

# BellSouth E911 Service Interfaces to Customer Premises Equipment at A Public Safety Answering Point



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This Technical Reference is published by BellSouth Telecommunications Inc. (BST) to provide a description of the interfaces between a BellSouth Enhanced 911 (E911) tandem office and an E911 Public Safety Answering Point (PSAP) and between the BellSouth E911 database system and a PSAP.

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## Introduction

### Purpose

This Technical Reference is published by BellSouth to provide a description of the interfaces between a BellSouth Enhanced 911 (E911) tandem office and an E911 Public Safety Answering Point (PSAP) and between the BellSouth E911 database system and a PSAP. These interfaces provide the network interaction with customer premises equipment that provide E911 PSAP functionality.

### Version Information

This document has been reissued to remove references to 1AESS(tm) tandem offices, change the format of the information sent by the E911 tandem to the PSAP, and change the format of the text portion of the response from the E911 database.

Chapter	Action Request #	Date/Issue	Description	Change Requested By/ Made By
Chapter 2.2 (a)	NA	November, 2004/7	Physical interface specifications have changed due to discontinuance of previous Channel Service Unit/Data Service Unit (CSU/DSU) devices. Speed has also increased to 9600 baud.	Bill Marczak/TML

## 1. Overview of Enhanced 911 Service

### 1.1 General

The number 911 is the 3-digit telephone number that has been designated by the FCC for public use throughout the United States to report an emergency and/or request emergency assistance. The number 911 is intended as a nationwide universal telephone number which provides the public with direct access to a public safety answering point (PSAP). A PSAP is an agency or facility which is designated and authorized to receive and respond to emergency calls requiring one or more public services such as police, fire, and/or ambulance services. Any one agency or a group of agencies may be designated as a PSAP. One or more attendants are located at a PSAP facility to receive and handle emergency calls in accordance with local requirements.

With E911 service, a BellSouth switching office is arranged to serve as an E911 tandem for all 911 calls from other local offices in the 911 service area and as a local office for 911 calls originated by customers served by the E911 tandem office. Calls may be routed by this E911 tandem office to one or more PSAPs in the 911 service area selectively. Calling party number identification is passed via the trunk facility to the PSAP location for display at the PSAP answering position. Additional information associated with the calling party number as stored in the BellSouth E911 database can also be delivered to the PSAP answering position. This information is queried real time from the database over dedicated data links by the customer premises control equipment.

This document describes the interfaces between an individual PSAP and the BellSouth E911 tandem and between the PSAP and the database system. An overview of a typical E911 system is given in Figure 1.

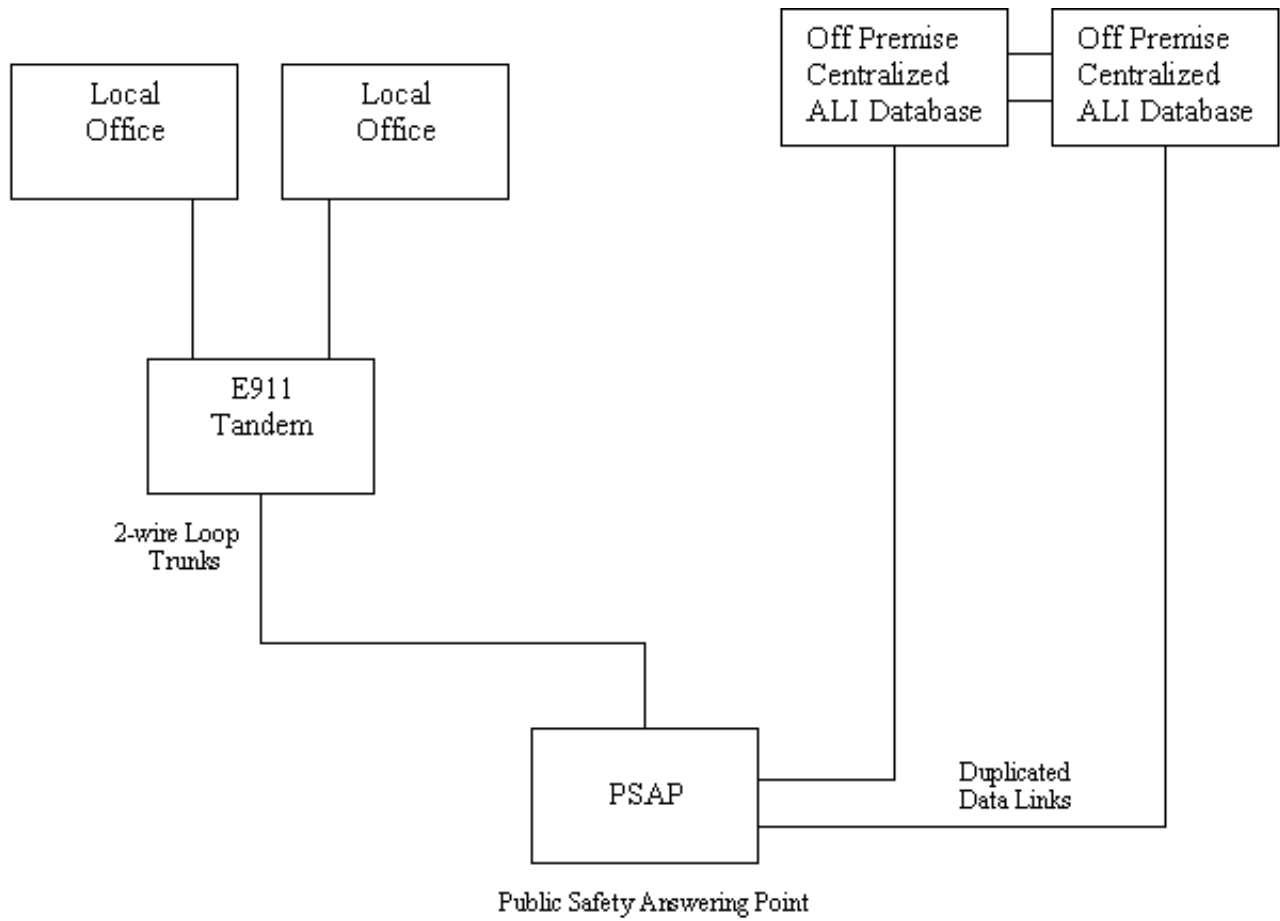


Figure 1 E911 System Overview

## 2. E911 Interfaces

### 2.1 Trunk Interface

Two wire, 1-way, outgoing trunks arranged for loop-reverse battery operation are provided in the central office and connected to the PSAP through a standard local loop. The E911 tandem trunks will be terminated at the network interface point at the customers premises in standard RJ21X jacks.

The electrical characteristics and signaling states used by trunks of the above type that may be used by the E911 tandem office are given in the Signaling section of Telcordia's, *LSSGR: Signaling for Analog Interfaces* [3] document. Additional information on local loop characteristics can be found in the documents *ANSI T1.414 - Network to Customer Installation Interfaces - Enhanced 911 Analog Voicegrade PSAP Access Using Loop Reverse-Battery Signaling* [1] and *Lightning and 60-Hz Disturbances at the Bell Operating Company Network Interface* [2].

#### (a) Calling Number Identification

The telephone number of the station calling into the PSAP is delivered to the PSAP equipment using standard Automatic Number Identification (ANI) techniques over the E911 tandem trunks. Operation of ANI number delivery is described in *TR-TSY-000350, LATA Switching Systems Generic Requirements (LSSGR)* [4]. Typically the number delivered to the PSAP is displayed at the answering position by the customer premises equipment. The PSAP is also required to formulate a request for associated data from the E911 database on this number. See section 2.2 for a description of this activity.

Once the PSAP detects that the E911 tandem has seized an idle trunk by the presence of an off-hook condition, the PSAP is expected to send a start pulsing signal ( $250 \pm 50$  ms wink) within 4 seconds. If the wink signal is not received within 4 seconds, the E911 tandem will retry once on a different E911 trunk after placing the original trunk on a maintenance list.

The E911 tandem will begin outpulsing the calling number as multifrequency (MF) tones within 4 seconds of receipt of the wink signal. If no calling number is received or if distorted tones are received, the PSAP should assume ANI failure has occurred and proceed to return audible ringing to the calling party and signal an attendant to answer. Although no calling information would be available to present to the attendant in this case, the customer provided equipment shall send the appropriate ANI failure digits to the E911 database system.

Once the ANI digits are received, the customer provided equipment shall return audible ringing to the 911 calling party at the same time as attendant positions are alerted of the incoming call by the customer provided system. Once an attendant answers, the customer provided equipment should remove audible ringing and cut the incoming call through to the position. At the same time, the customer provided equipment database request message is sent to the BellSouth E911 database system. This system will return information, relating to the calling telephone number, suitable for display on a terminal at the attendant position answering the call. The customer provided equipment is responsible for decoding the ANI MF data and formatting the ASCII encoded request to the BellSouth E911 database system. This database interface is described in section 2.2 of this document.



The format of the information sent by the E911 tandem will be one of the following:

8 digit ANI	KP-A-NXX-XXXX-ST
10 digit ANI	KP-II-NPA-NXX-XXXX-STP
Two 10 digit ANI	KP-II-NPA-NXX-XXXX-ST-KP-NPA-NXX-XXXX-ST (calling party's number) (dialed number or pseudo ANI)

The KP and ST are standard MF signals. The calling number is given by the NXX-XXXX. For 8 digit ANI, the "A" is coded as in Table 1 and represents the numbering plan area (NPA) from which the 911 call originated in those cases when the 911 service area includes two or more NPAs. In cases where special attention or handling may be required, the 4, 5, 6 and 7 digits are used. Examples of such cases are a 911 call originated via a foreign exchange (FX) line serving a station which is not physically located in the 911 service area or a telephone number which does not have an emergency service number (ESN) assigned. Other cases for the special handling digits may be defined by local practices.

The "II" represents encoded information indicating whether the calling line display device (ANI display) should remain steady or flash, or if the call is a test call. II digits will be used as follows:

<u>II Digit</u>	<u>Meaning</u>
40	Steady ANI display
44	Flashing ANI display
48	Test Call

**TABLE 1  
"A" DIGIT ENCODING**

<b>DIGIT</b>	<b>USE</b>
0	NPD 0 (Lowest Numbered NPA)
1	NPD 1 (Second Numbered NPA)
2	NPD 2 (Third Numbered NPA)
3	NPD 3 (Highest Numbered NPA)
4	NPD 0 (Special Handling Required)
5	NPD 1 (Special Handling Required)
6	NPD 2 (Special Handling Required)
7	NPD 3 (Special Handling Required)
8	Maintenance Test Call
9	Not Used

**ANI Failures**

If the E911 tandem office is unable to present a valid calling number, one of the following is sent to the PSAP:

8 digit ANI	0-911-0TTT	
10 digit ANI	NPA-911-0TTT	
Two 10 digit ANI with good CPN, bad pseudo-ANI	NPA-NXX-XXXX (good CPN)	NPA-911-0TTT (bad pseudo-ANI)
Two 10 digit ANI with bad CPN, good pseudo-ANI	NPA-911-0TTT (bad CPN)	NPA-NXX-XXXX (good pseudo-ANI)
Two 10 digit ANI with bad CPN and bad pseudo-ANI	NPA-911-0TTT (bad CPN)	NPA-911-0TTT (bad pseudo-ANI)

These formats are sent due to ANI failures between the end office and the E911 tandem, or possibly a 911 call received via a message trunk from outside the local tandem area. The digits TTT indicate the Emergency Service Central Office (ESCO) number associated with the originating office to tandem trunk.

**Anonymous Calls**

0-911-0000 (8 digits) or 000-911-0000 (10 digits) is sent when an anonymous call is made to a PSAP. An anonymous call is a 7 or 10 digit call (non-911) to the directory number of a PSAP. ANI identification is not available for such calls. A PSAP may be assigned a nondialable number to preclude such calls.

**(b) Call Transfer Interface**

Transfer of an incoming call to an alternate PSAP is available as a standard service. The primary PSAP may implement transfer to a secondary PSAP using the standard Call Transfer and Speed Calling features of the E911 tandem office. These features are implemented by switch hook flashes and abbreviated dialed digits issued by the customer provided equipment to the E911 tandem office trunks. The answering position may be provided a single button interface to these features by the customer premises control equipment if so arranged or they may be manually exercised by a standard station set at the answering position.

Normal call transfer sequences are used to initiate call transfer. The PSAP equipment should send an on-hook flash signal of  $500 \pm 50$  ms to the E911 tandem office. Normally the E911 tandem will seize a three port conference circuit and a DTMF (Dual Tone Multi-Frequency) receiver will be attached to the trunk to receive the transfer digits and dial tone will be returned to the PSAP initiating the transfer. If these facilities are not available in the E911 tandem due to load conditions, the flash signal will be ignored. After detecting dial tone, the desired transfer destination should then be sent by the PSAP as DTMF pulses conveying either the Speed Calling digits or regular directory number of the destination.

Three types of Call Transfer may be provided: selective, fixed and manual.

Selective Call Transfer - activated by receipt of a \*1X speed calling sequence from the PSAP equipment, where X is 1 to 6. The E911 tandem will selectively route the call to the desired type (specified by the "X" code) of secondary PSAP designated for the calling party's jurisdiction. The association of various PSAPs with selective Speed Calling codes should be done as part of the installation process for the E911 system.

Fixed Call Transfer - activated by receipt of \*NX speed calling sequences, where N is 2 to 4 and X is 0 to 9. Only single direct translation to a prespecified directory number will be performed by the E911 tandem in this case.

Manual Call Transfer - the PSAP attendant manually performs the on-hook flash sequence and then directly dials either the Speed Calling Code as specified in the Fixed Call Transfer or the directory number of the destination.

**(c) Trunk Supervision of Disconnect**

The E911 tandem maintains supervision of the off-hook status in both directions. To drop an incoming call, the PSAP equipment must present an on-hook condition greater than 1.2 seconds. The E911 tandem will disconnect the call in both directions, sending on-hook to the PSAP, and idling the incoming trunk. This prevents an incoming call that remains off-hook from tying up the PSAP trunk.

If a three party call has been established by the call transfer feature, the following disconnect supervision applies:

**Primary PSAP**

- (1) Receipt of a flash signal ( $500 \pm 50$  ms on-hook) from the initial PSAP in a 3 party call setup will release the added party and maintain a 2 party connection between the calling party and the primary PSAP.
- (2) Receipt of an on-hook signal longer than the minimum disconnect timing interval (1.2 seconds) from the initial PSAP will disconnect that PSAP from the call and maintain the connection between the calling party and the added party.

**Added Party**

- (1) If an added party sends an on-hook signal for longer than 16 seconds, it will be disconnected but the original PSAP will remain connected to the calling party.
- (2) If the added party returns off-hook before a 16 second interval has expired, it will be returned to the 3 party connection.
- (3) If the primary PSAP sends a flash signal during the 16 second interval after the added party has sent an on-hook signal, the added party is disconnected immediately. The primary PSAP remains connected to the calling party.
- (4) If one of the original parties disconnects before the added party's disconnect timing interval expires, that party is immediately released. However, the E911 tandem office continues the timing interval and will reconnect the added party to the party remaining off-hook if the added party returns off-hook within the interval.

**Calling Party**

Upon detection of the calling party disconnect, the calling party is released. The primary PSAP and the added party remain connected until either disconnects or the primary PSAP releases the added party.

**(d) Night Service / Alternate PSAP**

All calls destined for a PSAP may be automatically directed to an alternate PSAP or other answering location. This feature is available for each PSAP. A single directory number is assigned in the E911 tandem office for alternate routing and is used in any of the conditions where an alternate is needed. These conditions could be traffic busy, night service, power loss, or other failure at the PSAP.

Whenever calls are routed to an alternate PSAP, the ANI information of the calling party is also made available to the alternate PSAP. The E911 tandem presents the calling party number to the secondary PSAP using the same mechanism described in section (a) as used for a primary PSAP.

Alternate or night service is activated from the PSAP by key activation of a control lead to the E911 tandem office. The network interface required for this separate control lead is given in Telcordia Technical Reference TR-TSY-000349 [5].

**(e) Tones Used**

Standard tones (dial, busy, reorder, and audible ringing) are provided by the E911 tandem office for attendant transfer calls. Interrupted high tone (120 ipm) is also provided when speed dialing transfer is attempted, but not subscribed to by the PSAP.

**(f) Trunk Maintenance Test Calls**

From time to time the telephone company will place a test call to verify the integrity of the trunk circuit to the customer's premises. This call will be identified by the special ANI code given in Table 1 (KP-8-ST). The PSAP shall connect the trunk so identified to a permanent busy tone (continuous 60 ipm tone). This must be done within 20 seconds after receipt of the wink start pulse, otherwise, the E911 tandem office would consider the trunk test a failure. The E911 tandem will disconnect approximately 5 seconds after receiving the 60 ipm tone. The PSAP should then immediately release the trunk.

## 2.2 Database Interface

BellSouth provides a centralized database including information for each directory number used by wireline subscribers to the network. This information usually contains caller location and other information useful for a public safety response to emergency situations where a call is placed from a phone near the site of the emergency. A unique protocol is used over redundant data links between a PSAP and the BellSouth ALI Computers to retrieve this information. The PSAP equipment is responsible for formatting a request for ALI per this protocol and placing it on the data links. The returned information is available to the PSAP equipment to display on a terminal at an attendant position or in some other manner per the design of the equipment provider.

### (a) Physical Interface

Access to the BellSouth centralized E911 database is provided by asynchronous private line circuits to duplicated ALI Computers. These computers are located in different BellSouth Centers for redundancy and diversity. Two links are required for reliability; they are functionally identical. The ALI Computers receive the ALI request message from the PSAP, query the database and return the stored information to the PSAP over the data link. The actual network interface is that of a private line digital data service. Digital facilities shall be ordered as DDS-I.

The DDS unit must provide an In Band Diagnostic Management bandwidth sharing technique for test channel and data. The unit must be fully compatible with the SNMP test module deployed within each of the BellSouth Data Centers. This will allow end-to-end diagnostic and configuration capability from the master end (BellSouth Data Center) without disruptive consequences.

Each unit must be configurable for Data Carrier Holdover on the DTE side at 100ms. This is to prevent non-critical Data Carrier drops from being reported to the E911 monitoring systems.

The characteristics of the equipment used to modulate these data links are:

- 9600 baud digital Channel Service Unit/Data Service Unit (CSU/DSU)
- 9600 bps Async on the DTE side
- 10 bit data character
  - 1 start bit
  - 8 data bits (8<sup>th</sup> bit ignored)
  - 1 stop bit
- Full Duplex
- Continuous Carrier

Support for 2400 baud CSU/DSU with secondary channel has been grandfathered but is no longer available for new installations.

For reliability, an individual ALI request message is expected to be received from the PSAP over both links simultaneously by the duplicated ALI Computers. Responses from the database system are presented over one of the data links only. Both links must be monitored by the PSAP for responses since they are randomly chosen by the ALI Computers. If one data link is out of service, only the good link will be chosen by the ALI Computers for responses.

**(b) Link Protocol**

The protocol used over the data links consists of a request message sent from the PSAP to the ALI Computers and the response message from the database to the PSAP. In addition, a status message or "heartbeat" is expected from the PSAP during idle periods. The ALI Computers will respond with an "ACK" to the PSAP when a heartbeat is received.

**(1) Request Message Format**

Requests from the PSAP for additional data contained in the ALI database maintained by BellSouth shall consist of 13 or 15 ASCII encoded digits terminated by a carriage return. The message format for a request is given in Table 2.

**TABLE 2  
DATABASE REQUEST MESSAGE**

<NPD><NXX><TN> <POS><TRNK><CHECK><CR> or	
<NPA><NXX><TN><POS><TRNK><CHECK><CR>	
Where:	
<NPA>	Three digits identifying the caller's area code
<NPD>	One digit given by the tandem office to identify the caller's area code
<NXX>	Three digit Exchange prefix for caller's serving office
<TN>	Four digits identifying the Caller's Directory Number or wireless pseudo-ANI
<POS>	Two digit PSAP position answering call or a sequence number
<TRNK>	Two digit Incoming trunk number over which call was received, range 00-94 decimal for automatic lookup and 95-99 decimal for special lookup.
<CHECK>	One digit, that when added to the sum of the previous twelve digits, causes the sum to be evenly divisible by 8
<CR>	CR - Carriage return, hex 0D, signals end of request

**Example:** “0555121201020<CR>” would be transmitted for 555-1212 on position 01 trunk 02 for 14 character request messages. Note the check digit is 0 since the sum equals 24 which is evenly divisible by 8. Digit position 1 is transmitted on the data link first in sequence.

“404555121201020<CR>” would be transmitted for 404-555-1212 on position 01 trunk 02 for 16 character request messages. Note the check digit is 0 since the sum equals 32 which is evenly divisible by 8.

**NOTE:** A request of all zeroes, “000000000000<CR>” would be interpreted as indication that repair is needed on the PSAP ANI equipment. Upon occurrence of a large number of such messages, the BellSouth E911 Maintenance Center would notify responsible PSAP maintenance personnel.

(2) **ALI Response Message Format**

The ALI Computers provide an immediate response to a request message with either an ASCII ACK (hex 06) or NAK (hex 15) character. If the negative acknowledgement, NAK, is received, the request message should be retransmitted only once by the PSAP.

The ALI response message must use the format described in Table 3. The ALI response message is delimited by the ASCII STX (hex 02) and ETX (hex 03) characters. Response messages are presented over one of the two data links randomly chosen.

**TABLE 3**  
**ALI RESPONSE MESSAGE**

Character Position	Contents
1	STX - Hex 02, indicates start of message.
2	TYPE - One digit message type designation as described below.
3-4	POS - Two digit position/sequence number.
5-324	Text - Up to 320 characters of text formatted from the ALI database. The format of the text portion of the message is shown in Figure 2 <b>Longitude/latitude (X/Y coordinates) will be placed in the text portion of the message when the PSAP requests Wireless Phase 2 compliance and the wireless carrier provides coordinates. The longitude/latitude fields will contain spaces for wireline calls and wireless calls when coordinates are not available. PSAP CAD/Mapping software should validate the contents of the longitude/latitude fields prior to using. These optional fields will <u>not</u> be included in the text unless requested by the PSAP. <u>In this case the ETX immediately follows the ESN text data.</u> See Figure 2 note 2.</b>
Variable	ETX - Hex 03, immediately follows text to indicate end of message.

**TYPE Designations:**

Type = 1 (hex 31) Data retrieved, only one path available.

Type = 2 (hex 32) Data retrieved, both paths operational (normal).

Type = 9 (hex 39) No address data found, text portion of message is of form

“NPA-NXX-XXXX NO RECORD FOUND”

Type = 0,3-8 Not used

**Note:** If a problem is suspected in the received text, the PSAP may resend the request message.



FIELD	LENGTH	TYPICAL VALUE
<CR>	1	hex 0D
punctuation	1	( hex 28
NPA	3	205
punctuation	1	) hex 29
space	1	hex 32
NXX	3	456
punctuation	1	- hex 2D
Line Number	4	7890
space	3	hex 32
Time	5	14:25
space	4	hex 32
Date	5	08/12
<CR>	1	hex 0D
House Number	8	8600
House Number Suffix	4	-1/2
space	1	hex 32
Prefix Directional	2	NW
space	1	hex 32
Street Name	48	WALNUT ST
Community	18	BIRMINGHAM
State	2	AL
space	1	hex 32
ESN	3	056
space	1	hex 32
Class of Service	4	BUSN
<CR>	1	hex 0D
Customer Name	32	JOHN DOE INC
Location Information	20	BLG 3, FLR 10
space	1	hex 32
punctuation	2	P#

- continued -

- continued -

FIELD	LENGTH	TYPICAL VALUE
space	1	hex 32
Main NXX	3	454
punctuation	1	- hex 2D
Main Number	4	7891
<CR>	1	hex 0D
Additional Information	20	ALT# 205-454-7800 (see Note 1)
space	1	hex 32
punctuation	4	LEC:
Telco Company ID	5	BELSO
<CR>	1	hex 0D
<LF>	1	hex 0A
ESN Text (variable)	71	FIRE STATION 2 JEFFERSON EMS
<i>Optional &lt;CR&gt;</i>	<i>1</i>	<i>hex 0D (see Note 2)</i>
<i>Optional Longitude/X Coordinate</i>	<i>11</i>	<i>+000.000000 or spaces (see Note 2)</i>
<i>Optional Space</i>	<i>1</i>	<i>hex 32 (see Note 2)</i>
<i>Optional Latitude/Y Coordinate</i>	<i>10</i>	<i>+00.000000 or spaces (see Note 2)</i>

**NOTE 1:** This variable data field contains additional information that may be helpful to the PSAP. One example is to display an ALTERNATE CALL-BACK NUMBER of the caller for interim number portability or the CALL-BACK NUMBER for a wireless call if this feature is available. This field will contain spaces if no additional information is available. For wireless calls, the telephone number in the first part of the response text may represent the psuedo-ANI (pANI) used to identify the cell site or sector from where the wireless call originated. Cell site/sector information will be populated in various data fields based on local agreements.

**NOTE 2:** These optional fields will not be included in response message unless requested by a PSAP capable of processing X/Y. The ETX immediately follows the ESN Text field when these optional fields are not requested.

## Format of Text Portion of Response From E911 Data Base

### (3) Status Messages

During otherwise idle periods, the PSAP equipment shall place a "heartbeat" sequence on the data links at a minimum of once every two minutes of communications silence. Absence of data or a "heartbeat" on the data link from the PSAP for more than two minutes will be interpreted by the ALI Computers as a problem at the PSAP and reported to BellSouth maintenance personnel.

Upon notice of lack of a "heartbeat" from a PSAP, the BellSouth Maintenance Center will check the data links for possible trouble conditions. If the data links are found operational, the Maintenance Center will take action to notify responsible customer PSAP personnel of the failure.

The format of the "heartbeat" consists of the characters "H<CR>" (hex 48 and hex 0D).

### References

1. "Network to Customer Installation Interfaces - Enhanced 911 Analog Voicegrade PSAP Access Using Loop Reverse-Battery Signaling", ANSI T1.414, 1998.
2. "Lightning and 60-Hz Disturbances at the Bell Operating Company Network Interface", TR-EOP-000001, Telcordia, Issue 2, June 1987.
3. "LSSGR: Signaling for Analog Interfaces", GR-506-CORE, Telcordia, Issue 1, Revision 1, November 1996.
4. "LATA Switching Systems Generic Requirements (LSSGR)", TR-TSY-000350, LATA Switching Systems Generic Requirements (LSSGR) [4], Telcordia, Issue 1, November 1987.
5. "Interface Between Miscellaneous Control Functions of Customer Premises Equipment and 1/1A ESS Centrex Switching Systems", TR-TSY-000349, Telcordia, Issue 1, November 1986.

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