

E911 Call Processing

E-911 Calls between End Office and PSAP

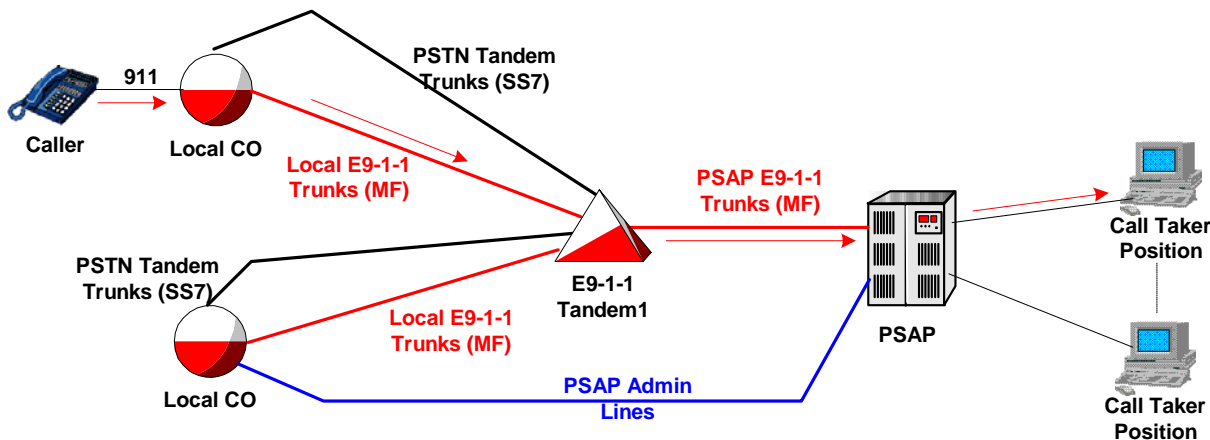


Figure 1 – Traditional E9-1-1 Trunk Network

Traditional E-911 Call Overview:

When a 911 call is placed, the local Central Office (CO) routes the call to the E-911 Network rather than the Public Switched Telephone Network (PSTN). The 911 call is routed to a Local E-911 Trunk between the local CO (also known as the End Office) and the E-911 Tandem CO. The Tandem CO then routes the 911 Call to the appropriate Public Safety Answering Point (PSAP) via a PSAP E-911 Trunk. The PSAP (Police, Fire, etc.) routes the call locally to a 911 Call Taker. The Automatic Number Identification (ANI) is sent over the Trunk using Multi-frequency Digits (MF) to the PSAP. The PSAP sends the ANI (911 caller's telephone number) to the Automatic Location Identification (ALI) computer via a data circuit to obtain the 911 caller's address. The 911 Call Taker can transfer the caller to the appropriate agency if necessary. A Flash, followed by DTMF digits is sent by the PSAP to the 911 Tandem CO to transfer the call.

Supervisory Signaling Protocol:

The E-911 Trunks use Loop/Reverse Battery supervisory signaling (Analog Tip/Ring access point) for On-Hook, Off-Hook, Wink, and Flash. Digital T1 channels (Digital access point) use A, B Signaling bits for On-Hook, Off-Hook, Wink, and Flash. Here are the Supervisory signaling states:

Table 1 - Local CO to Tandem CO Signaling

Signaling State	Analog TR	Digital A, B bits
On-Hook	TR = Open	A=0 B=0
Off-Hook	TR = Loop Closed	A=1 B=1

Table 2 - Tandem CO to Local CO Signaling

Signaling State	Analog TR	Digital A, B bits
On-Hook	T= Ground R= -48v	A=0 B=0
Off-Hook	T= -48v R= Ground	A=1 B=1
During Wink	T= -48v R= Ground	A=1 B=1
During Flash	T= Ground R= -48v	A=0 B=0

Table 3 - Tandem CO to PSAP Signaling

Signaling State	Analog TR	Digital A, B bits
On-Hook	TR = Open	A=0 B=0
Off-Hook	TR = Loop Closed	A=1 B=1

Table 4 - PSAP to Tandem CO Signaling

Signaling State	Analog TR	Digital A, B bits
On-Hook	T= Ground R= -48v	A=0 B=0
Off-Hook	T= -48v R= Ground	A=1 B=1
During Wink	T= -48v R= Ground	A=1 B=1
During Flash	T= Ground R= -48v	A=0 B=0

Addressing (Dialed Digits)

Local CO (End Office) to Tandem CO: MF digits for ANI

Tandem CO to Local CO: DTMF digits for calls being transferred

End Office to E9-1-1 Tandem E-911 Call Flow

1. End Office (EO) customer dials 911.
2. EO accesses trunk and sends Off-Hook to Tandem.
3. Tandem returns a Wink (momentary Off-Hook).
4. EO sends MF digits (ANI) to Tandem
5. Tandem returns an Off-Hook
6. The Trunk is now Off-Hook both ways (talk state)

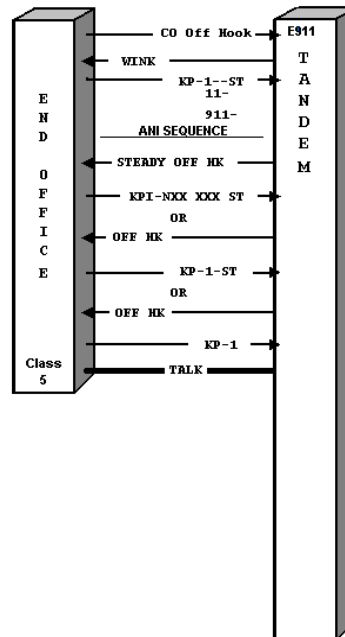


Figure 2 – End Office to E9-1-1 Tandem Signaling

E9-1-1 Tandem to PSAP Call Flow

(See above for End Office to Tandem)

1. Tandem sends Off-Hook to PSAP
2. PSAP returns a Wink
3. Tandem sends MF digits (ANI)
4. PSAP returns Audible Ring tone
5. PSAP sends Off-Hook to Tandem
6. Trunk is Off-Hook both ways (talk).

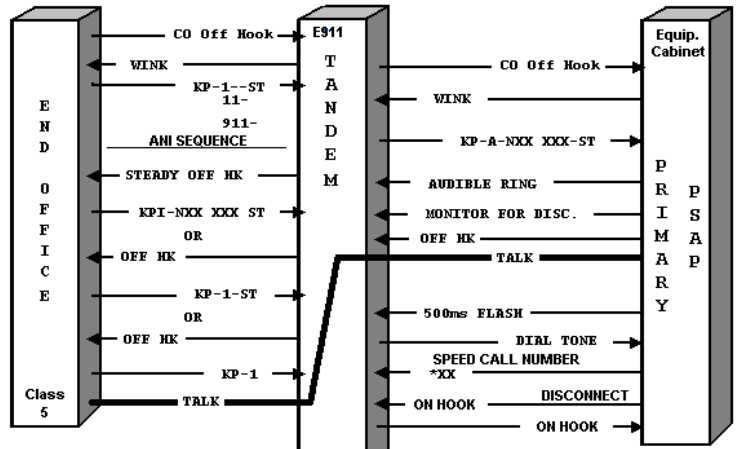


Figure 3 - E9-1-1 Tandem to Primary PSAP

E9-1-1 Call Transfer Call Flow

1. Call is already set up between Tandem and Primary PSAP.
2. PSAP sends 500ms Flash (momentary On-Hook)
3. The Tandem CO returns Dial Tone
4. Call taker hits Speed Dial number.
5. The PSAP sends DTMF digits to Tandem CO.
6. The Tandem CO routes call to Secondary PSAP Trunk.
7. The PSAP releases the Primary PSAP trunk (goes On-Hook).
8. Tandem sends Off-Hook to Secondary PSAP trunk.
9. Secondary PSAP sends Wink.
10. Tandem sends MF digits (original ANI).
11. Secondary PSAP sends audible ring tone.
12. Secondary PSAP sends Off-Hook.
13. The Trunk is now Off-Hook both ways in the talk state.

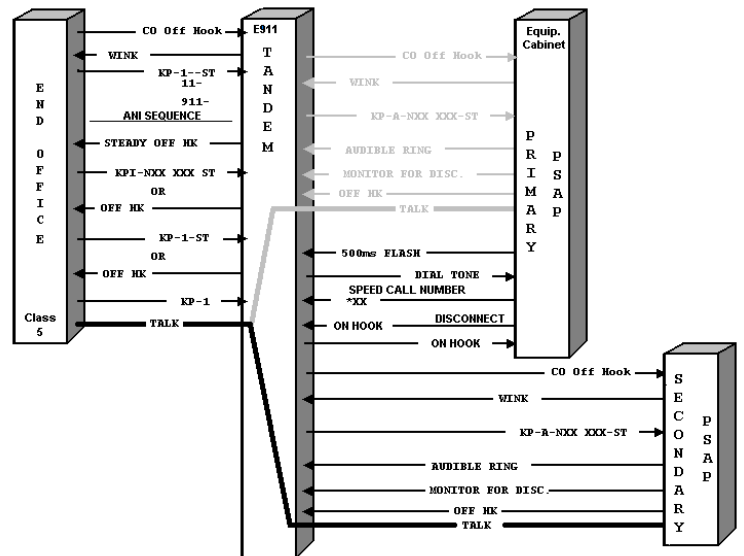


Figure 4 - E9-1-1 Tandem to Secondary PSAP

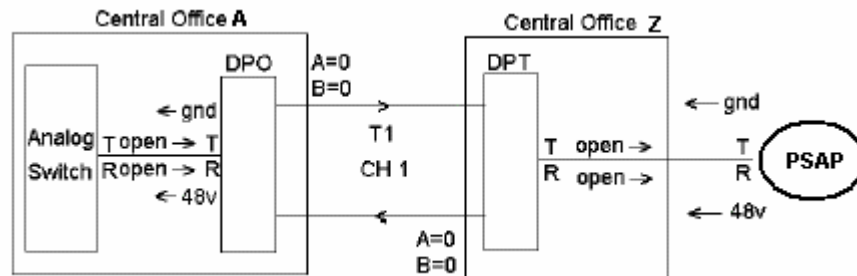
Analog and Digital Signaling

In order to demonstrate both analog and digital signaling, the Trunk design will use an analog CO Switch Interface, a Digital Facility (D4 Framing for simplicity), and the Analog Interface at the PSAP.

Trunk Idle

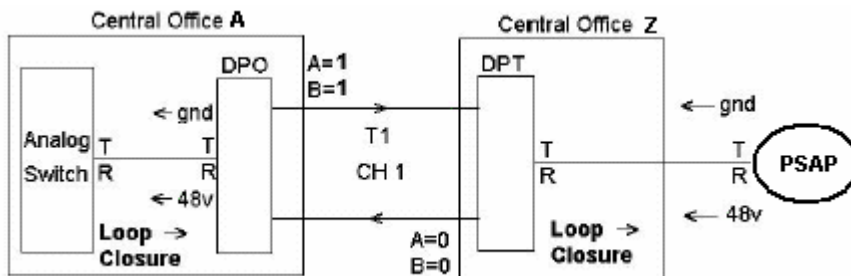
These are the idle signaling states for a PSAP Trunk.

Starting from the left, the TR is open from the Analog Switch Interface. The DPO channel unit (Dial Pulse Originating) sends Tip ground and Ring -48v (Loop Current Feed) toward the analog switch interface. On the digital side, the DPO sends A=0 B=0 (signaling bits) toward the far end DPT channel unit. The DPT (Dial Pulse Terminating) channel unit sends an Open on the TR toward the PSAP. The PSAP trunk card sends Tip ground and Ring -48v (Loop Current Feed) toward the DPT channel unit.



Incoming 911 Call

The analog switch interface sends a Loop Closure toward the DPO. The DPO sends A=1 B=1 toward the far end DPT. The DPT sends a Loop Closure toward the PSAP. The PSAP detects the incoming call (incoming seizure or Off-Hook).



Incoming E9-1-1 Call - Loop Closure State (TR Volts = 1/2 of 48V or 22volts)

PSAP Sends Wink

The PSAP responds to the Loop Closure with a Wink, which is a momentary battery reversal (reverse loop current feed). This lets the far end know that it is OK to send the ANI MF digits (MF receiver has been assigned). You will notice that the PSAP has reversed the Battery Feed. The DPT sends A=1 B=1 toward the DPO, the DPO sends Reverse Battery Feed to the Analog Switch Interface. The duration of the Wink signal is between 140 and 290 ms.

Trunk Idle

