Applications for Access Infrastructure
Type 2 Calling Identity Delivery on Call Waiting (CIDCW) CPE Alerting Signal (CAS)-Acknowledgement (ACK) Handshake Sequence

Application Note

Abstract

This note describes the CAS-ACK handshake sequence for calling identity on call waiting (CIDCW) and some of the implications for the design of line circuits that must be compatible with this service. The sequence is based on the initial condition that a call is in progress when the CAS-ACK handshake is initiated.

CAS-ACK HANDSHAKE

The following discussion of the CIDCW sequence defines the protocol and timing of the signaling and acknowledgement that must occur to ensure reliable data transmission and reception. It is based on the TIA SP-4078 Standard and follows Clause 4.6.6 (pages 14, 15, and 16) as the reference for the CAS-ACK handshake sequence. To simplify the discussion as an illustrative presentation, the terms *customer premise equipment* (CPE) and *acknowledge sender* (ACK-Sender) will be replaced by *ID box*. Phone 1 and phone 2 are handsets connected to the caller ID box.

Therefore:

ID Box = CPE and/or ACK-Sender.
Phone 1 = handset connected to ID box.
Phone 2 = extension handset connected to ID box.

CAS is a CPE (ID box) alerting signal that is not detected by the phone: it is defined as dual-tone (2130 Hz and 2750 Hz) with a duration of 80 ms to 85 ms [1]. ACK is defined as a DTMF D signal with a duration of 60 ms ± 5 ms [2].

With a single ID box connected to the phone line and two phones—a main phone (1) with extension phone (2)—connected to the ID box, the sequence described below is expected. This means no other MEI compatible CPE is connected to the line.

The sequence begins with the CAS sent by the central office (CO) to the ID box to indicate a message/call is waiting. The ID box:

- Detects the CAS
- Disconnects/mutes phone 1
- Presents an on-hook (high resistance >50 kΩ) state for the line connected to phone 1

This action has a timed delay and must happen no earlier than 25 ms and no later than 60 ms after the ID box detects the end of CAS. The CO incoming line is still connected to phone 2.

- When phone 2 is on-hook:
  - The CO line will transition to Line High state.
  - Immediately, the ID box checks for phone 2 state with phone 2 still connected to the CO line.
  - This check is voltage sensing and must not load the CO line.
  - If phone 2 is Line High state (>21 V) then the ID box will go off-hook to the incoming CO line.
  - The ID box off-hook to the CO line must happen between 5 ms to 8 ms after detecting phone 2 on-hook.
  - The only *loading* of the incoming CO line to the ID box during the phone 2 check is the state of phone 2.
  - For the line high state detected, the ID box must begin transmitting the ACK signal 30 ms to 40 ms after detection of the Line High state.

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- When phone 2 is off-hook:
  - The line state is Low (≤19 V) during the check, the ID box does not go off-hook, and should wait up to 100 ms.
  - If no Line High is detected during this time, the ID box then reconnects phone 1 and resets to receive any CAS.
  - If phone 2 is returned to on-hook soon enough during the 100-ms period and the CO line voltage becomes greater than 21 V, then the ID box will detect the line high and go off-hook to the CO line in 5 ms to 8 ms and then begin transmitting the ACK signal 30 ms to 40 ms after detecting the line High.
  - This may or may not result in transmitting the ACK signal in time to meet the timing parameters expected by the network line.
  - The determining factors are dependent on the variation of the initiation time of the ID box on-hook (25 ms to 60 ms) and the initiation of the ACK signal (30 ms to 40 ms after on-hook).
  - The transmission of the ACK signal must begin no later than 100 ms after the end of CAS as measured on the tip and ring interface.

IMPLICATIONS FOR LINE CARD DESIGN

For the first condition (phone 2 on-hook, no extension phone connected to the ID box), there are two problems:

1. **The ID box disconnects/mutes phone 1 presenting an on-hook condition to the telephone line.**
   Subscriber line interface circuits (SLIC devices) have an inherent slow voltage transition from off-hook condition to on-hook condition. The transition from low tip/ring voltage difference (off-hook) to greater than 21 V (on-hook) can take tens of milliseconds. For this situation, the Line High condition may not occur soon enough to activate the ID box into sending the ACK signal within the appropriate timing parameters. If the SLIC voltage transition takes sufficiently long enough to reach 21 V, the condition and sequencing will be as described above for phone 2 off-hook. Line interface circuits designed for CIDCW must present >21 V within 5 ms of a hook flash.

2. **After the hook flash, the battery feed and codec circuit must settle to the point that the ACK signal is not clipped and can be detected.**
   The ACK signal can begin as soon as 30 ms after the end of the hook flash and can last as little as 55 ms. It is very difficult to get the line interface circuit and codec to settle within 30 ms of the hook flash, but some clipping of the beginning of the ACK signal is allowable depending on the response time of the ACK signal detector. Line interface circuits designed for CIDCW generally need to settle to the point where the ACK signal is passed undistorted and properly encoded as pulse code modulation (PCM) within about 50 ms to allow the ACK signal detector to operate properly.

CONCLUSION

CIDCW compatibility presents some interesting challenges for line interface circuit design. The basic sequence and problem areas have been described within this document. Contact your Zarlink account representative for further applications assistance for SLIC-codec combinations.

REFERENCES

1. *Telcordia*, GR-30-CORE, *Voiceband Data Transmission Interface*, Pg. 2-21 and SP-4078, Pg. 6.
2. *Telcordia*, SR-TSV-002476, *CPE Compatibility Considerations for the Voiceband Data Transmission Interface* 2.1.2, Pg. 3.

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