Configuring CEM

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

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.

The RSP switchover with physical SSO is above 50 ms as follows:

- R0 to R1 is 5 seconds
- R1 to R0 is 10 seconds

Restrictions for CEM

The **framed** command is not supported.

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.

Overview of Framed Structure-Agnostic TDM over Packet (SAToP)

Framed Structure-Agnostic TDM over Packet (SAToP) is required to detect an incoming AIS alarm in the DS1 SAToP mode. An AIS alarm indicates a problem with the line that is upstream from the DS1 network element connected to the interface. Framed SAToP further helps in the detection of a packet drop.

In case of unframed mode of SAToP, data received from the Customer Edge (CE) device is transported ove the pseudowire. If the Provider Edge (PE) device receives a Loss of Frame (LOF) signal or Remote Alarm Indication (RAI) signal from a CE, the PE can only transmit the signal that is detected by the CE device. With the introduction of Framed SAToP, when the PE device receives the LOF or RAI signal, the PE device can detect the alarm for SAToP. Thus, the alarm can be detected earlier in the network. This helps in enhanced performance.

Note BERT is *not* supported in system direction for framed SAToP.

Note Framing type should be maintained same in all routers end to end.

Difference between Framed and Unframed SAToP:

1. For unframed SAToP, the incoming signal is transmitted to the far end. This signal is not analyzed by the PE device. Hence, no alarm is reported.
2. For framed SAToP, the incoming signal is analyzed but is not terminated. If a LOF or RAI signal is detected, the remote PE detects the signals and transmits towards the remote CE.

Difference between Framed SAToP and CESoP:

Table 1: Behaviour Difference between Unframed SAToP, Framed SAToP, and CESoP on LOF Alarm

Modes	Alarm Detected at PE	Controller Status at PE	Alarm Detected at CE (Remote)	Framing Bits Generationat PE (Remote)	Framing Bits Terminated at PE (Remote)
Unframed SAToP	None	Up	LOF	No	No
Framed SAToP	LOF	Down (Data path remians up)	LOF[1][2]	Yes	No
CESOP	LOF	Down (Data path remians up)	AIS	Yes	Yes

[1] AIS—Support until Cisco IOS XE 16.9.3 Fuji release
[2] LOF—Starting from Cisco IOS XE Fuji 16.9.4 or later releases

Table 2: Behaviour Difference between Unframed SAToP, Framed SAToP, and CESoP on RDI Alarm

Modes	Alarm Detected at PE	Controller Status at PE	Alarm Detected at CE (Remote)	Framing Bits Generation at PE (Remote)	Framing Bits Terminated at PE (Remote)
Unframed SAToP	None	Up	RDI	No	No
Framed SAToP	RDI	Down (data path remains up)	RDI	No	No
CESOP	RDI	Down (data path remains up)	RDI	M-bit is set into control word	Yes

Table 3: Behaviour Difference between Unframed SAToP, Framed SAToP, and CESoP on AIS alarm

Modes	Alarm Detected at PE	Controller Status at PE	Alarm Detected at CE (Remote)	Framing Bits Generation at PE (Remote)	Framing Bits Terminated at PE (Remote)
Unframed SAToP	AIS	Down (data path remains up)	AIS	No	No
Framed SAToP	AIS	Down (data path remains up)	AIS	No	No
CESOP	AIS	Down (data path remains up)	AIS	L-bit is set into control word	Yes

Remote Loopback from CE to PE Detection:

Framed SAToP does not detect any loopback.

	Loopback Detected at PE	Controller Status at PE (Remote)	Controller Status at CE (Remote)
Unframed SAToP	No	Not in Loopback	Loopback
Framed SAToP	No	Not in Loopback	Loopback
CESOP	Yes	Loopback	Not in loopback

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.

CEM Pseudowire Scale

Effective from the Cisco IOS XE Gibraltar 16.12.1 release, Cisco router supports the following pseudowire scale numbers:

- 21504 CEM Pseudowire (PWs) without protection (with SONET)
- 10752 CEM PWs with protection

Currently the Cisco NCS4200-3GMS supports a maximum of 1344 CEM PWs.

Currently the Cisco NCS4200-1T8S-10CS supports a maximum of **5376** CEM PWs.

The four Interface Modules can be used on the router to achieve the 21K CEM PWs.

This can be achieved by:

- Configuring CEM circuits on all the 192 STS on the 9th port of the Cisco A900-IMA3G-IMSG which supports OC-192.
- Configuring CEM circuits on all the 4 OC-48 ports of the Cisco A900-IMA3G-IMSG which supports OC-192.

Note The 21K CEM PW's can be achieved on the router by using the combination of the Cisco A900-IMA1Z8S-CX Cisco NCS4200-1T8S-10CS and Cisco NCS4200-3GMS IMs with the Cisco NCS4200-48T3E3-CE, and Cisco NCS4200-48T1E1-CE in multiple slot combinations.

Restrictions for PW Scale Increase

- CEM PW scale is supported in **only** in the SONET mode.
- When configured for scale beyond 21504 CEM PW, 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 PW is configured, the configuration fails although the CLI is not rejected with the mentioned syslog notification.
- While performing ISSU with 21504 CEM PW, sufficient interface-module-delay must be provided for each IM. This provision enables all PWs to program after the IM OIR. The minimum 'time for delay' in case of Cisco A900-IMA1Z8S-CX is 1800 seconds.
- To configure CEM circuits (for example, T1 or VT1.5 CEP pseudowire) at a large number (for example, 10,000), we recommend you to configure the CEM circuits in a batch of 2000 CEM circuits. Use the **show platform software tdm-combo cem ha-stray-entries** command to verify that there are no pending circuits to be programmed before proceeding to the next batch of configuration. The **show platform software tdm-combo cem ha-stray-entries** command can be used only in the standby RSP3 console.

Configuring CEM Group for SAToP for T1 Interfaces

To configure a CEM group for SAToP.

```
enable
configure terminal
controller t1 0/4/0
cem-group 0 unframed
end
```

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

By deafult, metroaggressive license is enabled for NCS 4200 Series Routers.

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 0/0/1
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 (Optional)

To specify the number of bytes encapsulated into a single IP packet, use the pay-load 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:

- E1 = 256 bytes
- 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 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

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

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

```
enable
configure terminal
controller MediaType  0/4/16
mode sonet
controller sonet 0/5/0
rate oc12
```

```
sts-1 1
mode ct3
t1 1 cem-group 100 unframed
t1 1 framing unframed
interface cem 0/5/0
cem 100
xconnect 2.2.2.2 10 encapsulation mpls
end
```

Configuring VT DS1 SAToP Mode

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

```
enable
configure terminal
controller MediaType 0/5/0
mode sonet
controller sonet 0/5/0
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 0/5/0
mode sonet
controller sonet 0/5/0
rate oc12
sts-1 1 - 3 mode sts-3c
cem-group 100 cep
interface cem 0/5/0
cem 100
xconnect 2.2.2.2 10 encapsulation mpls
end
```

Configuring CEP

To configure CEP:

```
enable
configure terminal
controller MediaType 0/5/0
mode sonet
controller sonet 0/5/0
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 0/5/0
mode sonet
controller sonet 0/5/0
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. Use the following commands:

```
enable
configure terminal
controller MediaType 0/5/0
mode sonet
controller sonet 0/5/0
rate oc12
sts-1 1
mode t3
cem-group 100 unframed
interface cem 0/5/0
cem 100
xconnect 2.2.2.2 10 encapsulation mpls
end
```

Configuring CEM APS

To configure CEM APS, use the following commands:

```
enable
configure terminal
controller MediaType 0/5/0
mode sonet
controller sonet 0/5/0
controller sonet-acr acr_no
sts-1 1
vtg 1 t1 1 cem-group 100 unframed
end
```

Configuring Unidirectional APS for SAToP

Note When the **aps adm** command is not used, the LOS is detected on active port and the L-AIS is transmitted to the remote-end to force APS switchover. This is similar to bi-directional APS mode.

'When the **aps adm** command is used, the ports are in strict unidirectional mode. When the LOS is detected on active port, the L-AIS is suppressed and behaves in a strict uni-directional mode.

Ensure that the configuration is performed under the protected interface.

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

```
enable
configure terminal
controller sonet 0/5/0
clock source internal
aps group acr 1
aps working 1
aps unidirectional
exit
controller sonet 0/4/0
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.

Configuring Bi-directional ACR (SONET Framing) for SAToP

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

```
enable
configure terminal
controller sonet 0/5/0
clock source internal
aps group acr 1
aps working 1
exit
controller sonet 0/4/0
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.

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

  <0-32000>    CEM ID
  detail     Detailed information of cem ckt(s)
  interface  CEM Interface
  summary    Display summary of CEM ckts
  |          Output modifiers
```

```
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 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                    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
```

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

```
Router# show cem circuit summary

CEM Int.       Total Active  Inactive
--------------------------------------
CEM0/1/0       1     1       0
```

Associated Commands

The following commands are used to configure CEM:

Commands	URL
cem	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2184138077
cem group *cem-group-number* **unframed**	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600

Commands	URL
cem-group *cem-group-number* **cep**	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp2440628600
class cem	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c1.html#wp7199841750
controller t1	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-c2.html#wp1472647421
mode ct3	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp5913349630
mode t3	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp5688885940
mode vt-15	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-l2.html#wp1137973905
payload-size dejitter-buffer	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp3946673156
rate	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-o1.html#wp4442889730
show cem circuit	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s2.html#wp1086825073
sts-1	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s6.html#wp2423232697
t1 t1-line-number cem-group	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2399838226
t1 t1-line-number framing	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp2623191253
t1 t1-line-number clock source	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t1.html#wp3480850667
vtg *vtg-number* **vt** *vt-line-number* **cem-group** *cem-group-number* **cep**	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp3494199143

Commands	URL
xconnect	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-t2.html#wp8578094790
show controllers t3	https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/command/ir-cr-book/ir-s3.html#wp1987423547

Additional References for Configuring CEM

Related Documents

Related Topic	Document Title
Cisco IOS commands	*Cisco IOS Master Commands List, All Releases*

Standards

Standards	Title
—	There are no standards for this feature.

MIBs

MIB	MIBs Link
—	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
—	There are no RFCs for this feature.

Technical Assistance

Description	Link
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.	http://www.cisco.com/cisco/web/support/index.html