Products & Services

# Understanding How Digital T1 CAS (Robbed Bit Signaling) Works in IOS Gateways

**Document ID: 22444**

Contents



## Introduction

Channel Associated Signaling (CAS) is also referred to as Robbed Bit Signaling. In this type of signaling, the least significant bit of information in a T1 signal is "robbed" from the channels that carry voice and is used to transmit framing and clocking information. This is sometimes called "in-band" signaling. CAS is a method of signaling each traffic channel rather than having a dedicated signaling channel (like ISDN). In other words, the signaling for a particular traffic circuit is permanently associated with that circuit. The most common forms of CAS signaling are loopstart, groundstart, Equal Access North American (EANA), and 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.

Each T1 channel carries a sequence of frames. These frames consist of 192 bits and an additional bit designated as the framing bit, for a total of 193 bits per frame. Super Frame (SF) groups twelve of these 193 bit frames together and designates the framing bits of the even numbered frames as signaling bits. CAS looks specifically at every sixth frame for the timeslot'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 timeslot. These occur in frames 6, 12, 18, and 24 and are called the A-, B-, C-, and D-bits respectively.

The biggest disadvantage of CAS signaling is its use of user bandwidth in order to perform signaling functions.

## Prerequisites

### Requirements

There are no specific requirements for this document.

### Components Used

The information in this document is based on these software and hardware versions:

- For AS5xxx, Cisco 2600/3600 platforms, all Cisco IOS® Software releases apply.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

### Conventions

Refer to the Cisco Technical Tips Conventions for more information on document conventions.

## CAS Signaling Types

### Loopstart Signaling

Loopstart signaling is one of the simplest forms of CAS signaling. When a handset is picked up (the telephone goes off-hook), this action closes the circuit that draws current from the telephone company 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.

A disadvantage of loopstart signaling is the inability to be notified upon a far-end disconnect or answer. For instance, a call is placed from a Cisco router configured for Foreign Exchange Station (FXS)-loopstart. When the remote end answers the call, there is no supervisory information sent to the Cisco router to relay this information. This is also true when the remote end disconnects the call.

**Note:** It is possible for answer supervision to be provided with loopstart connections if the network equipment can handle line-side answer supervision. Also, loopstart provides no incoming call channel seizure. Therefore a condition known as glare can arise, where both parties (Foreign Exchange Office [FXO] and FXS ) try to simultaneously place calls. Glare can be avoided when you configure the T1-CAS gateway's port selection order in such a way that the inbound and outbound calls are in reverse order. For example, if the inbound calls are sent by the provider on the FXO ports in the order of port 1, port 2, port 3 and port 4, then configure the Cisco CallManager Route Group to route outbound calls on those same ports in the order port 4, port 3, port 2 and port 1.

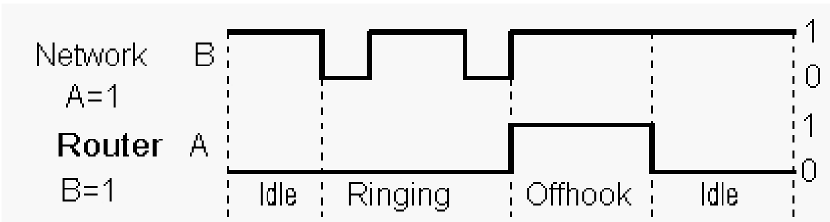
With loopstart signaling, the FXS side only uses the A-bit and the FXO side only uses the B-bit to communicate call information. The AB-bits are bi-directional. This state table defines this signaling information from the CPE's perspective (FXS).

**Note:** In this table, 0/1 indicates a signaling bit alternating between 1 and 0 in successive superframes.

| Direction | State | A | B | C | D |
|---|---|---|---|---|---|
| Transmit | On-hook | 0 | 1 | 0 | 1 |
| Transmit | Off-hook/Loop Closed | 1 | 1 | 1 | 1 |
| Receive | On-hook | 0 | 1 | 0 | 1 |
| Receive | Off-hook | 0 | 1 | 0 | 1 |
| Receive | Ringing | 1 | 1 | 1 | 1 |
| *Receive* | *Off-hook with Answer Supervision - SF framing Only* | *0* | *0/1* | | |

| | | | | | |
|---|---|---|---|---|---|
| *Receive* | *Off-hook with Answer Supervision - ESF framing Only* | *0* | *1* | *0* | *0* |
| *Receive* | Network Disconnect (600 ms+) | *1* | *1* | *1* | *1* |

This is the FXS-loopstart timing diagram.




On an incoming call (network -> CPE) this happens:

1. The network toggles the B-bit to indicate ringing. This is a standard ringing pattern. For instance, 2 seconds on, 4 seconds off.
2. CPE detects the ringing and off-hook states. A-bit goes from 0 to 1.

In an outgoing call (CPE -> network) this happens:

1. CPE goes off-hook and A-bit goes from 0 to 1.
2. The network provides dial tone. There is no signaling change.
3. CPE sends digits (dual tone multifrequency (DTMF) in Cisco's case).

During a disconnect from the network, this occurs:

1. CPE detects in-band that the call has dropped (someone says good-bye or a modem drops the carrier).
2. CPE goes on-hook and A-bit goes from 1 to 0.

During a disconnect from the CPE, only step 2 occurs.

The Answer Supervision and Disconnect Supervision States are only seen when provided by the network.

### Groundstart Signaling

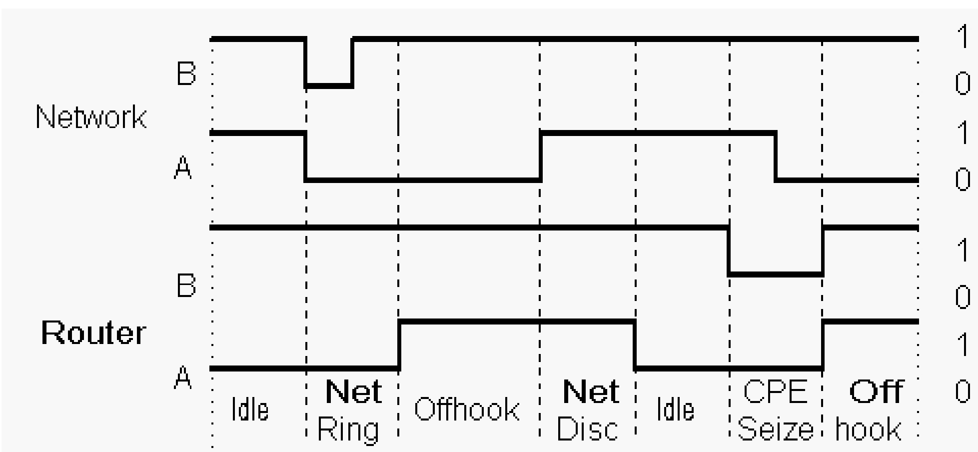
Groundstart signaling is very similar to loopstart signaling in many regards. It works by using ground and current detectors that allow the network to indicate off-hook or seizure of an incoming call independent of the ringing signal and allow for positive recognition of connects and disconnects. For 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. This is done by using the A- and B- bit on the network side instead of just the B-bit. The A-bit is also used on the CPE side. However, the B-bit can also be involved, based on the switch's implementation. Typically the B-bit is ignored by the Telco. This is a state table that defines this signaling information from the CPE's perspective (FXS).

**Note:** In this table, 0/1 indicates a signaling bit alternating between 1 and 0 in successive superframes.

| Direction | State | A | B | C | D |
|---|---|---|---|---|---|
| Transmit | On-hook/Loop Open | 0 | 1 | 0 | 1 |
| Transmit | Ground on Ring | 0 | 0 | 0 | 0 |
| Transmit | Off-hook/Loop Closed | 1 | 1 | 1 | 1 |
| Receive | On-hook/No Tip Ground | 1 | 1 | 1 | 1 |
| Receive | Off-hook/Tip Ground | 0 | 1 | 0 | 1 |
| Receive | Ringing | 0 | 0 | 0 | 0 |
| *Receive* | *Answer Supervision - SF framing Only* | 0 | 0/1 | | |
| *Receive* | *Answer Supervision - ESF framing Only* | 0 | 1 | 0 | 0 |

This is the FXS-groundstart timing diagram.




On an incoming call (network-> CPE) this happens:

1. The network goes off-hook and the A-bit goes from 1 to 0 and rings the line by toggling the B-bit between 0 and 1.

2. CPE detects the ringing and seizure and goes off-hook and the A-bit is set to 1.

3. The network goes off-hook and the B-bit stops toggling. B-bit is now 1.

In an outgoing call (CPE -> network) this happens:

1. CPE goes ground on ring and A-bit and B-bit are 0.

2. The network goes off-hook and the A-bit goes from 1 to 0. The B-bit is set to

1.

3. The CPE goes off-hook. The A-bit and the B-bit are 1.

4. CPE detects a dialtone and sends digits.

During a disconnect from the network, this occurs:

1. The network goes on-hook and the A-bit goes from 0 to 1.

2. CPE goes on-hook and the A-bit goes from 1 to 0.

During a disconnect from the CPE, the above steps are reversed.

## EandM Signaling

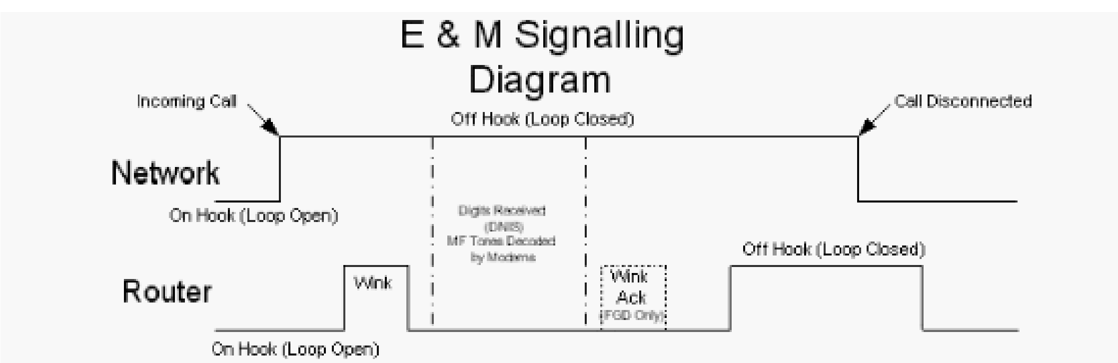
E&M Signaling is typically used for trunk lines. The signaling paths are known as the E-lead and the M-lead. Descriptions such as Ear and Mouth were adopted to help field personnel determine the direction of a signal in a wire. E&M connections from routers to telephone switches or to PBXs are preferable 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 discussed in this document. It provides both disconnect and answer supervision as well as glare avoidance. E&M signaling is simple to understand and is the preferred choice when you use CAS.

This table represents Standard (E&M) Trunk type A- and B-bits.

| Direction | State | A | B | C | D |
|---|---|---|---|---|---|
| Transmit | Idle/On-hook | 0 | 0 | 0 | 0 |
| Transmit | Seized/Off-hook | 1 | 1 | 1 | 1 |
| Receive | Idle/On-hook | 0 | 0 | 0 | 0 |
| Receive | Seized/Off-hook | 1 | 1 | 1 | 1 |

This is the E&M Signaling diagram.




The three types of E&M Signaling that are supported on Cisco routers are:

- Wink-start (FGB) - Used to notify the remote side that it can send the DNIS information.

- Wink-start with wink-acknowledge or double-wink (FGD) - A second wink that is sent to acknowledge the receipt of the DNIS information.

- Immediate start - Does not send any winks at all.

**Note:** FGD is the only variant of T1 CAS that supports ANI and Cisco supports it along with the FGD-EANA variant. In addition to FGD functionality, FGD-EANA provides certain call services, such as emergency (USA-911) calls. With FGD, the gateway supports the collection of ANI inbound only. With the use of FGD-EANA, a Cisco 5300 is able to send ANI information outbound as well as collecting it inbound. This latter capability requires the user of the **fgd-eana** signaling type in the **ds0-group** command, with **ani-dnis** option and **calling-number outbound** command in the POTS dial-peer. The **calling-number outbound** command is supported only on the Cisco 5300 as of Cisco IOS Software Release 12.1(3)T.

Therefore, on an incoming call (network-> CPE) this process happens:

1. The network goes off-hook. The A-bit and B-bit equal 1.

2. CPE sends wink. The A-bit and B-bit equal 1 for 200 ms. This only occurs when you use wink-start or wink-start with wink acknowledgement. Ignore this step for immediate start.

3. The network sends DNIS information. This is done by sending inband tones which are decoded by the modem.

4. CPE sends a wink acknowledgement. A-bit and B-bit equal 1 for 200 ms. This only occurs for wink-start with wink acknowledgement. Ignore this step for immediate start or wink-start.

5. CPE goes off-hook when a call is answered. A-bit and B-bit equal 1.

In an outgoing call (CPE -> network) the same procedure occurs. However, the network just described is the CPE and vice-versa. This is because the signaling is symmetric.

During a disconnect from the network, this process occurs:

1. The network goes on-hook. A-bit and B-bit equal 0.

2. CPE goes on-hook. A-bit and B-bit equal 0.

During a disconnect from the CPE, these two steps are reversed.

### Cisco Support Community - Featured Conversations

Cisco Support Community is a forum for you to ask and answer questions, share suggestions, and collaborate with your peers. Below are just some of the most recent and relevant conversations happening right now.

| | | | |
|---|---|---|---|
| signalling cas Vs CCS | **visentin.d** | **3 Replies** | 8 years, 7 months ago |
| " *ANI*DNIS* " Signaling on T1 CAS with... | **d.gavin** | **1 Reply** | 2 years, 1 month ago |
| T1-CAS vs T1-PRI | **pravkuma** | **4 Replies** | 3 years, 8 months ago |
| E1, Time slot 15 or 17 which one is use... | **kayih** | **2 Replies** | 4 years, 7 months ago |
| AS 5300 RAS solutions PRI vs a Digital... | **2plaidlaw** | **1 Reply** | 4 years, 8 months ago |
| Caller ID on Digital T1 CAS | **joel_at_netage.com** | **3 Replies** | 3 years, 2 months ago |
| Does the Cisco 26XX-XM router support... | **d-tay** | **1 Reply** | 7 years, 3 months ago |
| VoIP and E1 CAS3Bit Problem | **shafagh** | **2 Replies** | 9 years, 2 days ago |
| VoIP and E1 CAS3Bit Problem | **shafagh** | **0 Replies** | 9 years, 2 weeks ago |

**Start A New Discussion** **Subscribe**

## Related Information

- **VoIP with Channel Associated Signaling (CAS)**
- **Configuring and Troubleshooting T1 CAS Signaling**
- **Voice Technology Support**
- **Voice and Unified Communications Product Support**
- **Troubleshooting Cisco IP Telephony**
- **Technical Support & Documentation - Cisco Systems**

Updated: Jan 17, 2007 Document ID: 22444