Channel Associated Signaling

Table 1: Feature History

Feature Name	Release Information	Description
CAS feature to perform Super Frame to Extended Super Frame conversion	Cisco IOS XE Cupertino 17.8.1	Channel Associated Signaling (CAS) is a method of signaling each traffic channel rather than having a dedicated signaling channel. CAS uses the same channel, which carries voice or data to pass control signals. This provides an advantage as the implementation of CAS is inexpensive. Supports CAS feature with "in-band" signaling type. You can configure CAS on a specific interface or under global CEM class.

CAS is a method of signaling each traffic channel rather than having a dedicated signaling channel (like ISDN). The most common forms of CAS signaling are loop start, ground start, Equal Access North American (EANA), and receive and transmit (E&M). In addition to receiving and placing calls, CAS signaling also processes the receipt of Dialed Number Identification Service (DNIS) and Automatic Number Identification (ANI) information, which is used to support authentication and other functions. In CAS, the least significant bit of information in a T1 signal is "robbed" in the channels that carry voice and is used to transmit framing and clocking information. This is called "in-band" signaling.

Each T1 channel carries a sequence of frames. These frames consist of 192 bits and an extra bit designated as the framing bit, for a total of 193 bits per frame. Super Frame (SF) groups twelve of these 193-bit frames and designates the framing bits of the even-numbered frames as signaling bits. Trunk can carry line events as multifrequency signaling. Digital trunks use 4-bit signaling (ABCD). The TDM frames allows 4 states (A and B), and 16 states (A, B, C, D) signaling bit options. Signaling information is sent as robbed bits in frames 6, 12, 18, and 24 when using ESF T1 framing. A D4 Super Frame only transmits 4-state signaling with A and B bits. On the E1 frame, all signaling is carried in time slot 16, and two channels of 16-state (ABCD) signaling are sent per frame.

CAS looks specifically at every sixth frame for the time slot's or channel's associated signaling information. These bits are commonly referred to as A- and B-bits. Extended Super Frame (ESF), due to grouping the frames in sets of twenty-four, has four signaling bits per channel or time slot. These occur in frames 6, 12, 18, and 24 and are called the A-, B-, C-, and D-bits respectively.

Note If the Tx Framer PDH receives CAS pattern as 0x0000, then the pattern is replaced with 0x1111 before inserting it into the 16th time slot of E1 to avoid multiframe align word in the E1 frame.

CAS Signaling Types

CAS supports the following signaling types:

- Loop Start Signaling
- Ground Start Signaling
- E and M Signaling

Loop Start Signaling

Loopstart signaling is one of the simplest forms of CAS signaling. When a handset is picked up, this action closes the circuit that draws current from the telephone company Central Office (CO) and indicates a change in status, which signals the CO to provide dial tone. An incoming call is signaled from the CO to the handset by sending a signal in a standard on/off pattern, which causes the telephone to ring.

Ground Start Signaling

Groundstart signaling is similar to loopstart signaling in many regards. It works by using ground and current detectors that allow the network to indicate off-hook or seizure of an incoming call independent of the ringing signal and allow for positive recognition of connects and disconnects. For this reason, ground start signaling is typically used on trunk lines between PBXs and in businesses where call volume on loop start lines can result in glare.

The advantage of groundstart signaling over loopstart signaling is that it provides far-end disconnect supervision. Another advantage of groundstart signaling is the ability for incoming calls (network —> CPE) to seize the outgoing channel, thereby preventing a glare situation from occurring.

E and M Signaling

E&M Signaling is typically used for trunk lines. The signaling paths are known as the E-lead and the M-lead. Descriptions such as Ear and Mouth were adopted to help field personnel determine the direction of a signal in a wire. E&M connections from routers to telephone switches or to PBXs are preferable to FXS/FXO connections because E&M provides better answer and disconnect supervision.

E&M signaling has many advantages over the previous CAS signaling methods that are discussed in this document. It provides both disconnect and answers supervision and glare avoidance. E&M signaling is simple to understand and is the preferred choice when you use CAS.

CAS Interworking

In CAS interworking scenario, the SF framing is configured on one side and ESF framing is configured on the other side of the PSN. The two SF frames are sent in a single CESoP packet to align the TDM data for CAS and to match with the ESF mode.

The minimum payload size of T1 for SF or ESF should be multiples of 24. The amount of TDM data per CESoPSN packet must be constant.

The following table shows the payload sizes that are supported for T1 frames based on the time slots:

Table 2: Payload Size for T1 Frame

Time Slot	T1 Frame	Payload Size
1	4,8,12,24	5, 9, 13, 25
2	4,8,12,24	9, 17, 25, 49
3	4,8,12,24	14, 26, 38, 74
4	4,8,12,24	18, 34, 50, 98
5	4,8,12,24	23, 43, 63, 123
6	4,8,12,24	27, 51, 75, 147
7	4,8,12,24	32, 60, 88, 172
8	4,8,12,24	36, 68, 100, 196
9	4,8,12,24	41, 77, 113, 221
10	4,8,12,24	45, 85, 125, 245
11	4,8,12,24	50, 94, 138, 270
12	4,8,12,24	54, 102, 150, 294
13	4,8,12,24	59, 111, 163, 319
14	4,8,12,24	63, 119, 175, 343
15	4,8,12,24	68, 128, 188, 368
16	4,8,12,24	72, 136, 200, 392
17	4,8,12,24	77, 145, 213, 417
18	4,8,12,24	81, 153, 225, 441
19	4,8,12,24	86, 162, 238, 466
20	4,8,12,24	90, 170, 250, 490

Time Slot	T1 Frame	Payload Size
21	4,8,12,24	95, 179, 263, 515
22	4,8,12,24	99, 187, 275, 539
23	4,8,12,24	104, 196, 288, 564
24	4,8,12,24	108, 204, 300, 588

The following table shows the payload sizes that are supported for E1 frames based on the time slots:

Table 3: Payload Size for E1 Frame

Time Slot	E1 Frame	Payload Size
1	4,8,16	5, 9, 17
2	4,8,16	9, 17, 33
3	4,8,16	14, 26, 50
4	4,8,16	18, 34, 66
5	4,8,16	23, 43, 83
6	4,8,16	27, 51, 99
7	4,8,16	32, 60, 116
8	4,8,16	36, 68, 132
9	4,8,16	41, 77, 149
10	4,8,16	45, 85, 165
11	4,8,16	50, 94, 182
12	4,8,16	54, 102, 198
13	4,8,16	59, 111, 215
14	4,8,16	63, 119, 231
15	4,8,16	68, 128, 248
17	4,8,16	77, 145, 281
18	4,8,16	81, 153, 297
19	4,8,16	86, 162, 314
20	4,8,16	90, 170, 330
21	4,8,16	95, 179, 347

Time Slot	E1 Frame	Payload Size
22	4,8,16	99, 187, 363
23	4,8,16	104, 196, 380
24	4,8,16	108, 204, 396
25	4,8,16	113, 213, 413
26	4,8,16	117, 221, 429
27	4,8,16	122, 230, 446
28	4,8,16	126, 238, 462
29	4,8,16	131, 247, 479
30	4,8,16	135, 255, 495
31	4,8,16	140, 264, 512

CAS Idle Code

CEM FPGA supports two CAS idle codes, where the first code is sent for 2.5 seconds and the second code is sent for the remaining duration of fault. The default idle CAS code is 0x8, and you can configure the first and second codes from 0x0 to 0xF.

Restrictions for CAS

- CAS is not supported on the 1-Port OC-192 or 8-Port Low Rate CEM interface module.
- CAS is not supported in the 16th time slot of E1 CEM.

How to Configure CAS

Modifying Interface Module to CAS Mode

By default, the CEM interface modules are in the non-CAS mode. Before modifying the mode, ensure that you delete the iMSG-related configurations manually and use the **hw-module** *<slot/bay>* *<im-type>* **mode** *<im-mode>* command to change the CAS mode. The FPGA image is modified into the CAS mode.

To revert to the non-CAS mode, you have to remove the CAS configurations and execute the **no hw-module** *<slot/bay>* *<im-type>* **mode** *<im-mode>* command.

To modify the interface module into the CAS mode, enter the following commands:

```
Router(config)#platform hw-module configuration
```

```
Router(conf-plat-hw-conf)#hw-module <slot/bay> <im-type> mode <im-mode>
```

In the 48-Port T1 or E1 CEM interface module, the CAS and non-CAS modes are available in the same FPGA. So there is no requirement to change the IM into the CAS mode. You can add the CAS signaling configuration directly under CEM.

The interface module **`<im-mode>`** options that are supported are as follows:

- 48-Port T3 or E3 CEM interface module—Use the **fpga-cas** option.
- 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 CEM interface module—Use the **10g-fpga-cas** option.
- Combo 8-port SFP GE and 1-port 10 GE 20G interface module—Use the **20g-fpga-cas** option.

Note Once you change the interface module from the CAS to non-CAS mode or viceversa, the interface module restarts.

Verifying CAS Mode Configuration

Use the following **show platform hw-configuration** command to verify the CAS mode configuration:

```
Router#show platform hw-configuration
Slot   Cfg IM Type         Actual IM Type      Op State           Ad State IM Op Mode
------ ------------------- ------------------- ------------------ -------- ------------
 …
 0/2   -                   NCS4200-1T8S-20CS      N/A                N/A      20G_CAS
```

Enabling CAS

You can enable CAS on CESoP circuit in two ways:

1. On specific CEM interface
2. Under CEM class global configuration for the whole interface module

Ensure that you change the CEM interface module to the CAS mode for CESoP pseudowire configuration before proceeding to CAS configuration. By default, all the IMs are in the non-CAS mode.

Enabling CAS on CEM Interface

You can enable CAS on CEM interface using the **signaling** command on all the interface modules with the signaling type as inband CAS. The outband-cas signaling option is not supported on the CEM interface configuration.

```
Router(config)#interface CEM 0/x/y
Router(config-if-cem)#cem <cem-id>
Router(config-if-cem)#signaling inband-cas
```

Before enabling or disabling CAS on the CEM interace, you can retain the local connect or cross-connect configurations on that interface.

Enabling CAS over CEM Class Global Configuration

You can enable CAS under global CEM class using the **signaling** command.

Under the CEM interface, the configured CEM class can be mapped. One class CEM can be mapped to multiple CEM interfaces. When you enable CAS under the global class CEM, then this configuration applies to all the mapped CEM interfaces.

Create Class CEM and Enable CAS Under Global CEM Class

```
Router(config)#class cem cisco
Router(config-cem-class)#signaling inband-cas
Router(config-cem-class)#end
```

Map CEM Class to Interface

```
Router#configure terminal
Router(config)#interface cem0/3/2
Router(config-if)#cem 3
Router(config-if-cem)#cem class cisco
Router(config-if-cem)#end
```

Configuring Idle CAS Code

You can configure CAS Idle code patterns using the **idle-cas** command on a specific CEM interface or under the global CEM class.

Configuring Idle CAS Code on CEM Interface

```
Router(config)#interface CEM 0/x/y
Router(config-if-cem)#cem cem-id
Router(config-if-cem)#idle-cas 0x5 0x6
Router(config-if-cem)#end
```

Configuring Idle CAS Code Under Global CEM Class

```
Router(config)#class cem cas-code
Router(config-cem-class)#idle-cas 0xa 0xb
```

The default CAS idle code is 0x8, and you can configure one or two idle codes using the **idle-cas** CLI.

Verifying CAS Configuration

Use the **show cem circuit** command to verify the CAS configuration:

```
Router#show cem circuit int cem0/4/20
CEM0/4/20, ID: 3, Line: UP, Admin: UP, Ckt: ACTIVE
Mode: E1, CEM Mode: E1-CESoP
Controller state: down, T1/E1 state: up
Idle Pattern: 0x77, Idle CAS: 0x8 0x8
Dejitter: 8 (In use: 0)
Payload Size: 85
Framing: Framed (DS0 channels: 1-10)
CEM Defects Set
None

Signalling: In-Band CAS
RTP: No RTP
```

```
Ingress Pkts:    527521938            Dropped:             0
Egress Pkts:     527521938            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
```