



BellSouth Enhanced 911 for PBX/ALI Service Network Interface Specifications

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BELLSOUTH ENHANCED 911 FOR PBX/ALI SERVICE NETWORK INTERFACE SPECIFICATIONS

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BELLSOUTH ENHANCED 911 FOR PBX/ALI SERVICE NETWORK INTERFACE SPECIFICATIONS

1. GENERAL DESCRIPTION OF SERVICE

- 1.1** This document describes the network interface specifications for the product Enhanced 911 for a PBX/ALI service. It describes the transmission channel provided, the transmission performance parameters supported, and the interfaces available. It also describes the address signaling protocol requirements.
- 1.2** This document is intended as a guide for those requiring an understanding of the technical aspects of the PBX/ALI service. It defines the network interface and signaling protocol requirements which will ensure compatibility with the BellSouth E911 network.
- 1.3** The E911 Private Branch Exchange/Automatic Location Identification (PBX/ALI) Service provides a PBX customer, located in an E911 serving area, with the ability to offer full E911 service to its station users. Ordinarily, the location identification information displayed on a Public Service Answering Point (PSAP) attendant screen for a caller from a PBX not equipped with this service will be a billing or service number and address of the PBX (the station may be extended to a different premises, normally referred to as off-premise extensions). This information may not indicate the actual physical location from which the call is placed. With the PBX/ALI service the "off-premise" location identification information is available to the PSAP when a caller, using a connecting station of the PBX, dials 911.
- 1.4** PBX/ALI service provides the PBX customer with E911 trunks from their PBX (i.e., private switch) to the E911 Tandem. To utilize this service, the PBX must be capable of sending the calling station's Direct-In-Dial (DID)¹ telephone number to the BellSouth E911 network in a specified Multifrequency (MF) Address Signaling "protocol". A loop reverse-battery trunk similar to the one described in ANSI T1.405-1989 "Interface between Carriers and Customer Installations - Analog Voice Grade Switched Access using Loop Reverse-battery Signaling" is required. While the trunk is similar to that described, it is in the opposite direction of operation (i.e., the trunk is seized by the customer instead of the end office).
- 1.5** Location updates to PBX station data are supplied to BellSouth by the customer as required by moves and changes. For more information see BellSouth TR 73577 "BellSouth Enhanced 911 File Transfer System (FTS) Database Activity Service for PBX/ALI Customer Network Interface Specifications"^[1]. The manner and frequency in which these updates are accomplished is negotiated between the customer and BellSouth.

NOTE 1: DID is required for compatibility with this service.

2. DEFINITIONS, ABBREVIATIONS, ACRONYMS AND SYMBOLS

ADDRESS SIGNALS	This term refers to the signals used to convey call destination information, such as telephone station code, central office code, and area code. Some forms of address signals are called pulses, e.g., Dial Pulses (DP) and Multifrequency (MF) pulses.
AUTOMATIC NUMBER IDENTIFICATION (ANI)	The term denotes the automatic identification of the calling station (i.e., directory number). This party is presumed to be an end user of a PBX offering E911 capabilities.

CALLED NUMBER	The term is the telephone number originally dialed by the calling party.
CENTRALIZED AUTOMATIC MESSAGE ACCOUNTING (CAMA)	The term is an arrangement that provides for the recording of detailed billing information at a centralized location other than an end office, usually a tandem office. CAMA equipment also may be associated with operator systems, etc.
CENTRAL OFFICE (CO)	The term usually used to refer to a local switching system that connects lines and trunks. Sometimes it is used to refer to a telephone company building in which switching system and telephone equipment are installed.
CUSTOMER	The term is the party which has contracted with BellSouth to purchase Enhanced 911 capabilities for use with a PBX.
KEY PULSE (KP)	The term refers to a signal that indicates the start of a field of information.
START PULSE (ST)	The term refers to a signal that indicates the end of a field of information.
LOOP REVERSE -BATTERY	A method of signaling over trunks in which direct current (dc) changes, including directional changes associated with battery reversal, are used for supervisory states. This technique provides 2-way signaling on 2-wire trunks; however, a trunk can be seized at only one end – it cannot be seized at the switching system at which battery is applied. It is also called reverse-battery signaling.
MF PULSING	The term refers to the information communicated over telephone trunks by various combinations of two of five frequencies in the voiceband. Signals for control functions are provided by combinations using a sixth frequency.
ON-HOOK	The term refers to a supervision condition indicating that the equipment is in the idle state. It is used as a supervisory signal to indicate an “idle circuit/trunk”. The terms “on-hook” and “off-hook” are derived from supervisory conditions that exist in a customer’s loop.
OFF-HOOK	The term refers to a supervision condition indicating that the equipment is in-use or a request-for-service state. It is used as a supervisory signal to indicate a “busy circuit/trunk”. The terms “on-hook” and “off-hook” are derived from supervisory conditions that exist in a customer’s loop.
PRIVATE BRANCH EXCHANGE (PBX)	The term refers to an assemblage of equipment that allows an individual within a community of users to originate and answer calls to and from the public network (via CO trunks, Wide Area Telephone Service (WATS) trunks, and Foreign Exchange (FX) trunks), a private network, another PBX (tie trunks), special service trunks, and other users (PBX lines) within the community. In the case of PBX/ALI service the PBX would use special “CAMA” trunks to the E911 Tandem.

PUBLIC SAFETY ANSWERING POINT (PSAP)

The term refers to an agency or facility that is designated and authorized to receive and respond to emergency 911 calls requiring one or more public services such as police, fire, and/or ambulance services. Any agency, or a group of agencies, may be designated a PSAP.

SEIZURE

The term refers to a service condition indicating a “call for service”. It is indicated by an “off-hook” signal and the absence of any connection to another “circuit/trunk”.

TRUNK

This term in a telecommunications network, refers to a communication path connecting two switching systems used in the establishment of an end-to-end connection.

WINK

This term refers to a short duration “off-hook” signal from the network used to instruct the PBX to forward the called number.

3. SERVICE CONFIGURATION

3.1 Figure 1 illustrates a PBX/ALI service configuration where a customer has multiple station locations on different premises and these premises would be served by different PSAP locations. The BellSouth E911 Tandem will selectively route a PBX user’s 911 call to the appropriate PSAP based on the ANI sent by the PBX.

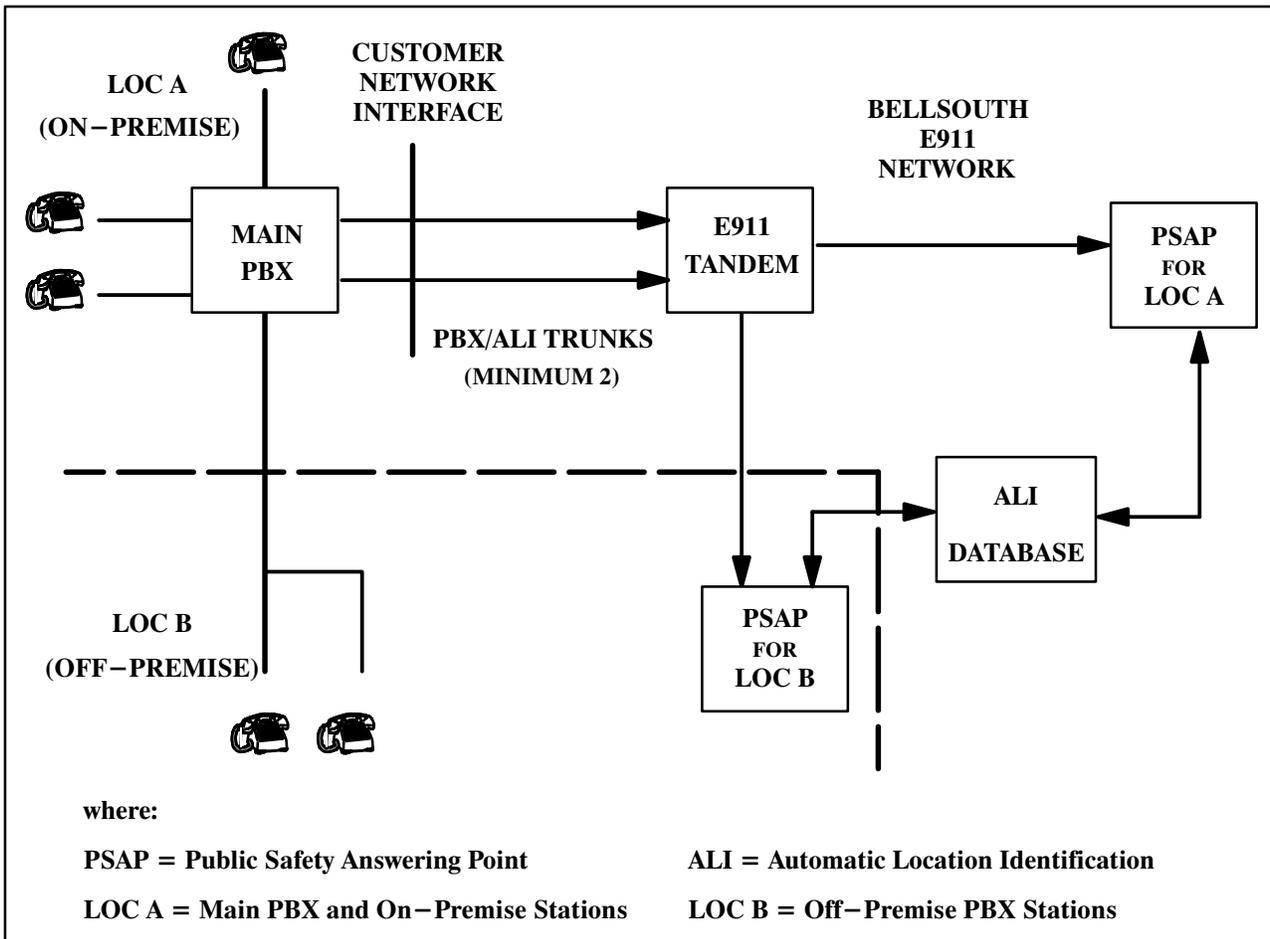


FIGURE 1 – PBX/ALI TO E911 TANDEM SERVICE CONFIGURATION

- 3.2 The PBX/ALI service is only provided in areas which BellSouth already offers E911.
- 3.3 Private dedicated trunks installed between the PBX and a BellSouth E911 Tandem provide the transport for E911 calls dialed by stations served by the PBX. The customer is required to install a minimum of two private 911 trunks. BellSouth will, upon request, assist the customer in determining if additional E911 trunks should be installed.

4. NETWORK SAFEGUARDS, ROUTING AND TESTS

NETWORK INTEGRITY

- 4.1. Because of the urgent nature of any 911 call and due to the constant need to guard against harm or misuse of the Public Switched Network as well as the E911 Network, BellSouth places certain restrictions and requirements on the Private Branch Exchange/Automatic Location Identification (PBX/ALI) service. It is not the intention of BellSouth to impede any customer from utilizing this service, but to ensure that those who do comply with these requirements will gain full E911 service without jeopardizing the safety of the network.

TRAFFIC ROUTING RESTRICTIONS

- 4.2. The dedicated trunks between a PBX and the BellSouth E911 Network are designed to carry only customer originated 911 traffic and will terminate that traffic only at the appropriate Public Safety Answering Point (PSAP). Due to the nature of the E911 network and to prevent fraudulent use of the network, BellSouth will not complete calls to other destinations should the PBX mistakenly route them to these trunks.
- 4.3 The PBX must be able to differentiate 911 calls from other traffic and route only 911 calls to these trunks. All other calls must continue to be routed by the PBX to regular outbound trunks. Should a non-911 call, with no or incorrect MF protocol, be delivered by the PBX to these trunks in error, the call would reach a reorder tone from the BellSouth E911 Tandem.

PRE-SERVICE TESTS

- 4.4 To ensure that the PBX/ALI service is functional and prevent harm to the E911 and Public Switched Network, tests between the customer and BellSouth will be conducted prior to final service turn-up. These tests will confirm that appropriate MF signaling protocol is received by BellSouth E911 Network and correct routing from the PBX is operational.

IN-SERVICE ROUTING PROBLEMS

- 4.5 To safeguard the BellSouth E911 and Public Switched Network the following guidelines will be followed when problems with PBX routing arise.
- 4.6 If a PBX routes a non-911 call in error but delivers the correct MF signaling protocol to a BellSouth E911 Tandem, the system will deliver the call to the appropriate PSAP based on the Automatic Number Identification (ANI) transmitted by the PBX.
- 4.7 The caller shall report instances of incorrect routing to the E911 trunks to their PBX telecommunications manager/administrator.
- 4.8 BellSouth will work with a customer to confirm that a routing problem has been corrected. Should such misrouting continue, BellSouth will suspend PBX/ALI service until tests conducted jointly between

BellSouth, the customer, and the Public Service Agency serving the customer area confirm that routing problems have been corrected. If routing problems can not be proven corrected, the PBX/ALI service will be terminated.

5. PHYSICAL DETAILS OF THE INTERFACE

GENERAL

- 5.1 The interface between the PBX/ALI equipment and the BellSouth E911 Tandem may be either a 2-wire analog interface or a digital (1.544 Mb/s) interface. Sections on “Connectors” and “DC Signaling” describe the 2-wire analog interface.
- 5.2 For information on the digital implementation refer to ANSI/EIA/TIA-464-A-1989 “PBX Switching Equipment for Voiceband Applications”^[3]. In this case, supervisory signals such as “on-hook”, “off-hook” and “wink” are encoded into A & B Signaling States. This signaling shall comply with the DPO tie trunk described on Table 22, “Summary of A & B Signaling States”, of the TIA-464-A document. AC signals shall be encoded using the μ -255 Law described in the same TIA document.
- 5.3 Sections on “AC Signaling” and “MF Transmitter Requirements” apply to both the analog and digital interfaces.

CONNECTORS

- 5.4 The interface connector shall be any of the following 2-wire connectors: RJ11C, RJ11W, RJ14C, RJ14W, RJ14X, RJ15C, RJ21X, RJ25C or RJ61X. For more information on these connectors see Committee T1 Technical Report #5[2].

DC SIGNALING

- 5.5 General – The Network shall provide a nominal -48 VDC (-42.75 to -56.5 VDC with respect to ground) on one conductor and ground on the other conductor. The sum of the battery and ground feed resistances shall be between 360Ω and 3000Ω . The PBX shall provide a minimum resistance to ground (from either tip or ring) of $5,000,000 \Omega$.
- 5.6 On-Hook – The Network shall signal “on-hook” by providing nominal -48 VDC on the ring and ground on the tip. The PBX shall signal “on-hook” by providing a minimum of $5,000,000 \Omega$ between the tip and the ring.
- 5.7 Off-Hook – The PBX shall signal “off-hook” by providing a maximum 670Ω resistance between the tip and the ring. The Network shall signal “off-hook” by providing “battery-reversal” (i.e., nominal -48 VDC on the tip and ground on the ring). The PBX shall be capable of recognizing such a reversal through up to 3000Ω of resistance external to the PBX, and with the minimum network battery voltage.
- 5.8 Wink – The term “wink” refers to a short duration (140 to 290 milliseconds) “off-hook” from the network preceded and followed by “on-hook”.

AC SIGNALING

- 5.9 The transmission of ANI information from a PBX capable of providing ANI to a BellSouth E911 Tandem shall be done by using Multifrequency (MF) pulsing. If the user interface is digital, MF pulses, as well as other AC signals, shall be encoded per the μ -255 Law convention.

- 5.10 The Multifrequency (MF) Pulsing system consists of transmitting and receiving equipment for communicating call set up information over telephone trunks by various combinations of two, and only two, of five precise frequencies in the voiceband. Each combination of two frequencies represents a pulse and each pulse represents a digit. The pulses are sent over the regular talking trunks. MF receivers detect the pulses and transfer the digit information to switching control equipment and or data collections systems. MF pulsing is used to transmit called and calling number (ANI) information from a PBX to a BellSouth E911 Tandem.
- 5.11 The MF system transmits numerical information and control signals. Pulses for the control signals are provided by combinations of tones using a sixth frequency. The six frequencies provide fifteen possible 2–frequency combinations and are spaced 200 Hertz apart.
- 5.12 The six frequencies are 700, 900, 1100, 1300, 1500 and 1700 Hz. Shown below is Table 1, which identifies the frequency combinations that form the various digits and control functions for the MF pulsing code.

Frequencies in HZ	SIGNALS			
	Digit and Control	Expanded Inband	CCITT	TSPS Equal Access
700 + 900	1			
700 + 1100	2	Coin Collect		
700 + 1300	4			
700 + 1500	7			
700 + 1700		Ringback	Code 11	ST3P(ST'')
900 + 1100	3			
900 + 1300	5			
900 + 1500	8	Operator Released		
900 + 1700			Code 12	STP(ST')
1100 + 1300	6			
1100 + 1500	9			
1100 + 1700	KP	Coin Return	KP1	
1300 + 1500	O	Operator Attached		
1300 + 1700			KP2	ST2P(ST'')
1500 + 1700	ST	Coin Collect Operator Released		ST

TABLE 1 – MULTIFREQUENCY CODE SYSTEM

MF TRANSMITTER REQUIREMENTS

- 5.13 When the PBX detects the appropriate DC start signal, it should transmit the required MF signals. The start of outpulsing should be delayed as little as possible, but it is desirable that the delay be not less than 50 milliseconds (ms) under normal conditions.

5.14 The transmitter and its signal should meet the following requirements:

- The two frequencies of each code should start and end within 1 ms of each other.
- The power output per frequency should be -7 ± 1 dBm (measured at the Network Interface (NI)).
- There should not be over 1.0 dB difference between the powers of the two frequencies of any code.
- The total power of extraneous signal components should be at least 30 dB below the power level of either frequency of the code.
- The KP signal length should be 90 to 120 ms.
- The ST and digit signal lengths should each be 58 to 75 ms.
- The interval between signals should be 58 to 75 ms.
- The frequencies should be within ± 1.5 percent of stated nominal values.
- The transmitter should have 600 Ω nominal impedance.
- During tone off periods transmitted power at any MF frequency should not exceed -58 dBm.

6. SIGNALING PROTOCOL

SIGNALING FORMAT

- 6.1 This section presents information on the protocol used by the PBX and the Network to furnish Automatic Number Identification (ANI) to the BellSouth Network. ANI is required for the provision of E911 features for a PSAP.
- 6.2 Automatic Number Identification (ANI) means that the calling party's station telephone number, also referred to as directory number (DN), can be identified by a switch or PBX, and passed on to another switch or data system. Generally this data is for use in routing or billing a call. In the context of this reference, it is assumed that the PBX planning to provide E911 service features has the capability to provide ANI to the BellSouth E911 Tandem.
- 6.3 Along with the calling telephone number, the PBX must be capable of passing an ANI Information (I) digit(s). Traditional signaling requires one (1) digit, while expanded signaling requires two (2) digits. At this time, BellSouth will require only the traditional signaling, single information digit, be used. See Table 2 for values of I applicable to this service.
- 6.4 The PBX must also have the capability to recognize an ANI request signal sent back to it from the BellSouth E911 Tandem, directly after the PBX has sent a KP (Key Pulse) signal, the called telephone number (i.e 911), and an ST (Start Pulse) signal.

"I" digit is an Information digit. It has the following meanings in the BellSouth network usage.	
<u>Information Digit (I)</u>	
Automatic Identification (AI)	0 (numerical zero)
Identification Failure (IF)	2
where:	
AI	– Automatic Identification of the calling number has been done in the originating PBX, the 7– digit calling (directory) number (NNX–XXXX) will follow.
IF	– An Identification Failure has occurred in the originating PBX.
KP	– Key Pulse signal indicates the start of a field of information.
ST	– Start signal indicates the end of a field of information.

NOTE: Primed start (ST) pulses, though not required by these formats, are accepted as start pulses by the E911 Tandem. Table 1 shows various examples of primed ST pulses.

TABLE 2 – INFORMATION DIGIT CODING**CALL SEQUENCE**

- 6.5** The call sequence for providing E911 service from a PBX to a BellSouth E911 Tandem is shown in Figure 2 at the end of this section.
- 6.6** The PBX goes “off–hook” to signal a “service request”. When the Network detects the “off–hook”, it sends a “wink”, signaling the PBX that it is ready to accept the called number from the PBX user. After the PBX sends “KP+911+ST”, the E911 Tandem sends a steady–state “off–hook” signal after receiving the called number. This is the request for the ANI outpulsing of the calling number. The ANI request signal (“off–hook”), also used as a supervisory signal, persists until after the calling party disconnects or until 11 to 13 seconds after the called party disconnect is received at the E911 Tandem office. It is desirable that the ANI request signal be detected as soon as possible by the PBX, but it should be differentiated from “off–hook” hits. On MF pulsing to a BellSouth E911 Tandem, the “off–hook” from the E911 Tandem can be returned to the sending PBX as soon as the ST pulse is recognized by the E911 Tandem. As a result, the “off–hook” can arrive at the sending PBX while the ST pulse is still being sent.
- 6.7** The “off–hook” indication sent, by the E911 Tandem, signals the sending PBX to start outpulsing the ANI information. There is no requirement for a delay between the receipt of the “off–hook” start dial by the PBX and its sending of the KP pulse of the ANI information. However, it is good practice to have a minimum delay of 50 milliseconds between these two signals to permit the transients associated with the “off–hook” start–dial signal to dissipate before the first MF pulse is sent.
- 6.8** When the calling party disconnects first, the PBX sends an “on–hook” signal to the E911 Tandem and may release the trunk after an “on–hook” signal is received from the E911 Tandem. When the E911 Tandem receives the “on–hook” signal, the Tandem connection is released and an “on–hook” signal is sent to the PBX.
- 6.9** When the PSAP attendant disconnects first, the PSAP equipment sends an “on–hook” to the E911 Tandem. The E911 Tandem begins a 1.2 second flash timing, which times out in this case, thus signaling a disconnect. The E911 Tandem sends an “on–hook” signal to the PBX and begins 4 to 5 second timing for receiving an “on–hook” from the PBX. This 4 to 5 second timing is unique for E911 calls to a PSAP and, in fact, is the forced disconnect service for the E911 feature.

SIGNALING SEQUENCE OF "911" CALLS

CUSTOMER PBX

E911 TANDEM

After a PBX station user dials "911":

1. SEIZE -----(PBX goes "OFF HOOK")----->
2. <-----WINK ("OFF-HOOK")-----140 ms to 290 ms----->
3. KP + 911 + ST----->
4. <-----OFF-HOOK----->
5. KP + I + 7D + ST (ANI information)----->
6. <-----E911 Tandem Connects Talking Path----->
7. <-----Conversation Interval----->

PBX goes "on-hook":

8. PBX Disconnects-----("ON-HOOK")----->
9. <-----BellSouth E911 Tandem Disconnects "ON-HOOK")----->

Note: See Table 2 for I digit information.

FIGURE 2 – SIGNALING SEQUENCE WHEN 911 AND ANI IS ENT FROM A PBX TO A BELLSOUTH E911 TANDEM

7. REFERENCES

7.1 References which support Enhanced 911 services and standard CAMA/ANI interface for BellSouth network requirements are shown below, as well as referenced within the text of this document.

BellSouth published document:

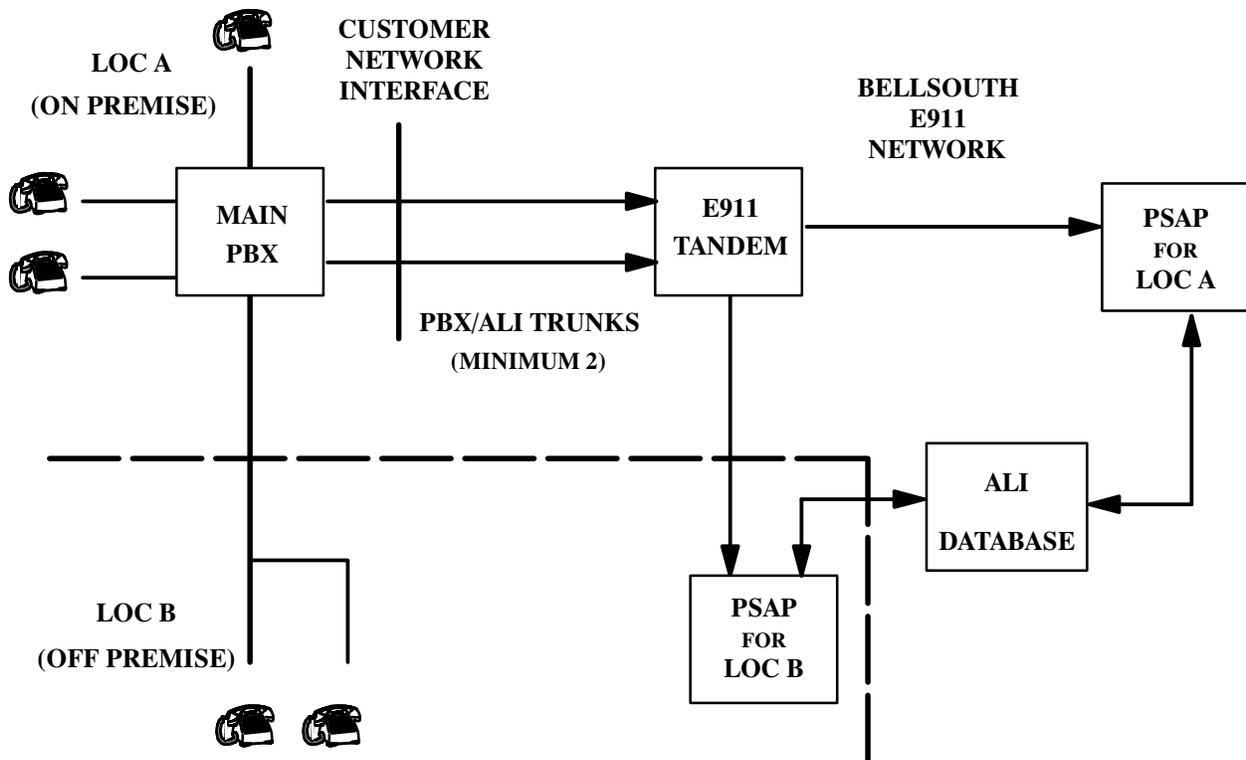
- [1] BellSouth Technical Reference (TR) 73577 – "BellSouth Enhanced 911 File Transfer System (FTS) Database Activity Update Service for PBX/ALI Customers Network Interface Specifications" Issue A, June 1993.

Committee 1 published document:

- [2] Technical Report #5 – "Carrier to Customer Installation Interface Connector Configuration Catalog" – June, 1990.

American National Standards Institute (ANSI) published document:

- [3] EIA/TIA-464-A-1989 – "Private Branch Exchange (PBX) Switching Equipment for Voiceband Application".



where:

PSAP = Public Safety Answering Point

ALI = Automatic Location Identification

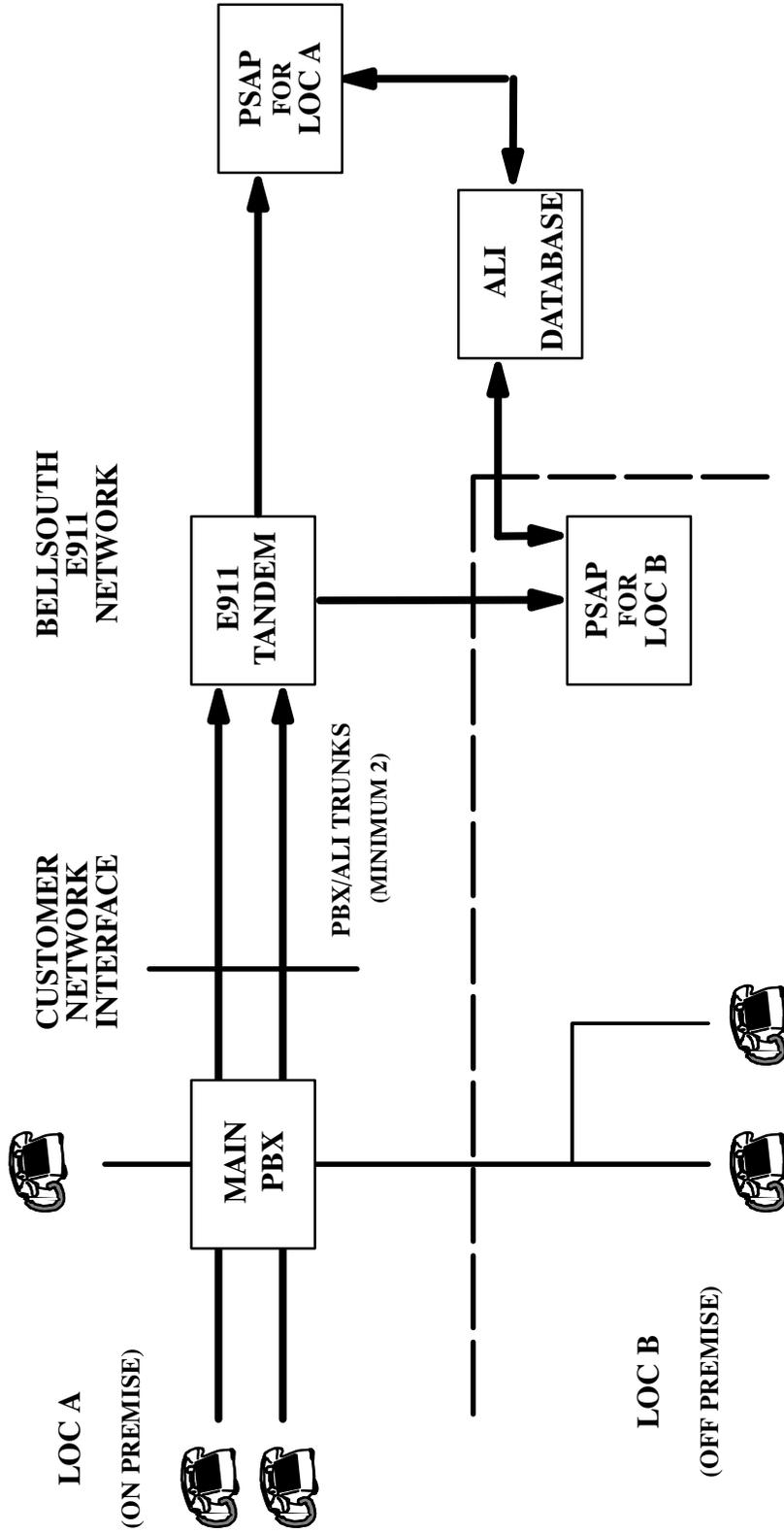
LOC A = Main PBX and On-Premise Stations

LOC B = Off-Premise PBX Stations

FIGURE 1 – PBX/ALI TO E911

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where:
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 LOC A = Main PBX and On-Premise Stations LOC B = Off-Premise PBX Stations

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