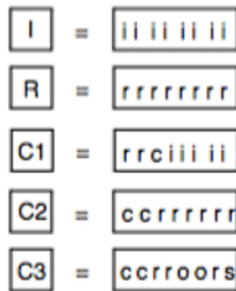
## Asynchronous Mapping for T3 or E3 CEP

An asynchronous mapping for a T3 or E3 in the payload capacity of an STS-1 signal is defined for clear-channel transport of T3 or E3 signals that meet the T3 or E3 requirements in GR-499-CORE. The asynchronous T3 or E3 mapping consists of nine subframes each of 125  $\mu$ s. Each subframe contains 621 information (I) bits, a set of five stuff control (C) bits, one stuff opportunity (S) bit, and two overhead communication channel (O) bits. The remaining bits of the STS-1 payload capacity are fixed stuff (R) bits. The O-bits are reserved for future overhead communication purposes. The values of the R and O bits are undefined. In each subframe, the set of five C-bits are used to control the S-bit. CCCCC = 00000 is used to indicate that the S-bit is an information bit, while CCCCC = 11111 is used to indicate that the S-bit is a stuff bit. The value of the S-bit (if it is stuff bit) is undefined.

Figure 2: Asynchronous Mapping for T3 or E3 CEP



Bytes



bits

- i: information (payload) bit
- r: fixed stuff bit
- c: stuff control bit
- s: stuff opportunity bit
- o: overhead communications channel bit

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## Restrictions

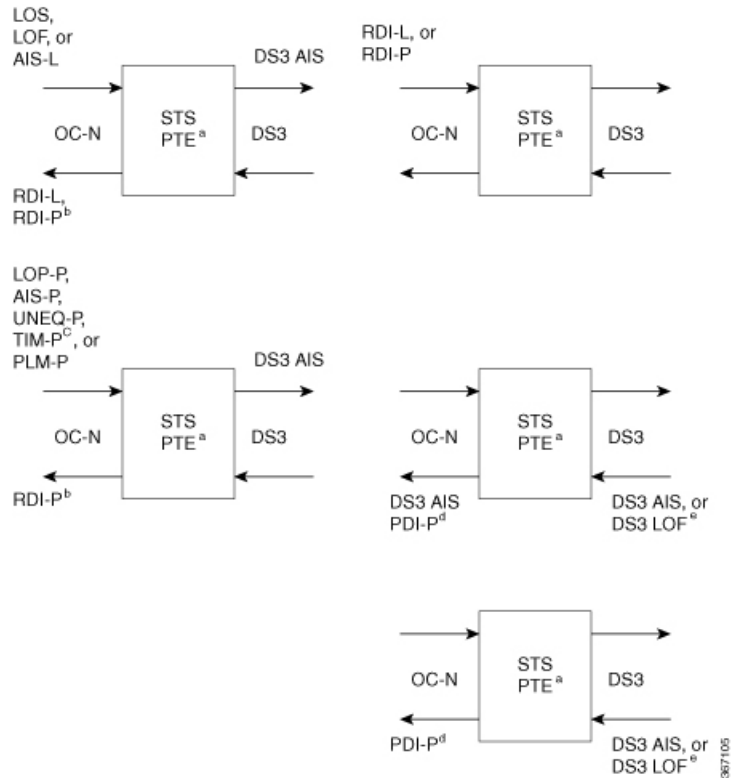
- BERT for both line and system directions is *not* supported until Cisco IOS XE Fuji 16.9.5 release.
- Card Protection is *not* supported.
- E3 CEP is not supported on optical or SDH controller.

## Alarms for T3 or E3 CEP

If an alarm is detected in the DS3 end, the C2 bytes are used to inform the remote Provider Edge (PE). For this, the alarm mapping table has to be followed as shown in the figure below.



Figure 3: Alarm Mapping Table



## Configuring DS3 CEP

### Pre-requisites:

The default mode is channelized mode. Use **no channelized** command to change to non-channelized mode.

To configure DS3 CEP for mode T3:

```
enable
controller MediaType 0/4/15
mode t3
controller t3 0/4/15
no channelized
cem-group 0 cep
```

To configure DS3 CEP for mode E3:

```
enable
controller MediaType 0/4/15
mode e3
controller e3 0/4/15
no channelized
cem-group 0 cep
```

### Configuration of Overhead C2 and J1 Bytes:

You can configure overhead C2 and J1 bytes after you configure DS3 CEP.

```
enable
controller MediaType 0/4/15
```

```

mode e3
controller e3 0/4/15
threshold sd-ber 6
threshold sf-ber 3
no channelized
framing g751
cablelength short
cem group 0 cep
overhead j1 tx length 16
overhead j1 expected length 16

```

For loopback configuration, see *Loopback on T3/E3 Interfaces* section.

## Verification of DS3 CEP Configuration

Use `show controller t3 0/4/15 path` to verify DS3 CEP configuration:

```

router#show controller t3 0/4/15 path

T3 0/1/20 PATH 1.

Asynchronous Mapping for DS3 into STS-1

TX : TDM to PSN direction
RX : PSN to TDM direction

Clock Source is internal

    AIS = 0          RDI = 0          REI = 349          BIP(B3) = 22
    LOP = 0          PSE = 0          NSE = 0           NEWPTR = 0
    LOM = 0          PLM = 0          UNEQ = 0

Active Defects: None
Detected Alarms: None
Asserted/Active Alarms: None
Alarm reporting enabled for: None

TCA threshold: B3 = 10e-6
Rx: C2 = FF
Tx: C2 = 01

Tx J1 Length : 64
Tx J1 Trace

    72 74 72 32 20 30 2F 31 2F 32 30 2E 31 00 00 00      rtr2 0/1/20.1...
    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

    72 74 72 32 20 30 2F 31 2F 32 30 2E 31 00 00 00      rtr2 0/1/20.1...
    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

    72 73 70 32 20 30 2F 35 2F 31 32 2E 31 00 00 00      rsp2 0/5/12.1...
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00      .....

```



Commands	URL
<b>show cem circuit</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s2.html#wp1086825073">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s2.html#wp1086825073</a>
<b>sts-1</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s6.html#wp2423232697">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s6.html#wp2423232697</a>
<b>t1 t1-line-number cem-group</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2399838226">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2399838226</a>
<b>t1 t1-line-number framing</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2623191253">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2623191253</a>
<b>t1 t1-line-number clock source</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp3480850667">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp3480850667</a>
<b>vtg vtg-number vt vt-line-number cem-group cem-group-number cep</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp3494199143">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp3494199143</a>
<b>xconnect</b>	<a href="http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp8578094790">http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp8578094790</a>
<b>show controllers t3</b>	<a href="https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp1987423547">https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp1987423547</a>

## Additional References for Configuring CEM

### Related Documents

Related Topic	Document Title
Cisco IOS commands	<i>Cisco IOS Master Commands List, All Releases</i>

### Standards

Standards	Title
—	There are no standards for this feature.

**MIBs**

<b>MIB</b>	<b>MIBs Link</b>
—	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>

**RFCs**

<b>RFCs</b>	<b>Title</b>
—	There are no RFCs for this feature.

**Technical Assistance**

<b>Description</b>	<b>Link</b>
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>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.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

