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Interface of an E911 PSAP to a 1AESS Switch and to an E911 Database

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TECHNICAL REFERENCE NOTICE

This Technical Reference is published by Ameritech to provide description of interfaces in two areas of an E911 system: The interface between a 1AESS switch and a Public Safety Answering Point (PSAP); and the interface between an E911 database and a PSAP.

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1. GENERAL

This document has been prepared by Ameritech as a technical reference that provides descriptions of interfaces in two areas of an E911 system: The interface between a 1AESS switch and a public safety answering point (PSAP); and the interface between an E911 database and a PSAP.

1.1. Introduction

The main purpose of this technical reference is to provide a description of the following interfaces in an E911 system: 1) the interface between the 1AESS switch and the CPE at the PSAP; and 2) the interface between the E911 database system and the CPE at the PSAP. (See Figure 1.) The first interface is from a switch via automatic number identification (ANI) trunks to the ANI trunk controller at the PSAP. The second interface is from a node of a database system via data links to the automatic location identification (ALI) multiplexer at the PSAP. Both, the ANI controller CPE and the ALI multiplexer CPE are generally referred to as common PSAP equipment.

1.2. Service Overview

E911 service selectively routes a call of a calling party (having dialed 911) to a PSAP which has jurisdictional responsibility for the calling party's location. The PSAP equipment, that has the interface to the 1AESS switch, receives emergency calls with ANI. The PSAP equipment, that has the interface to the node of the database, queries that database for ALI. Together, both interfaces enable the PSAP to provide E911 service which includes: 1) communication with the calling party; 2) calling number identification (ANI); and 3) calling number location (ALI). Another important factor in E911 is the selective capability of calls from PSAP to PSAP via the interface to the network.

1.3. System Architecture

There are three major divisions in the E911 system architecture: 1) the E911 control/tandem switch(s) of the network; 2) the E911 database system; and 3) the E911 PSAP(s). (See Figure 1.) Each division in this architecture plays a major role processing calls and providing ANI and ALI information. Following is an technical summary of E911 system operation within the architecture:

A system, having been assigned to serve specific municipalities, must be prepared properly before it can operate effectively. The major items that must be accomplished are as follows: 1) the E911 database must be built by matching telephone numbers to addresses (locations), then by grouping specific addresses and assigning them to PSAPs (primary PSAP for police department and secondary PSAP for fire district); 2) E911 software packages must be installed in 1AESS switches that are designated E911 control tandems, then the prepared database infor-

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mation is downloaded into the switch software which establishes translations for selective routing; and 3) the telephone company must coordinate PSAP equipment implementation for the customer (municipality).

In actual operation, all 911-originated calls at end-office switches, with calling number identification, home into a designated E911 tandem switch; after the tandem switch has been accessed, it performs a translation within the E911 software to determine the selective route. The call then progresses, with the same calling number identification, to the selected PSAP. The PSAP ANI controller (via controller/network interface) receives the call and displays the calling telephone number only; at this point there is voice communication between calling party and PSAP. The PSAP ALI multiplexer (via multiplexer/node interface) queries the database system for calling number location/address; the information is then displayed at the PSAP.

2. LIST OF E911 FEATURES

E911 service provides certain features that are functional in the tandem switch or interface areas of an E911 system. This section lists all features applicable in E911 (as switch-related or interface-related). The tandem switch-related features are summarized in this section. The interface-related features are explained in the respective interface description sections.

2.1. Switch-Related Features

- Selective routing
- Default routing
- Alternate routing

2.1.1. Selective Routing

Selective routing provides the capability to route a call of a calling party (having dialed 911) to the proper, primary PSAP which has jurisdictional responsibility for the location (originating station) of the calling party. Selective routing is based on ANI, office code or number group of the originating station.

2.1.2. Default Routing

Default routing is a standard arrangement which provides the capability to automatically route a 911 call to a predesignated (default) PSAP when ANI is not available or distorted from an end office, or when malfunction occurs. In some cases of default, the tandem will generate a fictitious ANI code of 911-0XXX (the XXX designating the end/originating office) to the PSAP for the attendant to determine the approximate origin of the call.

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2.1.3. Alternate Routing

Alternate routing is a standard feature and provides functional capability to alternate route to a predesignated PSAP when a primary PSAP has an all trunks busy condition, is closed at nighttime (night service elsewhere), or has a power failure.

2.2. Interface-Related Features (See respective interface section)

- Selective transfer (Switch-PSAP interface)
- Fixed transfer (Switch-PSAP interface)
- Manual transfer (Switch-PSAP interface)
- Forced disconnect (Switch-PSAP interface)
- ANI (Switch-PSAP interface)
- ALI (Database-PSAP interface)

3. INTERFACE BETWEEN 1AESS SWITCH AND PSAP

This section provides the description of the interface between the 1AESS switch (ANI trunk) of the network and the common CPE (ANI controller) of the PSAP.

3.1. Features

The network (ANI trunk) to PSAP interface serves as a means of providing voice communications and certain E911 features. The features that are functional between the network and PSAP are listed in Section 2.2. This section (3.1) will briefly explain these features (the trunk/PSAP interface description starts in Section 3.2):

- Selective Transfer

Selective transfer allows an established 911 call to be selectively transferred by an E911 tandem office from a primary PSAP to a correct secondary PSAP associated with the calling station ANI. The attendant at the primary PSAP must initiate the transfer to the proper type agency (fire department, etc.) desired. Secondary PSAPs receive calls only on a transfer basis.

- Fixed Transfer

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Fixed transfer allows an established 911 call to be transferred by an E911 tandem after the PSAP attendant initiates the proper destination to the type agency (fire department, etc.) desired. Fixed transfer uses the speed calling feature of the E911 control/tandem switch.

- Manual Transfer

Manual transfer is controlled by the PSAP attendant who determines the desired destination and manually dials the number of the secondary PSAP.

- Forced Disconnect

Forced disconnect allows a PSAP attendant to release a 911 call connection, even though the calling party has not hung up, thereby preventing a tie-up of dedicated 911 facilities. (Forced disconnect is an inherent capability with E-911 service.)

- ANI

Automatic Number Identification (ANI) display at the PSAP is an optional feature. In addition to the display of ANI for the customer at the PSAP, ANI has a functional role. ANI, which originates at a local/end office switch as the identification of the calling party station, is outpulsed (transmitted) to the tandem switch where it is used selective routing to a PSAP; when the PSAP responds, the same ANI at the tandem switch is retransmitted to the PSAP equipment for display.

3.2. Interface Description (Trunk/PSAP)

3.2.1. Trunk to PSAP Connection

The trunks or circuits which are used for connection to a PSAP are the standard, one-way outgoing, two-wire, local loop, reverse battery type. The electrical characteristics of a trunk call state of the 1AESS switch to PSAP communication are listed in Table 1. The electrical characteristics of a trunk call state of the PSAP to 1AESS switch communication are listed in Table 2. Additional information on loop characteristics can be found in the following documents: 1) “Description of the Analog Voiceband Interface Between the Bell System Local Exchange Lines and Terminal Equipment,” PUB 61100, Bellcore, January 1983; and 2) “Lightning and 60-Hz Disturbances at the Bell Operating Company Network Interface,” TR-EOP-000001, Bellcore, Issue 2, June 1987.

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3.2.2. Connection to a PSAP With ANI Display

After the E911 tandem office seizes a dedicated E911 ANI trunk (which is connected to a MF transmitter), the normal sequence of events which occur are described below:

1. The switch sends an off-hook signal to the PSAP over seized trunk.

2. The switch waits 16 to 20 seconds for receipt of the ANI start pulsing wink signal from the PSAP. (If the requirement is not met, the trunk is placed on a maintenance list and a new trunk is seized.)

3. The PSAP should return an ANI start pulsing wink signal (250 ± 50 ms wink signal) to the switch in less than 4 seconds after it recognizes the seizure. (The wink signal causes the switch to start MF outpulsing. The attendant answers the call in this mode - if there is an ANI failure, all zeros are displayed.)

4. The switch begins MF outpulsing of ANI to the PSAP with the format of KP-A-NXX-XXXX-ST. The KP and ST digits are part of standard MF signaling. NXX-XXXX represents the calling station. The “A” digit in the format represents the numbering plan area (NPA) from which the 911 all originated. Table 3 illustrates the encoding of the “A” digit; the NPAs in Table 3 will vary in each area of the network. If ANI of the originating station is not available, a fictitious NXX-XXXX is displayed as follows: 1) 911-0TTT - this format represents default routing due to inability of tandem switch to obtain ANI (digits TTT indicate the local originating office); 2) 911-0000 - this format represents an anonymous call to the PSAP (caller dialed seven-digit number of PSAP directly in lieu of dialing 911 that would have been processed through tandem switch with ANI); and 3) 000-0000 - this format represents an ANI failure between the tandem switch and PSAP.

5. The PSAP equipment should signal the attendant and send audible ringing to the called party after the PSAP receives complete ANI information. Then, when the call is answered, the PSAP should disconnect audible ringing, connect the call to an available attendant, display the appropriate information at the console of the attendant, and return an off-hook signal to the tandem office.

   NOTE: MF outpulsing consists of a stream of MF tone pulses of 55-65 ms duration separated by silent intervals of 55-65 ms. The NPD (“A”) digit and ANI (NXX-XXXX) digits are preceded by a KP digit of 115-125 ms duration and followed by a ST digit of 55-65 ms duration. The ANI information is therefore arranged in the final form of KP-A-NXX-XXXX-ST.

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3.2.3. Connection to a PSAP Without ANI Display

When an E911 PSAP does not have an ANI display option, an idle 911 trunk is automatically cut through to the PSAP. The PSAP equipment should signal the attendant and send audible ringing to the called party after the PSAP detects trunk seizure. When the PSAP answers the call, a talking connection is established to the PSAP and an off-hook signal is sent to the tandem switch. The tandem switch then supervises the call for disconnect and transfer requests.

3.2.4. Disconnection of Call

Disconnect supervision is maintained at the tandem switch. There is a difference in disconnect function dependent on which end, switch or PSAP, that disconnect first.

3.2.4.1. PSAP Disconnects First

The PSAP should send an on-hook signal to the tandem switch when the attendant disconnects first. The on-hook duration must be greater than the flash timing period (1.2 seconds) to be interpreted as a disconnect signal. The tandem switch then disconnects the call in both directions, sends an on-hook to the PSAP and idles the outgoing trunk to the PSAP.

3.2.4.2. Calling Party Disconnects First

The local office switch sends an on-hook to the tandem switch when the calling party disconnects first; the tandem then sends an on-hook to the PSAP and idles the outgoing trunk to the PSAP.

3.2.5. Transfer of Call From Primary to Secondary PSAP

Transfer of E911 calls are normally made from a primary PSAP to a choice of several secondary PSAPs. Transfers are enabled by using the standard Call Transfer and Speed Calling features of the tandem switch. (Note: The speed calling code formats are not in accordance with the standard numbering and dialing plan for central office switch vertical services. However, due to the design of the E911 feature, the formats must be used in this application.) The tandem switch recognizes a request for transfer when an on-hook flash signal of 500 ± 50 ms is received from the PSAP. There are three types of transfers: 1) selective; 2) fixed; and 3) manual. In each case, the 8-digit ANI code that was sent to the primary PSAP is also sent to the secondary PSAP after the call has been successfully transferred. ***The outstanding differences, of each type transfer below (Sections 3.2.5.1, 3.2.5.2, and 3.2.5.3), are shown in bold italics:***

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3.2.5.1. Selective Transfer

The PSAP equipment should send an on-hook flash signal (500 ± 50 ms) to the tandem switch after the PSAP attendant initiates a ***selective transfer. There can only be three options (one in each category) for selective transfer: 1) one for fire; 2) one for ambulance; and 3) one for other.*** After the flash signal is detected by the tandem switch, it attempts to seize a three-port conference circuit and a DTMF receiver; one of the following events will then occur: 1) if a three- port conference circuit is not available, the flash signal is ignored; 2) if a DTMF receiver is not available within 3 to 4 seconds of receiving the flash signal, the flash signal is ignored; and 3) if a three-port conference circuit and a DTMF receiver are seized, dial tone is returned to the PSAP to await ***coded*** information. ***The switch, having a stored list of secondary PSAP telephone numbers in memory, uses the list to perform a selective transfer to a specific secondary PSAP dependent on the following information: 1) the primary PSAP that originally received the selectively routed 911 call; 2) the particular calling station ANI; and 3) the emergency transfer digits (ETD) sent to the switch from the initial primary PSAP. The ETD is the selective transfer code in the form of *1X, where X = 1 to 6. The transfer code (*1X)*** is sent no sooner than 500 milliseconds after receiving dial tone. (The transfer code contains standard “Touch-Tone” digits of minimum duration, 50 ms on, 50 ms off.) After the tandem switch accepts the transfer digits and terminates to the secondary PSAP and the PSAP attendant answers, the 3-way talking connection is established via the 3-port conference circuit at the tandem switch. ***(If a selective transfer request is not valid due to no secondard PSAP telephone number in memory of the switch to match the *1X code, 120 ipm is returned to the PSAP.)***

3.2.5.2. Fixed Transfer

The PSAP equipment should send an on-hook flash signal (500 ± 50 ms) to the tandem switch after the PSAP attendant initiates a ***fixed transfer. There can be may options (possibly more than one in each category) available for fixed transfer: 1) one or more for fire; 2) one or more for ambulance; and 3) one or more for other.*** After the flash signal is detected by the tandem switch, it attempts to seize a three-port conference circuit and a DTMF receiver; one of the following events will then occur; 1) if a three-port conference circuit is not available, the flash signal is ignored; 2) is a DTMF receiver is not available within 3 to 4 seconds of receiving the flash signal, the flash signal is ignored; and 3) if a three-port conference circuit and a DTMF receiver are seized, dial tone is returned to the PSAP to await ***coded*** information. ***The PSAP attendant must determine the specific destination (secondary PSAP) and initiate a fixed transfer. (If it is a fire transfer, it must first be determined, by the location of the originating calling station, if Fire Zone A or Fire Zone B, etc. is responsible for the location. The attendant must then initiate the transfer to the specific secondary PSAP as a fixed transfer.) With fixed transfer, the prefixed 2-digit Speed Calling code has the form***

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of *2X, where X = 1 to 6. The transfer code (*2X) is sent no sooner than 500 milliseconds after receiving dial tone. (The transfer code contains standard (Touch-Tone" digits of minimum duration, 50 ms on, 50 ms off.) After tandem switch accepts the transfer digits and terminates to the secondary PSAP and the PSAP attendant answers, the 3-way talking connection is established via the 3-port conference circuit at the tandem switch.

3.2.5.3. Manual Transfer

The PSAP equipment should send an on-hook flash signal (500 ± 50 ms) to the tandem switch after the PSAP attendant initiates a ***manual transfer***. After the flash signal is detected by the tandem switch, it attempts to seize a three-port conference circuit and a DTMF receiver; one of the following events will then occur: 1) if a three-port conference circuit is not available, the flash signal is ignored; 2) if a DTMF receiver is not available within 3 to 4 seconds of receiving the flash signal, the flash signal is ignored; and 3) if a three-port conference circuit and a DTMF receiver are seized, dial tone is returned to the PSAP to await ***dialed*** information. ***With manual dialed transfer, there are two options: 1) an arrangement to manually dial the telephone number (all digits) of the specific secondard PSAP or other destination; and 2) a speed calling code arrangement to reach the desired secondard PSAP. Manually dialed speed calling codes for a PSAP have the form of *2X, *3X or *4X, where X = 0 to 9. If the transfer code (*2X, *3X or *4X) is applied, it*** is sent no sooner than 500 milliseconds after receiving dial tone. (The transfer code contains standard "Touch-Tone" digits of minimum duration, 50 ms on, 50 ms off.) After the tandem switch accepts the transfer digits and terminates to the secondary PSAP and the PSAP attendant answers, the 3-way talking connection is established via the 3-port conference circuit at the tandem switch.

3.2.5.4. Transfer Attempt Failure

If the transfer attempt fails, the tandem switch restores the 911 call connection to the original 2-part call configuration. If the destination (secondary PSAP) is traffic busy, if there is no answer, or if the destination is no longer desired, then the PSAP attendant controlling the 911 call can initiate the release to the destination; initiated release causes the PSAP equipment to generate and send a timed on-hook flash signal (approximately 500 ms) to the tandem switch which interprets the flash signal as a request to disconnect the added destination. The tandem switch releases the destination and three-port conference circuit and restores the initial two-party call connection.

3.2.6. Disconnect Supervision of Three-Party Connection

This section describes the disconnect supervision of an established E911 3-party connection where either party shall be the first to initiate disconnect action. The disconnect procedure is described in three possible situations: 1) primary PSAP disconnects first; 2) secondary (added) PSAP disconnects first; and 3) calling party disconnects first.

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3.2.6.1. Primary PSAP Disconnects First

After receiving an on-hook signal from the primary PSAP, the tandem switch begins flash timing (approximately 1.2 seconds). One of two events can occur:

1. If the primary PSAP sends a flash signal shorter than the 1.2 second timing period, the tandem switch releases the secondary PSAP and 3-port conference circuit and restores the original connection between the calling party and primary PSAP.

2. If the primary PSAP sends a flash signal longer than the 1.2 second timing period, the tandem switch releases/idles the 3-port conference circuit and trunk to the primary PSAP (that generated the flash) and a 2-party connection is made between the calling party and the secondary (added) PSAP. (The secondary PSAP can also transfer the 911 call to any other PSAP within control of the tandem switch or any 7/10 digit destination.)

3.2.6.2. Secondary (Added) PSAP Disconnects First

When detecting an on-hook signal from the secondary (added) PSAP, the tandem switch begins 10 to 11 second timing. There is a difference in functionality between an added party that is a PSAP (secondary PSAP) and an added party that is other than any type PSAP:

1. If the added party is a secondary PSAP, then after 10 to 11 second timing is done, the connection to the added party is disconnected; if an off-hook signal is received before the end of timing, the 3-party connection is held.

2. If the added party is other than any type PSAP where the tandem switch begins 10 to 11 second timing after receipt of an on-hook signal, one of four events can occur:

    A. If the added party returns off-hook before time-out occurs, timing is terminated and the added party remains on the 3-party connection.

    B. If the primary PSAP sends a timed on-hook flash before time-out occurs, timing is terminated and the connection to the added party and the 3-port conference circuit are released and idled. The call is reestablished as a 2-party call between the calling party and the primary PSAP.

    C. If time-out occurs, the connection for the added party and the 3-port conference circuit is released and idled. The call is reestablished as a 2-party call between the calling party and primary PSAP.

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D. If either the calling party or the primary PSAP disconnects before time-out occurs, the disconnecting party is immediately released. Timing continues until either time-out occurs (all connections are released and idled), or the added party goes off-hook. In this case, the call is established as a 2-party call between the remaining party and the added party.

3.2.6.3. Calling Party Disconnects First

When detecting a disconnect signal from the calling party, the calling party connection will be released; however, the 3-port conference circuit will not be released. The primary PSAP remains connected via the 3-port conference circuit to the added party until either the added party disconnects, the primary PSAP releases the added party, or the primary PSAP disconnects.

3.2.7. Transfer of Call from Secondary PSAP to Another PSAP

After establishing a 2-party connection between the calling party and secondary PSAP, the same secondary PSAP will be able to transfer the 911 call to another PSAP or any 7/10 digit destination; briefly:

1. All selective transfers to other secondary PSAPs associated with the primary PSAP of a calling station continues to function (continuous transfers) because the primary PSAP emergency service number (ESN) initially received by the tandem switch is saved in the switch call register.

2. Fixed transfers from the secondary PSAP to other PSAPs or destinations is dependent on the fixed transfer assignments at the controlling secondary PSAP.

3. Manual transfers function the same as above (3.2.5.3).

3.3. Tones Used for Functions

Standard tones (dial, busy, reorder, and audible ringing) are provided by the tandem switch for attendant transfer calls. Interrupted high tone (120-ipm) is also provided when selective transfers are attempted.

3.4. Trunk Maintenance Test Calls

Test calls are made routinely to verify the integrity of an E911 system, especially dedicated E911 trunks. Trunk testing from local/end offices to the tandem switch is a telephone company procedure that is not included in this paper. However, trunk testing from the tandem switch to the PSAP is included in this section:

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Test calls can be made from the tandem switch using encoded ANI to a PSAP common CPE equipped with an ANI display. The PSAP common CPE should decode the special ANI as a test call and should connect the trunk under test to a test termination facility at the same CPE. Specifically, when KP - 8 - ST to the PSAP, the E911 trunk under test is connected to a permanent busy circuit in the PSAP common CPE. This allows the tandem switch to verify the integrity of the trunk circuit using the trunk diagnostic program. The test call sequence is listed in three steps:

1. After seizing the selected idle trunk and receiving the wink start signal prior to time-out, the tandem switch outpulses KP - 8 - ST to the PSAP.

2. The PSAP should interpret the digit 8 (See Table 3 as a maintenance test call and should connect the incoming E911 trunk to permanent busy tone (continuous 60-ipm tone). The tone should be returned to the tandem switch within 20 seconds after receipt of the wink start pulse; otherwise, the tandem switch considers the trunk test a failure.

3. Approximately 5 seconds after receiving the 60-ipm tone, the tandem switch disconnects and idles the trunk under test. The PSAP is not required to do any timing for a trunk test call, but the PSAP should react to seizure and disconnect from the tandem switch.

4. INTERFACE BETWEEN DATABASE SYSTEM AND PSAP

This section provides the description of the interface between the node of the database system and the common CPE (ALI muliplexer) of the PSAP.

4.1. Features

The database system (node) to PSAP interface serves as a means of providing Automatic Location Identification (ALI) which displays the street address and any other available data in direct relation to the calling party station. The ALI display at the PSAP is an optional feature. ALI, which is displayed at a PSAP position, is extracted via data links from a main computer of the database system (see Figure 1). Before the ALI extraction could occur, the PSAP common CPE must send the calling station telephone number and the PSAP position number via the data links to the database computer. The system is normally a hierarchical computer system with three distinct levels: 1) the main processor; 2) the node processor; and 3) the CPE display miniprocessor (ALI multiplexer). A specific protocol is applied over data links between the database system node and the PSAP equipment.

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4.2. Interface Description (Node/PSAP)

4.2.1. Physical Arrangement of Interface

At all times, there should be two data links (private line voice grade channels), which are identical, between the node processors and PSAP equipment. Both channels are required for reliability; a single request is send over both channels simultaneously by the PSAP equipment to the two (paired) node processors. However, the response from the database system is returned to the PSAP equipment over one channel only. The channels should be full duplex, continuous carrier, 4-wire lines. The interface between both points (node and PSAP) should be ASCII, 1200 baud, asynchronous. The bit stream should be the 10 bit type consisting of 1 start bit, 8 data bits, and 1 stop bit; the 8th data bit (parity) is to be ignored (disabled) and may be odd, even, or none. (See Table 4 for concise information of physical arrangement of interface.)

4.2.2. Data Link Protocol

There are three separate and distinct areas of protocol messages that are transmitted over the data links: 1) Request to database message; 2) Response from database messages; and 3) A "heartbeat" sequence type of message. (Messages which are formatted are from PSAP to Database or from Database to PSAP.)

4.2.2.1. Protocol of Request to Database Message

The request from the PSAP to the node processor consists of a format of thirteen (13) ASCII digits (hex 30 to hex 39) and a carriage-return character which are sent over both data links simultaneously. The protocol is formatted in the following order: NPD, NXX, TN, POS, TRNK, CHECK, CARRIAGE RETURN. Refer to Table 5 for a comprehensive description of "Request to Database Message" protocol.

4.2.2.2. Protocol of Response from Database Message

The response from the node processor to the PSAP is immediate with either an ASCII ACK (hex 06) indicating acknowledgment or an ASCII NAK (hex 15) indicating negative acknowledgment. If NAK is sent, the message should be retransmitted once only. All responses are sent to the PSAP over only one of the two data links.

The main message response is enclosed by two characters, STX (hex 02) and ETX (hex 03). The protocol of the message is formatted in the following order: STX, TYPE, POS, Text, ETX. Refer to Table 6 for a description of "Response from Database Message" protocol.

There are five types (TYPE) of messages (see Table 7). The POS represents the position number at the PSAP which is awaiting the particular response. The "Text" in the message is sent to

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the PSAP position. The manufacturer should develop equipment which can support the variable data streams identified in Table 8. The specific arrangement of the “Text” is dictated by customer-specific negotiations. The “Text may not contain STX, ETX, ACK, or NAK.

4.2.2.3. Heartbeat Sequence Message

The PSAP equipment must transmit a “heartbeat” message at intervals of every two (2) minutes to the node processor when there are no requests/responses in progress. The message should consist of characters “H<CR>” (hex 48 and hex 0D) that means “all seems well here.” The node processor will generate a message according to prearrangements when it does not receive the 2 minute “heartbeat.”

The PSAP equipment should send all zeros in the format of a request message (“0000000000000<CR>”) to the node processor when the PSAP ANI equipment requires repair service.

5. SUPPLEMENTAL INFORMATION

5.1. Description of Terms (Acronyms & Abbreviations)

A- The “A” digit which is coded to represent NPA origin

ACD- Automatic Call Distribution

ACK- ASCII character indicating “acknowledgment”

ALI- Automatic Location Identification

ANI- Automatic Number Identification

ASCII- American Standard Code for Information Interchange

CPE- Customer Premises Equipment

CR- Carriage Return

DTMF- Dual-Tone Multifrequency

E911- The enhanced version of 911 service

EIA- Electronic Industries Association

EOT- ASCII character indicating “end of transmission”

ESN- Emergency Service Number (usually PSAP telephone #)

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ETD- Emergency transfer digits

ETX- ASCII character indicating “end of text”

Hex- Hexadecimal

Hz- Hertz (a unit of frequency - 1 cycle per second)

ID- Precedes node and PSAP identification # in text

ipm- Impulse per minute

KP- Multifrequency code indicating beginning of pulsing

LATA- Local Access and Transport Area

LSSGR- LATA Switching Systems General Requirements

MF- Multifrequency

ms- Milliseconds

NAK- ASCII character indicating “negative acknowledgment”

NPA- Numbering Plan Area

NPD- Numbering Plan Digit

NXX- Prefix of 7-digit number (N = 2 to 9, X = 0 to 9)

POS- Position (PSAP)

PSAP- Public Safety Answering Point

ST- Multifrequency code indicating end of pulsing

STX- ASCII character indicating “start of text”

TN- Calling station directory number (used with ANI)

TRNK- Trunk (used with request message sent to node)

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5.2. References

1. “Description of the Analog Voicebank Interface Between the Bell System Local Exchange Lines and Terminal Equipment,” PUB 61100, Telcordia (formerly Bellcore), January 1983.

2. “LATA Switching Systems Generic Requirements (LSSGR),” TR-TSY-000064, Telcordia (formerly Bellcore), Issue 2, July 1987.

3. “Lightning and 60-Hz Disturbances at the Bell Operating Company Network Interface,” TR-EOP-000001, Telcordia (formerly Bellcore, Issue 2, June 1987.

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Figure 1. A Typical E-911 System

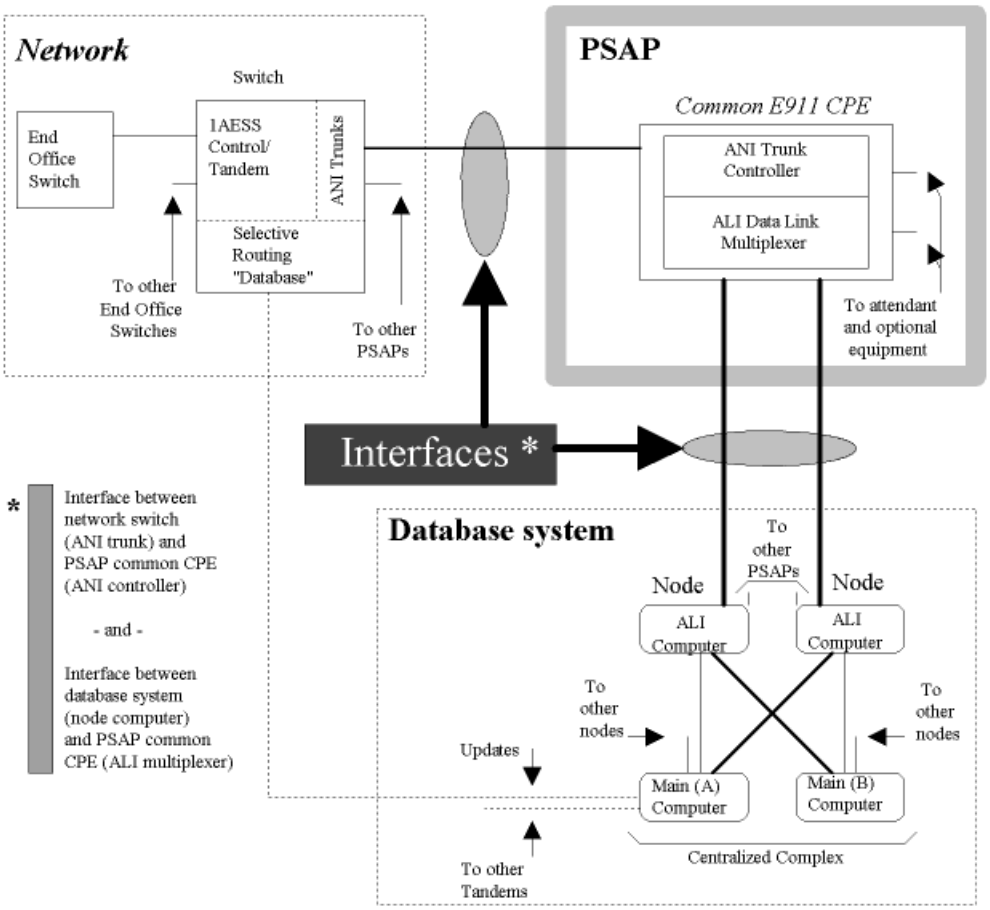

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Table 1.
Electrical Characteristics of Trunk Call State (1AESS switch to PSAP)

Leads	Call State			
	Idle	Seizure	Pulsing	Talking
T and R lead Conditions	Open >30 kΩ	200Ω ± 10% resistive loop. Inductive Holding bridge Plus loop Resistance.	Same as seizure. Multifrequency (MF) ANI information (when required). See Signaling Section of LSSGR For MF pulsing Information (see Note 1).	Same as seizure Plus 900Ω, 2 μF Reflected Impedance. For Nominal speech Levels, see PUB 61100.

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Table 2.
Electrical Characteristics of Trunk Call State (PSAP to 1AESS switch)

Leads	Call State		
	On-Hook	Off-Hook	Pulsing
T and R lead Conditions	R lead potential Negative with Respect to T lead (see Note 2)	R lead potential Positive with Respect to T lead (see Note 2)	See notes 3 and 4

Notes:
1. LATA Switching Systems Generic Requirements (LSSGR), TR-TSY-000064, Telcordia (formerly Bellcore), Issue 2, July 1987.
2. The CPE supervisory battery (nominally 48 volts must be capable of supplying 10 mA over maximum length loops (loop reverse battery signaling required – see Signaling Section of LSSGR).
3. The CPE must be capable of returning audible ring toward the originating party before the attendant answers (provided the PSAP is equipped with an ACD) and be capable of MF digit reception (ANI information), when required.
4. The CPE must be capable of generating wink and flash signals and outpulsing DTMF, when required.

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Table 3.
Encoding Information of “A” Digit in an ANI Display at PSAP

Digit (NPD)	Display	Representation (See notes)
0	Steady	NPA 0 (Primary NPA)
1	Steady	NPA 1 (Lowest numeric secondary NPA)
2	Steady	NPA 2 (median numeric secondary NPA)
3	Steady	NPA 3 (Highest numeric secondary NPA)
4	Flashing	NPA 0 (FX line or special treatment)
5	Flashing	NPA 1 (FX line or special treatment)
6	Flashing	NPA 2 (FX line or special treatment)
7	Flashing	NPA 3 (FX line or special treatment)
8	- - - -	Maintenance test call
9	- - - -	Not presently used

Notes:
1. The "A" digit is used to indicate the NPA from which a 911 call originated in cases when the 911 service area includes two or more NPAs.
2. If the 911 service area has only one NPA, no "A" digit is displayed.
3. A flashing "A" digit alerts the attendant that the call might have originated via a FX line serving a station which is not physically located in the 911 service area or a calling station which is not assigned to a PSAP.
4. Digits 4, 5, 6 and 7 represent NPAs 0, 1, 2 and 3 respectively (digits 0 and 4 always represent the primary NPA).

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Table 4.
Physical Arrangement of Interface Between Database System and PSAP

Characteristics of Physical Interface (2 each always)			
Physical Connection	Type Lines	Interface Requirments	Data Bit Stream
2 Data Lines (Private line voice grade channels)	Full duplex Continuous Carrier 4-wire	ASCII 1200 Baud Asynchronous	10 Bit type (1 start bit, 8 data bits, 1 stop bit) (See note)

Note: The 8th data bit (parity) is to be ignored (disabled) and maybe odd, even or none.

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Table 5.
Request to Database Protocol

Relationship of ASCII Digits and Input Data (See example below)	
Arranged Position Of ASCII Digit	Representative Information (See example below)
1st	NPD = Calling station area code ("A" digit)
2nd – 4th	NXX = Calling station local/end office prefix
5th – 8th	TN = Calling station directory number
9th – 10th	POS = PSAP position number answering call
11th – 12th	TRNK = Incoming trunk number connected to same PSAP position
13th	CHECK = One digit, then when added to the sum of the previous Twelve digits, causes the sum to be evenly divisible by 8
-	CARRIAGE RETURN = Hex 0D, signals end of request

Example: 0555121201020<CR> would be transmitted for 555-1212 on position, trunk 2. Zero (0) which is the first digit indicates that the call origination on the same area code of where the PSAP is located (see Table 3). Note the check digit is 0 since the sum equals 24.

Note: All zeros are sent to the node processor inthe format of a rquest (0000000000000<CR>) when the PSAP is in need of repair.

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Table 6.
Response from Database Protocol

Relationship of ASCII Digits and Output Data	
Arranged Position Of ASCII Character	Representative Information
1st	STX = Should be used at start of response message – (Hex 02)
2nd	TYPE = Indicates type of message as shown in Table 7
3rd – 4th	POS = PSAP position number requiring response information (Position 00 is valid for TYPE 3 or 5 only)
5th – 324th	Test = 320 characters or less – (See Table 8 for typical format)
325th or lower (see note)	ETX = Should be used at end of response message – (Hex 03)

Note: The quantity of "Text" characters will vary in each application. The ASCII character representing ETX will be in the 325th position when the maximum of 320 characters are used for "Text" information; the ETX will be in a lower position tham 325 when there are less than 320 "Text" characters.

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Table 7.
List of "TYPE" Messages As Part of Response Message

2 nd Character of Database Response ("TYPE")	Representative Information	Hex
1	Data retrieved; only one path available.	31
2	Data retrieved; both paths operational (normal).	32
3	Broadcast from host: "ALI OPERATIONAL;" test length = 0.	33
5	Broadcast from node: "GOING DOWN IN 5 MINUTES;" text length - 0.	35
9	No address data found; text from "NPA-NXX-TN NO RECORD FOUND."	39
0, 4, 6, 7, 8	No used.	

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Table 8: Model of Format of "Text" Data Stream as Part of Response Message

Designation	Characters	Comments
Month	2	Definitely grouped
/ punct	*	
Day	2	
pad	*	
Hour	2	
; punct	*	
Minute	2	
pad or <cr>	*	
(punct	*	Definitely grouped
NPA	3	
) punct	*	
pad	*	
NXX	3	
- punct	*	
Telephone Number	4	
pad or <cr>	*	
Customer Name	n	31-32 charaacters
<cr>	*	
House Number	8	Normally grouped
pad	*	
suffix (house #)	4	
pad	*	
Direction	2	
pad	*	
Street Name	n	Street name =
<cr>	*	30-46 chars, 1 or 2 line

Designation	Characters	Comments
Location	n	Location =
pad	*	18-20 characters
City	n	City =
pad	*	28-32 characters
State	2	Normally grouped
pad or <cr>	*	
Police+Fire+Ambulance	70	Normally 3 lines
<cr>	*	
Node ID	1	Normally grouped
pad	*	
PSAP ID	2	
pad	*	
Attentant Position	2	
pad	*	
ESN	3	
pad or <cr>	*	
Class of Service	4	
pad or <cr>	*	
Pilot NXX	3	Definitely grouped
- punct	*	
Pilot XXXX	4	
pad or <cr>	*	
Telco Free Field	n	30 chars if applicable
<cr> or none	*	

Both columns of table are one unbroken data stream.

See notes in reference to both columns. * See note 8

Notes:
1. Table 8 is a model only and does not necessarily exist; there can be several variations in a region where Month or NPA or Node ID are at the beginning of the data stream.
2. Brackets indicate items that are definitely grouped or normally grouped; the items within normally grouped brackets can be grouped as shown or in other ways.
3. The node ID, PSAP ID, Attendant Position, and ESN items are optionally preceded by spelled-out characters such as "NODE" or "PSAP".
4. The "+" signs which are between Police, Fire and Ambulance signify <cr> in arranging data stream; one line (of 3 lines in this grouping) will provide information for each agency.
5. The quantity of characters indicated by a number will always remain the same value in all cases.
6. The quantity of characters indicated by the letter "n" will vary as shown in comments.
7. Pad meaning space(s) or <cr> meaning carriage return are variable in mose cases.
8. Use ASCII equivalent for indicated punctuation, pad (space), or <cr> (carriage return).

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