FXS and FXO

- FXS Foreign eXchange Subscriber
  - Provides Battery to the loop
  - Generates Ring Voltage on the loop
  - Performs Battery Reversal for Call connections
  - Performs Battery Denial to signal Disconnect
  - Detects Flash Hook, DTMF, Off-Hook, On-Hook
  - Standard PSTN Loop provides 48vdc
  - Acts like CO Switch Port
- FXO Foreign eXchange Office
  - Signals Off hook by connecting the loop
  - Signals On-hook
  - Signals Hook Flash
  - Generates DTMF Tones
  - PBX Analog Trunk Port that connects to CO or a basic Phone

Major FXS Features

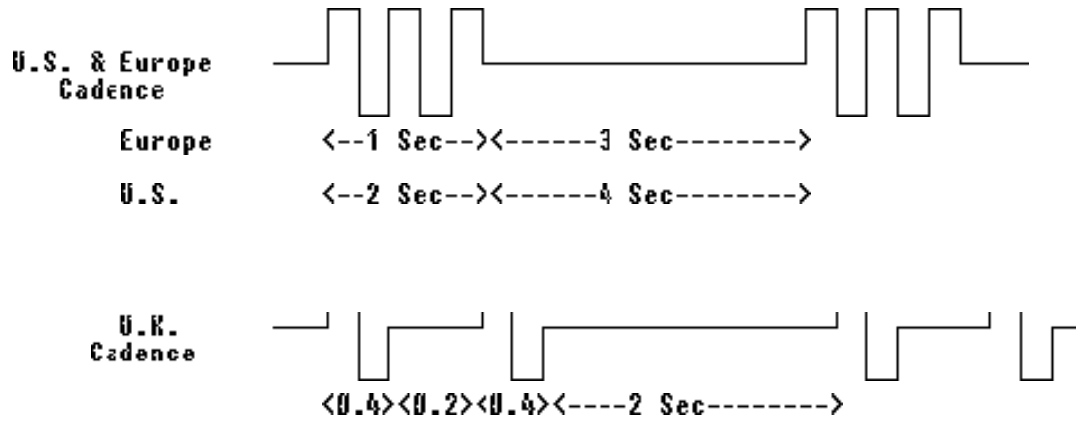
- FXS Features
    - Loop Start Signaling
        - No Ground Start Signaling
    - Default ringing voltage is around 81vdc when set to default 600ohms. A impedance setting of (600ohms at 20Hz) will generate around 90vdc for key systems that require higher VDC.
    - Provides Stutter Tone for VM indications and light signal for phones that support this feature
    - Call waiting
    - Flash Hook for N-Way Calling
    - The FXS ports support 1 tip and ring pair, not 2. Additional wiring has to be designed for have the BiB work with multi-lines systems through 1 RJ-11 port
    - Supports Generation of RFC2833 DTMF. In-band DTMF via RTP can also be configured as of 8.8.3.9 version for BIB

FXS Major Features Continued

- Supports adjusting timing of DTMF tones (Default 200ms)
- Support CLID via Bell 202 Standard
  - CLID Type II Support for Call Waiting
  - CLID Privacy Support
  - CLID Adjustments or Information Order, Field Length and Time zone that is daylight savings aware
- 16ms of EC on 4500 and 4600 Systems,
  - the EdgeMarc 250 supports 32ms of EC
  - The add on 4570 and 4603 Supports 32ms of EC
  - The 4608T4WDPoE add on supports 16ms of EC
- Adjustments of Disconnect Signal timing (CPC Timer)
- Termination Impedance Options (600ohms is default US)
- Inter-digit Timer adjustments
- The 4600 systems support 20 REN = meaning 20 phones can be connect to all 6 ports

Ringing on FXS Ports

- Ringing Cadence is ring for 2s, silent for 4s, ring for 2s, silent for 4s and so on
- The BiB Supports adjusting the ring time. The default ring time is 40 seconds. 40s = around 8-10 rings.
- Ringer Time can be extended with the following configuration added to the "/etc/config/sipua_defs.conf" file
    - SIPUA_INCOMING_ANS_WAIT_DELAY=<time_in_sec>



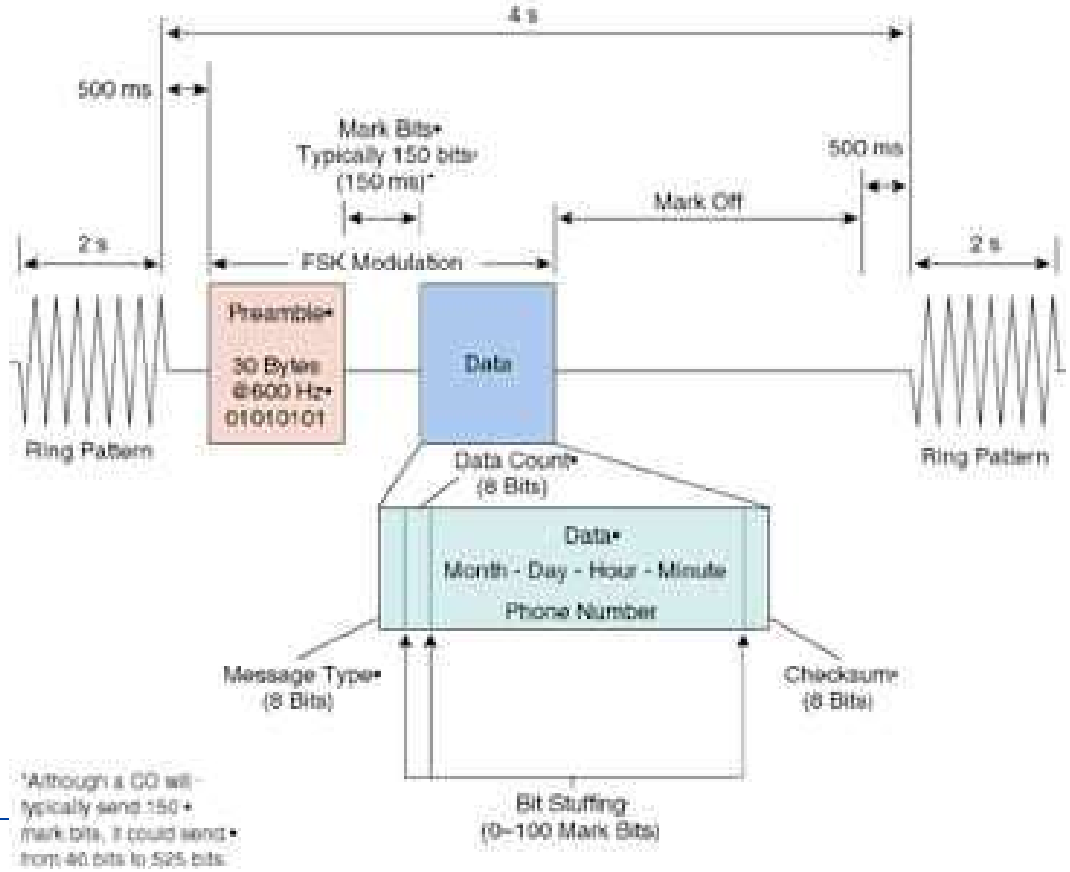
DTMF Features on FXS

- The FXS Ports are RFC2833 Compliant for DTMF by default
- DTMF standard is play each tone for 80-300ms and the FXS ports on the EM are configured for 200ms max
- Configuration Options for DTMF are as Follow and are added or any edits are done in the "/etc/config/sipua_defs.conf" file
    - SIPUA_DTMF_MAX_TIME=<time in milliseconds>
        - Configured for 200ms as default
    - SIPUA_DISABLE_RFC2833=<on/off>
    - For PRI Lines, the file to edit is "/etc/config/sipua_pri_defs.conf"
        - PRI_DTMF_MAX_TIME=<time_in_ms, 50-400>
        - PRI_DTMF_MAX_VOLUME=<volume, 2-15>

CLID Feature Set

- Caller ID, CID and CLID are the terms used for the same function
- Two Modes of CLID
  - SDMF (older mode and Not Supported on BiB)
    - Single Data Message Format
      - Date Stamped with calling Number
  - MDMF (Supported)
    - Multiple Data Message Format
      - Date, calling Number and Name
- CLID starts 500ms after the 2nd Ring for incoming calls
- CLID Type I and Type II for Call Waiting are supported
- Several Configuration Sections for the FXS
- CLID standard is Bell 202 modem (1200 bps frequency-shift keying, or FSK)

Depiction of Caller ID On the Line



Configuration Options for CLID

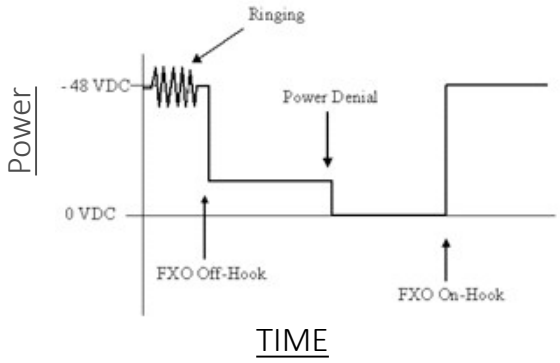
- If the Order of the CLID Information needs to change
  - SIPUA_CID_FIELD_ORDER=date:name:number (default)
- If the Length of the Name Field needs to change
  - SIPUA_CID_MAX_NAME_LENGTH=1-20 (default = 12)
- Of the Length of the Number Field Needs to Change
  - SIPUA_CID MAX_DIGITS=1-12 (default = 10)
- In some rare cases the CLID voltage needs to change, add this line to increase the voltage
  - SIPUA_CID_TX_LEVEL=4163 (not set)
- When inbound CLID needs to be disabled, set this line to “on”
  - SIPUA_CLID_SEND_DISABLE=on/off (not set, default to off)

Answer and Supervisory Disconnect BiB Features

- We all know answering on FXO is going off hook
- We all know hanging up on FXO is going back on hook
- FXS Signals as well for call connect and call disconnect. This is critical in cases when calls are processed by a PBX and Key systems
- FXS Signal for Call connect is "Battery Reversal"
- FXS Signal for Call over is "Battery Denial" or End of "Battery Reversal"
- "CPC Timer" on the EM Sets the "Advisory Disconnect" signal
    - CPC Default Timer is set to 800ms

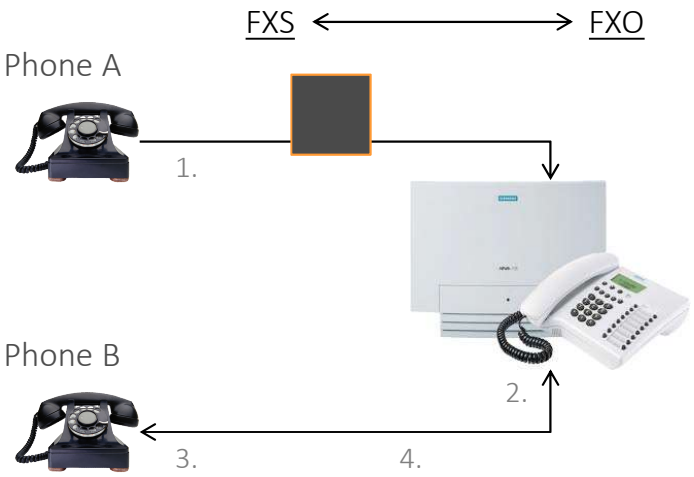
Time (h:m:s:ms)	dt (ms)	Tx	State	Rx	Cause
0:00:04:927	.....				
0:00:05:569	642			Idle	
0:00:05:575	6	Loop closed	ANSWER		Connect
0:00:05:689	114			Battery reversal (RLCF)	
0:00:22:388	16,699			Battery denial	
0:00:23:198	810			Battery reversal (RLCF)	
0:00:27:056	3,858	Loop open	IDLE		Disconnect
0:00:27:104	48			Idle	

More on Disconnections



FXS ⟷ FXO

Time (h:m:s:ms)	dt (ms)	Tx	State	Rx	Cause
0:00:04:891	.....				
0:00:05:634	743			Idle	
0:00:05:641	7	Loop closed	ANSWER		Connect
0:00:05:782	141			Normal (LCF)	
0:00:21:800	16,018			Battery denial	
0:00:22:628	828			Normal (LCF)	
0:00:27:117	4,489	Loop open	IDLE		Disconnect
0:00:27:165	48			Idle	



1. Phone A Calls PBX
2. PBX Forwards Call to remote Phone B
3. Phone B Hangs Up
4. System has to Signal Leg 2 Call has ended

Inter-Digit Timer for FXS

- Most folks are familiar with inter-digit timer and dial plans on Cisco GW and CCM.
- The EM does not have dial peer plans like when XXX-XXX-XXXX number of digits are dialed, send the digits via SIP immediately
- A dialing of "#" after the last digits would trigger the number to dial immediately on FXS.
- The inter-digits feature is used for knowing when to send the call. For the AT&T configuration we set this to 2s. This means that once the FXS receives each digit, the SIPUA waits for an additional 2s for any other digits before sending a call to the network.
- The number of digits does not matter, the inter-digit timer triggers after the 1st digit or 10th digit if more than 2s lapse before dialing another digit.
- If a customer dials only 4 digits, and then the timer threshold of 2s is reached, the 4 digit is number is sent by the FXS/SIPUA to the IPBE with an INVITE for what may be a wrong or not finished number.
- Inter-digit setting only effects dialing outbound and does not effect DTMF being dialed while in a call.
- PRI signaling is different and is not effected by Inter-digit

Gain Settings on SIPUA/FXS

- Default setting is -4/-4 for TX/RX
- -# TX means the voice being transmitted needs to be softer sound
- +# TX means the voice being transmitted needs to be louder

- -# RX means the voice being received is softer
- +# RX means the voice being received is louder than needed
- Changing gain can help offset echo if the echo is Near End Echo created between the FXS port and PBX system