Overview of the T1 or E1 Interface Module

Table 1: Feature History

Feature Name	Release Information	Description
	Cisco IOS XE Cupertino 17.8.1	The router supports the following features for the 48-Port T1/E1 Circuit Emulation (CEM) interface module: • Basic mode, and T1 or E1 controller required configurations • CEM clocking, ACR, and DCR • CEM pseudowires such as Structure-Agnostic TDM over Packet (SATOP) and Circuit Emulation over Packet-Switched Network (CESoPSN) • BERT, loopback, and alarms • Performance monitoring The support for the interface module provides cost-effective delivery of CEM over a packet-based network (MPLS).

The T1 or E1 interface module delivers T1 or E1 connectivity on the router with the RSP3 module. The module can be software configured as either T1 mode or E1 mode per interface module The module provides physical connectivity using a single high-density connector and requires a breakout cable and patch panel for individual port connections.

The T1 or E1 interface module supports the following modes:

- T1

- E1

Note Mixing T1 and E1 ports on the same interface module is not supported.

CEM configurations are supported on different modes on the interface module. The troubleshooting, monitoring, and redundancy features are supported on the module. The module can be clocked from a line or from an internal clock source. The table describes the configurations and features for the modes that are supported on the T1 or E1 interface module.

Table 2: Configurations on T1 or E1 Interface Module

	T1	E1
Required Configurations		
Mode	Yes	Yes
Internal/Line Clock Source	Yes	Yes
ACR/DCR Clock	Yes	Yes
CEM Configurations		
Structure-Agnostic TDM over Packet (SATOP) (Framed/Unframed)	Yes	Yes
Circuit Emulation over Packet-Switched Network (CESoPSN)	Yes	Yes
Troubleshooting Features		
Bit Error Rate Testing (BERT)	Yes	Yes
Loopback	Yes	Yes
Monitoring Features		
Performance Monitoring	Yes	Yes

Restrictions for Configuring T1 or E1 Interfaces

- You can configure CEM to support serial interface configuration.
- The card can be configured either in the T1 or E1 mode. A combination of T1 and E1 ports is not supported.

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.

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.

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

Overview of CEM 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. CEM is a way to carry TDM circuits over packet switched network. CEM embeds the TDM circuits into packets, encapsulates them into an appropriate header, and then sends that through Packet Switched Network. The receiver side of CEM restores the TDM circuits from packets.

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.

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 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 3: 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)	AIS[1][2]	Yes	No
CESOP	LOF	Down (Data path remians up)	AIS	Yes	Yes

[1] AIS—Cisco IOS XE Amsterdam 17.3.1 to later releases
[2] LOF—Support until Cisco IOS XE Amsterdam 17.2.1

Table 4: 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 5: 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

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.
- DS0 loopback is not supported on the T1 interface.
- Alarm forwarding is not supported on the T1 interface.
- Card protection is not supported on the T1 interface.