NENA Recommended Generic Standards for E9-1-1 PSAP Equipment

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Recommended Generic Standards for E9-1-1 PSAP Equipment

Prepared by:
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TECHNICAL REFERENCE

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This Technical Reference is published by National Emergency Number Association (**NENA)** as a guide and recommendation for the designers and manufacturers of customer-premise systems that are used for the purpose of processing emergency calls at a PSAP. It is not intended to provide complete design specifications or parameters or to assure the quality of performance of such equipment.

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It is possible that certain advances in technology will precede these revisions. Therefore, this Technical Reference should not be the only source of information used to purchase the Customer Premise Equipment (CPE). **NENA** members are advised to contact their Telephone Company representative to ensure CPE compatibility with the Telco network.

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This document has been developed by the **NENA** PSAP standards Committee. The **NENA** executive board has recommended this document for industry acceptance. Recommendations for change to this document may be submitted to:

National Emergency Number Association

800.332.3911

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1 INTRODUCTION

1.1 General

This NENA Technical Reference NENA-04-001 defines the Public Safety Answering Point (PSAP) equipment requirements intended for use by users, manufactures and providers of E9-1-1 Customer Premise Equipment (CPE).

A PSAP is an agency or group of agencies designated and authorized to receive and respond to emergency calls requiring one or more public services (Police, Fire, EMS or all three).

1.2 Purpose and Scope of Document

This Technical Reference is a guide for designers and manufacturers of PSAP equipment. It defines conditions and identifies engineering and technical requirements to be considered before the purchase of such equipment. It may also be of value to purchasers, maintainers and users of such equipment.

This document is not intended to provide complete design specifications for PSAP equipment. It will neither ensure the quality of the performance of the equipment nor should it serve as an exclusive procurement specification.

1.3 Organization of Document

This document is organized into the following major sections:

Section 1 - Introduction
Section 2 - E9-1-1 System Description and Feature Definition
Section 3 - Trunk, Transfer and Peripheral Interfaces
Section 4 - Call Progress Signals
Section 5 - PSAP Feature Requirement Specifications
Section 6 - Power Requirements
Section 7 - Environmental Requirements
Section 8 - Installation, Maintenance and Administration
Section 9 - Registration Requirements
Section 10 - Quality and Reliability
Section 11 - References
Section 12 - Glossary
Section 13 - Appendix

1.4 Document Terminology

The terms "shall ", "must " and "required" are used throughout this document to indicate required parameters and to differentiate from those parameters that are recommendations. Recommendations are identified by the words "desirable" or "preferably".

1.5 Reason for Issue

This document is issued to serve as a NENA standard and guide for E9-1-1 PSAP equipment.

The purpose of this standard is to identify the minimum requirements as well as desirable requirements for PSAP equipment and interfaces provisioned today as well as to identify requirements for future PSAP equipment and interfaces.

1.6 Reason for Reissue

NENA reserves the right to modify this technical reference. Whenever it is reissued, the reason(s) will be provided in this paragraph.

This document is being reissued to update sections 1.3, 1.4, 1.7, 2.1.1, 2.5.1, 2.6.2, 2.10, 3.1.1, 3.1.2, 3.3, 3.3.1.1, 3.3.1.4, 3.3.1.6, 3.4.1, 3.4.6, 3.4.8, 3.5.1.2, 3.5.1.4.3, 3.5.2, 3.5.3.2, 3.6, 3.7.1, 3.8, 3.9.2, 3.9.4, 3.9.5, 3.11.2.1, 3.11.2.5, 3.12.1, 3.12.2, 3.12.3, 3.15, 3.16.3, 3.17.1, 4.1.1, 4.1.2, 4.3.2.1.3, 4.3.2.1.5, 4.3.2.2.2, 5.1, 5.3, 5.5.1, 5.13, 5.14, 5.18, 5.18.1, 5.18.2, 6.2, 7.2.1.2, 7.2.3, 7.4.2, 7.5.1, 7.5.2, 8.1, 8.3, 8.5, 8.8, 9.1, 10.1, 11.1, 11.2, 12., Table 1a, Table 2, Table 3, Add Sections 2.10, 2.11 3.15.1, 3.15.2, 3.15.3, 3.15.4, 3.16.2, 5.18.3, 5.20, 13.5, 13.5.1, 13.5.2., Update Acknowledgments and add “Recommended” to document title.

1.7 Year 2000 Compliance

All systems that are associated with the 9-1-1 process shall be designed and engineered to ensure that no detrimental, or other noticeable impact of any kind, will occur as a result of the date change to the year 2000, or any date up to 30 years subsequent to the manufacture of the system. This should include embedded application, computer based or any other type application.

To ensure true compliance the manufacturer shall upon request provide verifiable test results to an industry acceptable test plan such as BellCore GR-2945 or equivalent.

2 ENHANCED 9-1-1 SYSTEM DESCRIPTION AND FEATURES DEFINITIONS

2.1 E9-1-1 System and Feature Overview

The 3-digit telephone number 9-1-1 has been designated for public use throughout the United States to report an emergency, request emergency assistance, or both. This number is intended as a nationwide, universal telephone number to provide the public with direct access to a PSAP. A PSAP is an agency or group of agencies designated and authorized to receive and respond to emergency calls requiring one or more public services (Police, Fire, EMS, or all three).

The E9-1-1 feature provides Enhanced 9-1-1 service capabilities and optional PSAP customer services for completing and handling 9-1-1 calls. This feature provides the capability for the E9-1-1 tandem office to serve several PSAPs within the E9-1-1 service area. The main characteristic of E9-1-1 service is the capability of the E9-1-1 tandem office to selectively route a 9-1-1 call originated from any station in the E9-1-1 service area to the correct primary (or controlling) PSAP designated to serve the originating station's location. The following are some of the services that are available with the E9-1-1 feature in addition to those available in the basic 9-1-1 feature:

- Selective Routing (SR)
- Default Routing
- Alternate Routing for PSAPs that are traffic busy, on night service or have a power failure
- Central Office Transfer (selective, fixed and manual)
- Automatic Number Identification (ANI)
- Automatic Location Identification (ALI)/Data Management System (DMS)
- Forced Disconnect
- Night Service
- Automatic Call Distribution (ACD)

2.1.1 General Feature Assignments

E9-1-1 service is provided on a per-system basis.

In an E9-1-1 service area, typically one switching office is designated as an E9-1-1 tandem office for all 9-1-1 calls.

This E9-1-1 tandem office serves all PSAPs in the E9-1-1 service area and can provide Selective Routing (SR) for incoming 9-1-1 calls from other offices.

Dedicated E9-1-1 trunks are equipped in the E9-1-1 tandem office for each PSAP served.

2.2 Selective Routing

Selective Routing is a standard service which routes an E9-1-1 call to the appropriate (primary) PSAP based on the calling party's telephone number.

2.3 Default Routing

Default Routing is a standard service that allows a 9-1-1 call to be routed to a default PSAP when the call cannot be selectively routed.

2.4 Alternate Routing

Alternate Routing is a standard service which allows the E9-1-1 Tandem Office to route a 9-1-1 call to a pre-designated alternate PSAP if the primary or controlling PSAP is unable to accept the call.

2.5 Central Office Transfer

Central Office Transfer is a standard service available for each PSAP. This service provides the capability for an established 9-1-1 call to be transferred by the PSAP attendant, via the E9-1-1 tandem office, to another PSAP or some other destination. A call transfer is accomplished at the E9-1-1 tandem office via a 3-way conference connection. This permits a simultaneous 3-way connection for the calling party, primary PSAP attendant, and the desired destination, which may be another PSAP or some other Directory Number (DN).

Three types of Central Office transfer services: selective, fixed and manual are available individually or in combination for a PSAP.

2.5.1 Selective Transfer

Selective transfer is an optional service that allows an established 9-1-1 call to be selectively transferred by the E9-1-1 tandem office from the primary PSAP to the correct secondary PSAP associated with the calling station ANI DN. This transfer occurs without the primary PSAP attendant having to determine and manually dial the digits for the correct destination. Each primary PSAP may have several secondary PSAPs associated with it for this transfer feature. To initiate selective transfer to the correct secondary PSAP, the PSAP attendant operates a key associated with the particular type of emergency service desired (e.g., a fire department). The E9-1-1 tandem office automatically determines the designated secondary PSAP (e.g., fire department A) to serve the calling station, and selectively transfers the 9-1-1 call to that secondary PSAP. 9-1-1 calls can also be selectively transferred to non-PSAP locations (e.g., Poison Control Centers).

Note: *Typically, a PSAP is designated as primary or secondary; the designation refers to the order in which 9-1-1 calls are directed for answer. Primary PSAPs respond first; secondary PSAPs receive calls only on a transfer basis.*

2.5.2 Fixed Transfer

Fixed transfer is a service that allows an established 9-1-1 call to be transferred by the PSAP attendant to another PSAP destination (e.g., fire department A). By the operation of a transfer key or a speed dial code, fixed transfer uses the Speed Calling feature of the E9-1-1 tandem office. E9-1-1 calls can also be transferred to non-PSAP locations (e.g., Poison Control Centers).

Fixed transfer provides for call transfer to any limited number of destinations. The PSAP attendant determines the desired destination and operates the particular key associated with that destination.

2.5.3 Manual Transfer

With manual transfer, the PSAP attendant determines the desired destination and manually dials the number of the destination or associated Speed Call code (if Speed Calling is provided).

2.6 Automatic Number Identification (ANI)

ANI allows (for 9-1-1 calls only) the ANI DN of the calling station to be automatically forwarded to the PSAP and shown on a display within the attendant position.

2.6.1 7 Digit ANI

When the ANI DN of the calling station is available, the display indicates a Numbering Plan Digit (NPD) that provides an indication of the Numbering Plan Area (NPA/Area Code) of the calling station and the 7-digit ANI DN of the calling station. In cases where the ANI DN is available, but the call either cannot be properly routed by the E9-1-1 tandem office, or the call requires special attention by the PSAP attendant, the ANI DN displayed may be optionally flashed to alert the answering PSAP attendant of default routing.

2.6.2 10 Digit ANI

Refer to NENA 03-002 NENA Recommendation for the implementation of Enhanced MF Signaling, E9-1-1 Tandem to PSAP.

2.7 Automatic Location Identification (ALI)

ALI provides street address information and dispatch information associated with the ANI to be displayed at the answering PSAP. (For further details, refer to NENA Database Standards Document).

2.8 Forced Disconnect

Forced disconnect is an inherent capability of E9-1-1 service that prevents a calling station which remains off-hook from indefinitely holding the connection to a PSAP. It allows a PSAP attendant to release a 9-1-1 call connection even though the calling party has not hung up, thereby preventing a tie-up of dedicated 9-1-1 facilities.

2.9 Night Service

Night service is a standard feature available for each PSAP. When night service is in effect, all 9-1-1 calls to that PSAP are automatically forwarded to the assigned alternate DN. This alternate DN may be associated with a secondary PSAP or some other destination.

2.10 Automatic Call Distributor (ACD) CPE or Central Office Based

An ACD automatically distributes incoming calls to available PSAP attendants in the order the calls are received, or queues calls until an attendant becomes available. ACDs may work in conjunction with an external E9-1-1 ANI/ALI controller, or may have integrated ANI/ALI capabilities.

When an ACD is used as the primary answering device for emergency calls the ACD shall follow the same guidelines as outlined in this document except those which pertain only to Key Telephone Systems (such as 1A2 systems).

3 PSAP INTERFACES

The PSAP equipment will provide several interfaces in accordance with the following interface specifications.

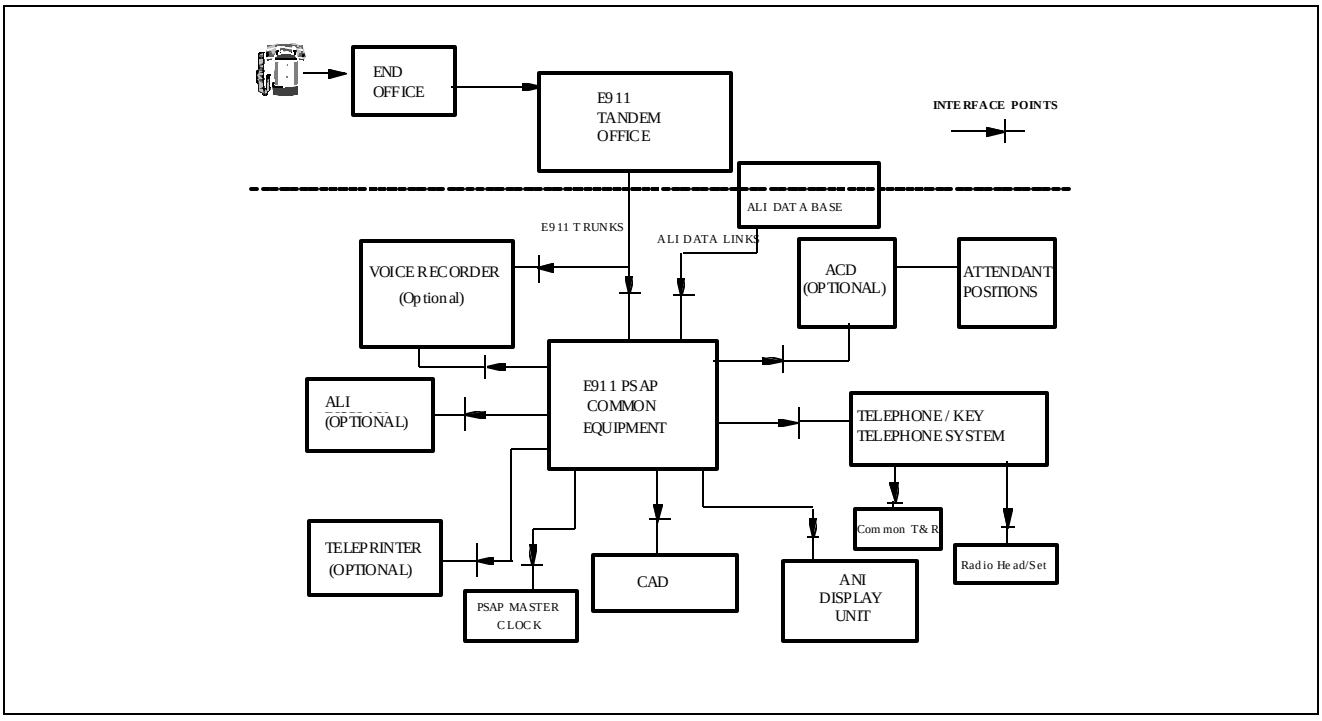

FIGURE 1
CUSTOMER PREMISES SYSTEM INTERFACE

3.1 Trunk Interface

The E9-1-1 trunk interface shall control a Central Office link carrying ANI. To ensure compatibility to any type of terminal equipment (Key System, PBX, ACD, etc.), each trunk interface shall transform the E9-1-1 trunk (or other reverse battery supervision trunk) using MF signaling into a Class "C" or equivalent service line. The trunk interface shall decode MF tones presented with various protocols and then send the corresponding ANI to the attendant position handling the emergency call

3.1.1 E9-1-1 Tandem Trunk Connection to a PSAP

The connection between the E9-1-1 Tandem and the PSAP, as shown in Figure 2, is made using 2-wire, 1-way trunks incoming to PSAP. These are standard trunking circuits arranged for loop-reverse battery operation. The electrical characteristics of the trunks during various call states are listed in Tables 1a and 1b.

Table 1a lists the electrical characteristics for 9-1-1 Tandem to PSAP CPE communications.

Table 1b lists the electrical characteristics for PSAP CPE to Tandem communications.

Additional information on loop characteristics can be found in the following Bellcore documents:

TA-NPL-000912 Description of the Analog Voice-band Interface Between the Bell- System Local Exchange Lines and Terminal Equipment

TR-EOP-00001 Lightning and 60-Hz Disturbances at the Bell Operating Company Network Interface.

TR-TSY-000350 E9-1-1 Public Safety Answering Point: Interface Between a 1/1AESS Switch and Customer Premises Equipment

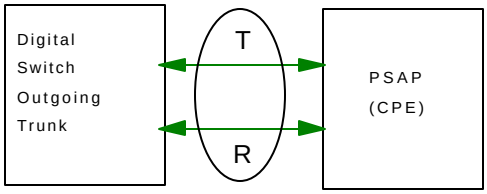

FIGURE 2
E9-1-1 TRUNK CONNECTION TO PSAP
(See T and R Load Characteristics in Tables 1a. and 1b.)

Leads	Call State			
	Idle	Seizure	Pulsing	Talking
T and R lead Conditions	Open >30kΩ	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.	Same as Seizure plus 900Ω, 2 µF reflected impedance. For nominal speech levels, see EIA RS-478, and TA-NPL-000912.

TABLE 1a

TRUNK CALL STATE ELECTRICAL CHARACTERISTICS
(Control Tandem-To-PSAP)

Leads	Call State		
	Idle	Seizure	Pulsing
T and R lead conditions respect to T lead (see Note 1 below).	R lead potential negative with respect to T lead (see Note 1 below)	R lead potential positive with respect to T lead (see Note 1 below)	See Notes 2 and 3 below.

TABLE 1b

TRUNK CALL STATE ELECTRICAL CHARACTERISTICS
(PSAP-to-Control Tandem)

Notes:

1. *The CPE supervisory battery (nominally -48 dc Volts) must be capable of supplying 10 mA over maximum length loops (loop-reverse battery signaling required; see Signaling Section of LSSGR).*
2. *The CPE must be capable of returning audible ring toward the originating party before the attendant answers and be capable of MF digit reception (ANI information), when required.*
3. *The CPE must be capable of generating wink and flash signals and outpulsing Dual Tone Multifrequency (DTMF), when required.*

3.1.2 E9-1-1 End Office Trunk Connection to a PSAP (Direct Trunk)

The connection between the E9-1-1 originating central office and the PSAP is similar to Tandem to PSAP in that it delivers ANI and Voice to the PSAP on a 2-wire reverse battery trunk. On direct trunking, the following features are not provided by the Telephone network:

- 3 way conference call
- Call transfers via the E9-1-1 trunk
- Selective Routing

Call process signals vary depending on the originating central office type. Two common types are:

(Wink) KP 911 ST (Wink) KP I(I) xxx-xxxx ST (Off Hook)
(Wink) KP I(I) xxx-xxxx ST (Off Hook)

I = One or two information digits
x = ANI

Additional information on loop characteristics can be found in the following Bellcore documents:

- TA-NPL-000912 Description of the Analog Voice-band Interface Between the Bell System Local Exchange Lines and Terminal Equipment
- TR-EOP-00001 Lightning and 60-Hz Disturbances at the Bell Operating Company Network Interface.
- TR-TSY-000350 E9-1-1 Public Safety Answering Point: Interface Between a 1/1AESS Switch and Customer Premises Equipment

Notes:

1. *The CPE supervisory battery (nominally -48 dc Volts) must be capable of supplying 10 mA over maximum length loops (loop-reverse battery signaling required; see Signaling Section of LSSGR).*
2. *The CPE must be capable of returning audible ring toward the originating party before the attendant answers and be capable of MF digit reception (ANI information), when required.*
3. *The CPE must be capable of generating wink signs.*

3.1.3 Network Tones

Standard tones (dial, busy, reorder and audible ringing) are provided by the E9-1-1 Tandem office for attendant transfer calls.

Note: *For an incoming E9-1-1 call, the attendant must receive an audible and/or visual signal. An audible ringing indication shall be returned to the E9-1-1 calling party from the E9-1-1 PSAP CPE.*

3.2 Central Office Based E9-1-1 Interface

Central Office based E9-1-1 service may offer alternative emergency call handling functionality (e.g. CO based automatic call distribution). For this service, many of the features may be performed through a different interface, utilizing CO based equipment to perform functions that could otherwise be performed at the PSAP. At a minimum CO based E9-1-1 equipment shall provide the required features and functionality contained in their PSAP premises based counterparts. See section 3 and 5 for additional information.

3.3 ALI Database Interface

PSAP equipment shall interface to either an Off Premise ALI Database or a Premise ALI Database as described below.

3.3.1 E9-1-1 Off-Premise ALI Data Base Interface

3.3.1.1 Overview

The PSAP equipment interfaces to the ALI database in order to request ALI information for a 9-1-1 caller's telephone number.

The PSAP equipment issues 'ALI requests' to the ALI database under the following conditions:

- Requests issued automatically for calls received on 9-1-1 trunks with valid ANI.
- Request issued automatically for calls received on 9-1-1 trunks with x911-xxxx.
- Request issued automatically for calls received on 9-1-1 trunks with no ANI or partial ANI, "0's" shall be substituted in place of a valid ANI.
- Requests issued as a result of a manual retransmit request issued by a 9-1-1 attendant position.
- Requests issued as a result of a manual database request issued by a 9-1-1 attendant position.

The following describes the interface protocol between the ALI database and the PSAP equipment.

3.3.1.2 Physical

For reliability reasons, two communication links are required between the ALI database and the PSAP equipment.

Each communication link has the following default physical interface requirements:

Communication Standard: EIA RS-232C Asynchronous

Code:	ASCII
Data bits:	8
Parity bit:	None
Stop bits:	1
Baud rate:	1200 bps minimum
Communication:	Full Duplex
Facilities:	4-wire lines
Modems:	As provided or specified by Telephone Company

Apart from the default interface requirements, it is desirable that the PSAP equipment allow the programming of the baud rate (1200-9600), data bits (7,8), parity (Odd, Even, None), and stop bits (1,2).

The PSAP equipment must detect the presence of the carrier detect signal from the modem on each communication link and must provide local and/or remote alarming if the carrier signal is lost.

3.3.1.3 Protocol

When both links are operational, the PSAP equipment transmits each 'ALI request' on both links simultaneously. The maximum delay between the transmissions on both links is 200 ms.

If a trouble condition results in the temporary loss of one link, the PSAP equipment can continue to issue requests only on the operational link.

3.3.1.4 ALI Requests

The ALI request consists of fourteen or sixteen ASCII characters sent in the following format:

<NPD><NXX><TN><POS><TRK><CHECK><CR> or

<NPA><NXX><TN><POS><TRK><CHECK><CR>

Note: If 10 or 20 Digit ANI - Refer to NENA 03-002 NENA Recommendation for the implementation of Enhanced MF Signaling, E9-1-1 Tandem to PSAP

Where:

NPA	Three digits given by the tandem office and used by the ALI database to identify the caller's area code
NPD	One digit given by the tandem office and used by the ALI database to identify the caller's area code
NXX	Three digits given by the tandem or end office MF tones to identify the caller's Telco exchange
TN	Four digits given by the tandem or end office MF tones to identify the caller's Directory number
POS	Two digits given by the PSAP equipment to identify the position associated with the request. Range 00 to 99 (decimal). For requests that occur prior to answering a call it is desirable that this value be 00. For requests that occur after answering a call (including Repeat, Manual and Test ALI requests) it is desirable that this value be the number of the position associated with the request.
TRK	Two digits given by the PSAP equipment to identify the trunk number over which the call was received. Range 00 to 94 (decimal) for automatic lookup and 95 to 99 (decimal) for special lookups. (See section 3.3.2 for more details). In order that ALI data-bases be able to report accurate call accounting it is desirable that special lookups use the following trunk numbers: 97 = Repeat ALI (used for ALI requests subsequent to answering a 9-1-1 call). 98 = Manual ALI (used when the operator requests ALI based on a manually entered ANI, not necessarily related to a received call). 99 = Test ALI (used for verification of operational ALI system, typically using a pre-defined ANI). This shall not be a result of receiving a Test call on a 9-1-1 Trunk.
CHECK	One digit checksum given by the PSAP equipment to verify the integrity of the message. The value of this digit is calculated such that when it is added to the sum of the previous digits, the total sum is evenly divisible by 8.
CR	Carriage Return character (hex 0D) inserted by the PSAP equipment to signal the end of the request

3.3.1.5 Response to an ALI request

The ALI database responds to an 'ALI request' with an ACK (hex 06) or a NAK (hex 15) to acknowledge the positive or negative receipt of the message.

The PSAP equipment shall retransmit a request upon reception of a NAK from both data links. The PSAP equipment shall also detect and report a link failure condition if 3 or more consecutive NAK's are received on a given link. Upon detection of a link failure condition, the PSAP equipment shall stop sending new requests on that link and shall issue 'heartbeat' messages until an ACK is received from the ALI database. The PSAP equipment must also provide local and/or remote alarming of this condition.

Once the ALI database processes the 'ALI request', the ALI database returns an 'ALI text' message on one of the two communication links.

3.3.1.6 'ALI text' message

The ALI database returns an 'ALI text' message with the following format:

<STX><TYPE><POS><TEXT><ETX>

Where:

STX	One character (hex 02) which represents a 'start of message' signal
TYPE	One digit message type as described below assigned by the ALI database
POS	Two digit position number as received in the POS field of the ALI request
TEXT	Up to 511 characters, as formatted by the telephone company (512 characters are not supported by some CRT's or Terminals).
ETX	One character (hex 03) which represents an 'end of message' signal

TYPE designations:

1 (hex 31) Data retrieved, only one path available
2 (hex 32) Data retrieved, both paths operational
3 (hex 33) Broadcast message from ALI database (text may or may not be included)
5 (hex 35) Broadcast message from ALI database indicating host going out of service
9 (hex 39) No address information found message. Text portion of message is of the form "NPA-NXX-TN No Record Found"

3.3.1.7 Heartbeat Messages

The PSAP equipment must transmit a 'heartbeat' message to the ALI database on each operational link at least once every two minutes of communication silence on the given link. The message consists of the character 'H' followed by a carriage return.

The PSAP equipment shall also detect and report a link failure condition if 3 consecutive NAK's and/or no response are received for a heartbeat on a given link. Upon detection of a single NAK or no response to a heartbeat, the PSAP equipment shall stop sending new requests on that link and shall issue 'heartbeat' messages within 10 seconds intervals until an ACK is received from the ALI database. The PSAP equipment must also provide local and/or remote alarming of this condition.

It is desirable that the PSAP equipment allow the idle heartbeat message time interval to be programmable.

3.3.2 Manual ALI Request

For manual ALI requests the trunk number shall be between 95 and 99 (98 being desired). It is desirable that the Position number be the valid position number of the attendant issuing the request. The PSAP equipment user interface shall allow the attendant to enter a 10 digit ANI (NPA + NXX + TN). The PSAP equipment shall convert the NPA to the corresponding trunk number and NPD digit as programmed in the PSAP equipment.

3.3.3 Premise ALI Database Interface

As an alternative to the E9-1-1 Telco ALI database, PSAP equipment can interface to a Premise ALI Database in order to request ALI information for a 9-1-1 caller's telephone number.

Unless the premise ALI database is integrated to the PSAP equipment, to maintain compatibility with existing PSAP equipment, the Premise ALI Database must comply to the E9-1-1 ALI database protocol described above, in sections 3.3.1 and 3.3.2.

3.4 Computer Aided Dispatch (CAD) Interface

The CAD interface allows other system devices to interface with emergency call information. It will provide the retrieved ANI/ALI for an emergency call, as well as the answering position identification on an ASCII RS-232C port.

3.4.1 Physical Interface

The interface connector from the PSAP equipment shall be EIA RS-232-C or EIA/TIA - 574 and is desirable to be configured as DCE, DB25 female EIA connector (See section 13.5 for pin out information).

Note: *The CAD provider is responsible for wiring any hardware flow control signals required by the CAD equipment.*

3.4.2 Electrical Interface

The electrical interface shall comply with the EIA-RS-232-C or EIA/TIA-574 standards.

3.4.3 Serial Interface

Minimum baud rate:	1200 bps
Communication link:	Asynchronous Full Duplex
Bits per character:	7 or 8
Parity:	Odd, Even, None
Synchronization:	1 Start bit, 1 or 2 stop bits.

3.4.4 Protocol

Following is a basic description of the recommended protocol.

3.4.5 Messages Exchange

Positive Acknowledgment (ACK) or negative acknowledgment (NAK) is sent after the reception of the block check character (BCC) of the message by the CAD to accept or reject data. ACK character value is decimal 06 and NAK value is decimal 21.

If a NAK is received by the E9-1-1 Customer Premises Equipment, it shall retransmit the message. The message will be lost if this retry is not successful.

If ACK/NAK is not received within 1 second by the E9-1-1 Customer Premises Equipment, it shall retransmit the message. The message will be lost if this retry is not successful.

It is desirable for the CPE to have an option to not expect ACK/NAK from the CAD system and dump the message one time.

Note: From a maintenance perspective this mode is least desirable.

3.4.6 ALI text message

The E9-1-1 Customer Premises Equipment shall send the ALI information within a block framed with a start of text character (STX) and an end of text character (ETX). STX character value is decimal 02 and ETX value is decimal 03.

The format of the ALI text message shall be:

<STX><TYPE><POS><ALI TEXT><ETX><BCC>

Where:

TYPE	One ASCII digit (from decimal 49 to 57) reflecting the ALI condition.
POS	Two ASCII digits representing the attendant position in decimal.
ALI TEXT	ALI text format shall be negotiated by the data base provider, CPE vendor and their customer prior to the installation. The ALI text shall not include ACK, NAK, STX, or ETX characters.
BCC	A block check character shall immediately follow the ETX character. It shall have a value of decimal 0 to decimal 255. It is obtained by taking the continuous Exclusive OR (XOR) of all characters preceding the BCC, but does not include the STX character.

Note: The TYPE, POS and ALI TEXT fields shall contain information identical to that of the associated ALI request (see Section 3.3.1.6).

3.4.7 Heartbeat message

The PSAP equipment shall send a heartbeat message at least once every two minutes during idle conditions. It is desirable that the PSAP equipment support the option to disable the transmission of heartbeats. If the PSAP equipment does not support this disable option, the PSAP equipment shall

continue transmitting new messages to the CAD even if it does not receive an ACK in response to the heartbeat messages.

The format of the heartbeat message shall be:

<STX><H><ETX><BCC>

3.4.8 Erase message

The E-9-1-1 Customer Premises Equipment shall send this message in order to indicate the attendant has released the call or put the call on hold.

The format of the erase message shall be :

<STX><E><POS1><POS2><ETX><BCC>

3.4.9 Flow control

If the CAD system transmits a XOFF character (decimal 19), transmission from the E-91-1 Customer Premises Equipment shall suspend for 2 seconds or until the CAD transmits a XON character (decimal 17). At the end of the 2 seconds, transmission from the E9-1-1 Customer Premises Equipment shall resume as if a XON character has been sent by the CAD.

3.5 Recorders and Teleprinters Interface

The E9-1-1 Customer Premises System design shall provide access leads for optional connections to customer-provided voice recorders and teleprinters (see Figure 1).

These optional connections are described in the following sections:

3.5.1 Voice Recording Interface

3.5.1.1 Overview

Logging and recall recorders are used by the Public Safety Answering Point to record 9-1-1 conversations.

3.5.1.2 Logging and Recall Recorder Requirements

As a minimum, each emergency telephone line or each emergency answering position must be recorded on a logging recorder.

It is desirable that the logging recorder be equipped with dual decks / drives such that the failure or unavailability of one deck/drive will cause the other deck / drive to automatically take over the recording function.

It is desirable that the recall recorder has the ability to play and record simultaneously such that an operator may listen to a previous call while recording a current call.

It is desirable that both logging and recall recorders be synchronized with the Master Clock.

Per FCC docket # 20840, federal law grants specific exemption of warning tones on calls made to telephone numbers published for emergency services.

WARNING: *Unless required by local or state law, there shall not be recorder warning tones on emergency and administrative lines since this may disrupt TDD/TTY communications, MF ANI reception and DTMF transfer dialing.*

If warning tones are required, they must be generated in accordance with the following FCC requirements (per FCC docket #6787 of 11/26/47 and 5/20/48):

Tone frequency	1400 Hz ± 10%
Tone duration	200 ms ± 20%
Tone repetition interval	12 to 18 seconds
Tone level	Average telephone talk level (-30 to -20 dBm)

It is desirable, as a minimum, that the logging recorder be connected to an uninterruptible power supply (UPS) regardless of whether or not the recorder supports a battery for backup power.

The logging and recall recorders shall connect to one of the following audio interfaces:

- Direct connection to emergency trunks and 7 digit emergency lines.
- The telephone set's analog Common Tip & Ring Interface.
- The telephone set's analog handset interface receiver signal.

Alternatively, the recorder could be directly integrated to the telephone set or answering position computer.

Note: *Refer to sections 3.11, 3.13, 3.14 & 5.17 for telephone set interface requirements.*

Regardless of the interface connection, the logging and recall recorders shall satisfactorily reproduce the recorded audio signals.

3.5.1.3 Recorder Start Signal

The logging and recall recorders shall have one or more of the following means of activating and deactivating the recording function:

- Record continuously
- Record during voice activity (VOX)
- Record while the Off-hook Signal Contact is closed
- Record while telephone line voltage indicates off-hook

VOX activation/deactivation is the least preferred alternative.

Note: *Recorders that use the Off-hook Signal Contact for activation shall have a Recorder Start Signal Pair per channel.*

3.5.1.4 Electrical Interfaces

3.5.1.4.1 Audio Pair

The analog audio input of the recording equipment must meet FCC Part 68.

AC impedance: Greater than 10,000 Ω at 1000 Hz
DC resistance: Greater than 10 M Ω

3.5.1.4.2 Recorder Start Signal Pair

The recorder start signal must provide a signal source and signal input which, together, comply to the Off-hook Signal Contact Pair rating identified in section 3.13.

3.5.1.4.3 Physical Interfaces

The interface can be RJ11, RJ21 with the following pin-out:

1. Recorder Start Signal Pair - lead 1
2. Audio Pair - lead 1
3. Audio Pair - lead 2
4. Recorder Start Signal Pair - lead 2

Properly identified screw terminals are also acceptable.

3.5.1.4.4 Synchronization Clock Interface

If the recorder uses amplitude modulated IRIG as the synchronization source then it is desirable that it accepts a mark signal level range of 2 to 7 volts peak-to-peak.

It is desirable that recorders using IRIG as a source have an IRIG input impedance greater than 2000 ohms to accommodate multiple recorders bridged across the source signal.

3.5.2 Connections / Interface to Printers

The E9-1-1 Customer Premises System design shall provide access leads for optional connections to customer-provided printers. The printer is used to record certain information available for 9-1-1 calls. These optional connections are described as follows:

- Serial Interface: (EIA RS-232C, Asynchronous, ASCII)

Data Input Method: 7 or 8 bit
Parity Odd, Even or None
Data Transmission: Speed: Minimum 1200 BPS
Flow control: Software and/or Hardware
Synchronization: Start-Bit: 1 bit
Stop-Bit: 1 bit or 2 bits

- Parallel Interface: (ASCII)

Distance Limitations: (15 feet)
Centronics: Standard
IEEE 1284 Standard

- Network Connection Direct connection to Ethernet or similar network

The printer used to receive information on 9-1-1 calls shall be a type that will not go into graphics mode upon receipt of the standard ALI stream (i.e. STX, ALI Data, ETX). If the E9-1-1 Customer Premises System reformats ALI prior to printing, graphics mode is not a consideration.

Customer Premises equipment must also respond to flow control signals from printers so that, for a reasonable amount of time, data is not lost when printers jam or run out of paper. These control signals can also be used by the Customer Premises equipment for alarms to remote maintenance sites and local alarms.

It is desirable that the printer be connected to an Uninterruptible Power Source (UPS) and this source be capable of powering the printer for a minimum of 15 minutes.

3.5.3 CDR (Call Detail Record) Printer Interface

A printer shall be equipped at all primary PSAPs to provide a CDR (Call Detail Record) printout at the end of each 9-1-1 call. This is sometimes called a "log" printer.

The printout shall include the following fields at a minimum:

- Trunk seize time
- Caller's telephone number (including NPA or NPD)
- Answer time
- Answering position number
- Trunk number
- Trunk release time
- Time call was transferred
- PSAP name or number that the call was transferred to
- Abandoned call indicator
- Date (See note)

It is desirable that the record also include:

- Ringing start time
- Time call was placed on hold
- Time call was taken off of hold and by what position number
- ALI

It is also desirable that the ANI/ALI controller be able to optionally output the ALI record as a part of the CDR printout. This shall include the name, complete street address, city and ESN.

Note: The date does not necessarily need to be a part of each record. As a minimum, the date shall be printed at least once per page.

It is desirable that the ANI/ALI system has the ability to store CDR records to a data file that can be downloaded onto a floppy drive or other media on demand.

3.5.3.1 Physical Interface

The Printer may be either serial (RS-232C) or parallel. (See section 3.5.2 for complete physical interface information.)

3.5.3.2 Electrical Interface

See Connections / Interface to Printers section 3.5.2 for complete electrical interface information.

3.6 ANI Display Interface

The ANI display unit (which may be displayed directly on the attendant position) is required to display the seven, eight or ten digit ANI telephone number of the station from which the E9-1-1 call originated. If the ANI telephone number is not available, then other associated data indicating the originating local office or call status may be displayed.

3.7 ALI Display / Interface

3.7.1 ALI Displays (Current)

ALI Displays must be capable of displaying 512 characters of ALI data transmitted by the ALI system to the PSAP. The ALI display can be a VT100 or VT320 compatible terminal, a 16-line x 32 character ALI display, a PC monitor, or any other display device capable of displaying 512 characters.

Physical/Electrical Interface for dumb terminals and ALI displays - EIA RS232-C interface

Serial Interface:	
Minimum Speed:	1200 bps
Recommended Speed:	9600 bps or higher
Communications Link:	Asynchronous Full Duplex
Bits per character:	7 or 8
Parity:	Odd, Even or None
Synchronization:	1 Start Bit, 1 or 2 Stop bits

The Physical/Electrical Interface for PC displays is standard VGA as a minimum. Higher resolutions are desirable but not required.

This standard does not specify flow Control between ALI controller and ALI displays.

3.7.1.1 Protocol/Format

The data sent from the ALI system to the PSAP is of the form described in section 3.3.1.6. The exact format of the ALI data will be defined in a future NENA standard.

3.7.1.2 ALI Display Requirements

The ALI data received from the ALI host can be dumped to the screen or terminal in the same format it was received or it can be parsed and displayed in a format more meaningful to the calltaker. If the ALI

display merely displays the raw ALI data received from the ALI database, the special characters contained in the ALI data record such as STX and ETX shall not cause the display to go into graphics mode or any other state that would cause it to be non-functional for displaying ALI data.

The minimum ALI display shall be capable of displaying 511 characters each with the last position on the screen reserved for the cursor for a total of 512 characters.

3.7.1.3 User Interface

The ALI Display device will allow the user to view the ALI data, clear the screen, print the ALI data on a printer, or repeat the last ALI request.

3.7.2 ALI Display / Interface (Future Enhancements)

New ALI formats are being addressed and standards will be developed as the formats are completed.

3.8 PSAP Time Synchronization Interface

In order to insure consistency of time stamps added to event records and reports, PSAP equipment such as CAD Computers, ANI/ALI Controllers, Voice Recorders, Radio Consoles, etc., shall be able to synchronize their internal clock to a PSAP master clock.

Detailed specification of a Master PSAP Clock is described in NENA Document " NENA 04-002 PSAP MASTER CLOCK STANDARD"

3.9 Remote Data Transfer Interface

It is desirable that E9-1-1 Customer Premises Equipment have the option to be equipped with modems and/or facsimile machines. Those modems/facsimile machines are used to transmit information to a remote location. The user interface allows the PSAP attendant to manually execute a data transfer. The PSAP equipment shall provide attendant with positive and/or negative feedback on the data transfer.

The remote connection can be achieved through the Public Switched Telephone Network (PSTN, 2-wire) or through a dedicated link (2-wire or 4-wire).

3.9.1 External Modem/Facsimile Machine Control

In cases where the E9-1-1 Customer Premises Equipment uses external modems/facsimiles, the interface between the modem/facsimiles and the E9-1-1 Customer Premises Equipment shall meet the following specifications:

3.9.2 Modem/Facsimile Serial Interface

- EIA RS-232-C.
- Minimum baud rate: 1200 bps
- Recommended baud rate: 9600 bps or higher
- Communication link: Asynchronous Full Duplex
- Bits per character: 7 or 8
- Parity: Odd, Even, None
- Synchronization: 1 Start bit, 1 or 2 stop bits

3.9.3 Modem Protocol

- Hayes compatible (AT command set).
- Sending and receiving modems must be compatible to ensure proper functionality.

3.9.4 Facsimile Protocol

EIA/TIA-578 (Asynchronous Facsimile DCE Control Standard - Service Class 1). This standard is in fact an extension of the Hayes command set that allows support for facsimile. Sending and receiving Facsimiles must be compatible to ensure proper functionality.

3.9.5 Modulation

For modem connectivity modulation schemes shall be compliant to ITU standards.

3.9.6 Flow Control

Sending and receiving equipment must support compatible software or hardware flow control protocol.

3.10 1A2 Key Telephone System Interface

Systems that are based on 1A2 key technology must comply with EIA RS-478 and EIA RS-487.

3.11 Telephone Analog Audio Interface

The following sections define a telephone system interface to external ancillary devices such as TDD, fax/modems and recall recorders that require a 2-wire bi-directional analog interface.

This interface shall be provided by the telephone system provider if the telephone system does not support an integrated TDD and recall recorder functionality that complies with the recommendations made in this document.

It is desirable that the telephone system supports this interface in order to accommodate future requirements for ancillary devices not yet covered in this document.

3.11.1 Common Tip and Ring Interface (For Analog Telephone Sets)

3.11.1.1 Overview

The Common Tip & Ring Interface of the telephone set shall provide a parallel interface between the selected line of the telephone set and ancillary devices such as TDD devices, auto dialers, fax/modems, recall recorders, etc.

3.11.1.2 Operation

When the user selects a telephone line, the telephone set connects the Tip and Ring of the selected line directly to the Common Tip and Ring Interface. The connection is maintained until the line is placed on hold or released.

3.11.1.3 Telephone Set Requirements

Some ancillary devices bridge onto the Common Tip and Ring (i.e., recall recorders), others terminate the selected line (i.e., TDD devices).

Bridged connectivity implies that the ancillary device connects with an impedance greater than 10,000 ohm impedance, not drawing loop current nor loading the audio signal. This form of connectivity is satisfied by the parallel Common Tip and Ring interface.

It is desirable that the telephone set also allows ancillary devices to terminate the selected line; in which case, the ancillary device connects with a 600 ohm impedance and draws loop current. To achieve this, the telephone set must permit the disconnection of its internal termination so that the line is not loaded and audio signal levels are not attenuated.

3.11.1.4 Ancillary Device Requirements

Any attached ancillary device(s) that support both bridged and termination connectivity must fail in the bridged mode (allowing normal voice communications of the telephone set).

It is also desirable these ancillary devices support an operator control to manually switch from the termination mode to the bridged mode (to restore voice communications).

3.11.1.5 Electrical Interfaces

Telephone Set

Voltage:	
Line unselected:	OPEN Circuit
Line selected & off-hook:	As per FCC part 68 No ringing voltage shall be present on T&R
AC Impedance:	600 ohms + 2.2uF (as per FCC part 68)
Signal Characteristics:	Bi-directional audio in voice band frequency range
Insertion Loss:	Total loss of all PSAP equipment connected to the Common Tip & Ring interface shall not exceed 3db.

Ancillary Devices

Must comply with FCC part 68 and part 15.

AC Impedance:	Bridged:	> 10,000 ohms
	Terminated:	600 ohms + 2.2uF (as per FCC part 68)
DC Resistance:	Bridged:	> 10 M ohms
	Terminated:	200 ohms nominal

3.11.1.6 Physical Interfaces

RJ11, 14, 21, 35, 45 with the following pin-outs:

1. Off-hook Signal Contact Pair #1 - lead 1
2. Common Tip or Ring (Tip)
3. Common Tip or Ring (Ring)
4. Off-hook Signal Contact Pair #1 - lead 2

Properly identified screw terminals are also acceptable.

Note: *The Off-hook Signal Contact pair need not be physically on the same connector as the Common Tip & Ring Pair (refer to section 3.13 for details).*

3.11.2 Telephone Audio Interface (For Digital Telephone Sets)

3.11.2.1 Overview

The Telephone Audio Interface (TAI) provides a 2-wire analog interface between the selected line of the telephone set and ancillary devices such as TDD devices, recall recorders, fax/modems, etc.

The telephone set provider shall be capable of providing the TAI regardless of whether it is built into the telephone set or an external device that is attached to the telephone set.

3.11.2.2 Operation

When the user selects a telephone line, the telephone set provides an audio path between the selected line and the TAI. The connection is maintained until the line is placed on hold or released.

3.11.2.3 Telephone Set Requirements

The TAI shall provide a 2-wire analog interface to ancillary devices that meets FCC part 68.

It is desirable that the TAI provide an optional mode in which battery feed is supplied to ancillary devices connected to the TAI.

3.11.2.4 Electrical Interfaces

Telephone Audio Interface (TAI)

Voltage:

Line not selected:	Open Circuit
Line selected & off-hook:	

Dry Mode:	0 VDC	
Battery Feed Mode:	As per FCC part 68 (The telephone set shall not present any ringing voltage on the TAI.)	
AC Impedance:	600 ohms + 2.2uF (as per FCC part 68)	
Signal Characteristics:	Bi-directional analog audio in voice band frequency range	
Insertion Loss:	Total loss of all ancillary equipment connected to the TAI shall not exceed 3db.	

Ancillary Devices

Must comply with FCC part 68 and part 15.

AC Impedance:	Bridged:	> 10,000 ohms
	Terminated:	600 ohms + 2.2uF (as per FCC part 68)
DC Resistance:	Bridged:	> 10 M ohms
	Terminated:	200 ohms nominal

3.11.2.5 Physical Interfaces

RJ11, 14, 21, 35, 45 with the following pin-outs:

1. Off-hook Signal Contact Pair #1 - lead 1
2. TAI (Tip) - lead 1
3. TAI (Ring) - lead 2
4. Off-hook Signal Contact Pair #1 - lead 2

Properly identified screw terminals are also acceptable.

Note: *The Off-hook Signal Contact pair need not be physically on the same connector as the TAI Pair (refer to section 3.13 for details).*

3.12 Radio/Telephone Headset Interface

3.12.1 Overview

The Radio/Telephone Headset Interface (RTHI) is used for applications where it is desired to use one headset for both telephone and radio communications.

This interface provides connectivity and control signaling between the radio console and the telephone set.

Typically, the headset is connected to the radio console. The radio console RTHI circuit detects a closure of the Off-hook Signal Contact Pair by the telephone set which causes the headset audio to be switched from the radio console to the telephone set.

3.12.2 Telephone Set Requirements

When a user seizes a telephone line, the telephone set closes the Off-hook Signal Contact causing the RTHI circuit to pass the headset audio to the telephone set. The headset audio remains connected to the telephone set until the telephone line is released at which point the telephone set opens the Off-hook Signal Contact and the RTHI circuit return the headset audio to the radio console.

If the telephone line is placed on hold via the Hold button on the telephone set, the telephone set shall open the Off-hook Signal Contact.

The Off-hook Signal Contact shall be disabled (remain opened) when a headset/handset is connected to the telephone set, regardless of telephone line status. It is desirable that this function be performed automatically when a handset/headset is inserted into the telephone set. Alternatively, this function can be performed manually via a button on the telephone set.

The telephone set shall be equipped with a backup handset (not normally connected) that can be inserted into the telephone set in the event of radio console failure.

3.12.3 Radio Console Requirements

When the Off-hook Signal Contact is opened, the radio console shall isolate its audio paths from the RTHI transmit and receive pairs.

It is desirable that the radio console support an independent receive volume adjustment for telephone and radio communications, independent of the volume control supplied by the headsets.

The radio console must support a headset receive volume control.

It is desirable that the radio console supports a microphone ON/OFF switch, especially if the telephone set does not support this function.

3.12.4 Electrical Interfaces

3.12.4.1 Option 1:

Direct connection to the telephone set's handset/headset interface

- Receive Pair (receive audio from telephone set to radio console)
  Impedance: 150 ohms
- Transmit Pair (transmit audio of radio console to telephone set)
  Impedance: 50 ohms

The interface shall comply with carbon compatible microphone standards.

The radio console shall provide a DC load, as needed by the telephone set's microphone bias circuit, capable of a minimum of 20 mA. (Consult the telephone set vendor for microphone bias circuit requirements.)

3.12.4.2 Option 2:

Dedicated radio/telephone interface

- Receive Pair (receive audio from telephone set to radio console)
  Balanced, 600 ohms impedance
  0 VDC
  Electrically isolated
  The telephone set shall inject a 10 dB gain to the signal received from the telephone line.
  The radio console shall accept a maximum signal level of 0 dBm.
- Transmit Pair (transmit audio of radio console to telephone set)
  Balanced 600 ohms impedance
  0 VDC
  Electrically isolated
  The radio console shall output a maximum signal level of 0 dBm.
  The telephone set attenuates the signal received from the radio console by 10 dB.

It is desirable that both the telephone set and radio console support a method of adjusting the transmit and receive signal levels.

- Radio/Telephone Headset Control Signal Pair:

  The radio console must provide a signal source and signal input, which together, complies with the Off-hook Signal Contact Pair rating identified in section 3.13.3.

3.12.5 Physical Interfaces

The interface can be RJ14, RJ45, RJ48 with the following pin-out:

- Off-hook Signal Contact Pair #2 - lead 1
- Transmit to telephone line (microphone)
- Receive from line (earpiece)
- Receive from line (earpiece)
- Transmit to telephone line (microphone)
- Off-hook Signal Contact Pair #2 - lead 2

Properly identified screw terminals are also acceptable.

Note: *The Off-hook Signal Contact Pair need not be physically on the same connector as the transmit & receive pairs.*

3.13 Off-Hook Signal Contact Pairs

3.13.1 Overview

The telephone set shall provide at least one Off-hook Signal Contact Pair used to activate and deactivate ancillary devices.

It is desirable that the telephone set support two independent Off-hook Signal Contact Pairs; Pair 1 used by ancillary devices connected to the Telephone Analog Audio Interface (i.e. recorders) and Pair 2 used for Radio / Telephone Headset Interface.

3.13.2 Operation

When the user seizes a telephone line, the telephone set closes the contact. When a line is placed on hold the set opens the contact. When the line is released the telephone set opens the contact.

3.13.3 Electrical Interfaces

3.13.3.1 Off-hook Signal Contact Pair

- The Off-hook Signal Contact Pair shall be a dry contact pair with a rating of 28VA (1A at 28VDC) or more.
- The minimum isolation voltage shall be 600V.
- When closed (off-hook condition), the contact resistance shall be less than 5 ohms.
- When opened (on-hook condition), the contact resistance shall be greater than 5 M ohms.

3.13.3.2 Signal Pair

- The telephone shall be considered off-hook when there is 50 ohms or less across the signal pair.
- The telephone shall be considered on-hook when there is 1 M ohms or more across the signal pair.
- The signal pair shall have no more than 60 volts DC or AC from signal-to-signal and from signal-to-earth ground.
- It is desirable that the current flow in the shorted condition be between 5 and 50 mA.
- There shall be no more than 250 mA of current flow in the signal pair when shorted.

3.13.4 Physical Interfaces

The physical connections of the Off-hook Signal Contact Pairs 1 and 2 shall be provided on RJ11, 14, 21, 35 or 45 connectors or properly identified screw terminals.

It is desirable that the physical connections of the Off-hook Signal Contact Pairs 1 and 2 are provided with the Common Tip & Ring Interface (see section 3.11) and the Radio/Telephone Headset Interface (see section 3.12) respectively.

3.14 Handset/Headset Interfaces

3.14.1 Overview

In integrated telephone radio applications, the headset shall be connected to the radio console and the telephone set shall be connected to the radio console via the radio/telephone headset interface described in this document.

In non-integrated applications, the headset shall be connected to the telephone set as described below.

3.14.2 Telephone Set Requirements

It is desirable that the telephone set support two handset/headset interfaces.

It is desirable that each telephone headset interface be equipped with its own independent bias circuit to power the headset.

Each handset/headset jack must be equipped with independent receive volume adjustments.

The telephone set must support a microphone mute function. Apart from using this function when the attendant needs to have a confidential discussion with another attendant, this function is also used in integrated radio console applications to prevent audio feedback from the radio speaker to the telephone handset/headset microphone.

3.14.3 Headset Requirements

If the telephone headset interface is equipped to power the headset, the headsets own bias circuit shall be disabled either by internal setting or by removing the batteries.

Although less desirable, if the telephone system does not support a headset bias circuit, a battery operated headset can be used.

It is desirable that the headset is equipped with a microphone mute function for applications where the telephone set or radio console does not support this feature.

3.14.4 Electrical Interfaces

- If the headset is to be connected to the telephone set:
  To ensure compatibility and the best audio quality, consult the telephone system provider for recommended headsets.
- If the headset is to be connected to the radio console:
  To ensure compatibility and the best audio quality, consult the radio console provider for recommended headsets.

3.14.5 Physical Interfaces

It is desirable that the telephone set support a 4-wire modular handset/headset jack with the following pin-outs:

Pins:
1. transmit (microphone)
2. receive (earphone)
3. receive (earphone)
4. transmit (microphone)

Alternatively, a dual prong headset jack could be used, compatible with a PJ327 plug or equivalent with the following pin-outs:

Tip 1	transmit (microphone)
Tip 2	transmit (microphone)
Sleeve 1	receive (earphone)
Sleeve 2	receive (earphone)

It is desirable that the telephone set support a 6-wire modular handset/headset jack option for telephone radio applications where the handset/headset is to be connected to the telephone set and push to talk (PTT) signals are required.

The following pin-outs are recommended for the 6-wire jack configuration:

Pins:
1. PTT
2. transmit (microphone)
3. receive (earphone)
4. receive (earphone)
5. transmit (microphone)
6. PTT

Alternatively, a dual prong headset jack could be used, compatible with a PJ7 plug or equivalent with the following pin-outs:

Tip 1	transmit (microphone)

Tip 2	transmit (microphone)
Sleeve 1	receive (earphone)
Sleeve 2	receive (earphone)
Ring 1	PTT
Ring 2	PTT

3.15 PBX / Automatic Call Distribution (ACD) Interface (Non Integrated)

3.15.1 Physical Interface

The interface connector from the ACD equipment shall be EIA RS-232-C or EIA/TIA - 574 and is desirable to be configured as DTE, DB25 male EIA connector. (See section 13.5) for pin out information.

Note: The ACD provider is responsible for wiring any hardware flow control signals required by the ACD equipment. Hardware leads shall be provided to detect an interface failure.

3.15.2 Electrical Interface

The electrical interface shall comply with the EIA-RS-232-C or EIA/TIA-574 standards.

3.15.3 Serial Interface

Minimum baud rate:	1200 bps for Existing Equipment
Recommended baud rate:	9600 bps or Higher in New Installations
Communication link:	Asynchronous Full Duplex
Bits per character:	7 or 8
Parity:	Odd, Even, None
Synchronization:	1 Start bit, 1 or 2 stop bits

3.15.4 Minimum Record Content from ACD

Note: The following data must be output in real time and include Trunk and Position Number.

Answer

Disconnect

Monitor / Barge-In

In addition the following items are desirable:

Hold

Log-on / Log-off

Ready / Not Ready

Abandoned

3.16 PSAP Alarms

3.16.1 General

The systems shall be equipped with circuitry that monitors all major system components and data streams for alarm conditions. The alarm circuitry detects when a malfunction or data error occurs, automatically activates audible and visual alarms to warn PSAP attendant of the condition.

Example of alarm conditions may include, but are not limited to the following:

- Equipment failure
- Power failure
- Thresholds exceeded for service affecting failures
- ALI data link failure

3.16.2 Integrated Alarm Operation

When an alarm condition is detected, the Central Processor operates an audible/visual alarm. These alarms shall be both audible and visible to dispatch center personnel while working at their normal answering positions. A distinction shall be made between alarm conditions classified as major and minor in nature and shall be separately indicated. The audio portion of the alarm may be switched to a silent mode so that dispatch center operation is not disrupted, but the visual indication must remain on as long as the trouble condition exists. In the event of a total PSAP failure a local alarm will be generated.

3.16.3 External Alarm Operation

When an alarm condition is detected, the Central Processor closes alarm relay contacts that operate external audible/visual alarms. Upon detection of an alarm condition, the normally open alarm contact(s) are closed.

A distinction shall be made between alarm conditions classified as major and minor in nature and shall be separately indicated. These alarms shall be both audible and visible to dispatch center personnel while working at their normal answering positions. The audio portion of the alarm may be switched to a silent mode so that dispatch center operation is not disrupted, but the visual indication must remain on as long as the trouble condition exists. In the event of a total PSAP failure a local alarm will be generated.

3.16.4 Electrical Specifications

The minimum requirements for an external alarm interface shall be dry contact closures. Separate contacts shall be provided for alarms classified as major and minor.

3.16.5 Remote Alarms

The remote alarm interface shall be compatible with dial up or dedicated line, asynchronous ASCII communications. See section 4.3.2 for additional information.

3.16.6 Definitions

Major Alarms shall be considered major when the trouble condition triggering the alarm causes a disruption in the normal operation of the PSAP (service affecting) and places the continued operation of the PSAP at serious risk. If back-up systems are unable to correct the problem, immediate action is required to restore the PSAP to normal operation.

Minor Alarms shall be considered minor when the trouble condition triggering the alarm causes some disruption in the normal operation of the PSAP (may or may not be service affecting) and back-up systems are able to temporarily correct the problem.

Note: *Some systems may provide additional levels of alarms. (e.g.: Critical, Major, Minor, Power). The Equipment shall provide, at a minimum, Major and Minor alarms.*

3.16.7 Alarm Messages

It is desirable when alarm conditions are detected, the system not only operates audible/visual alarms, but also generates alarm messages with a date and time stamp to a RS-232C or equivalent serial port.

3.17 TDD/TTY Interface

3.17.1 Interconnection

The TDD/TTY device shall be capable of being connected to the call taking position by one or more of the following means:

- Direct connection to the incoming emergency lines or other line in parallel with the answering position.
- Direct connection to the calltaker telephone set's analog audio (see section Telephone Analog Audio Interface 3.11 or Handset/Headset Interfaces 3.14)
- Direct integration of the TDD/TTY functionality into the emergency telephone answering system.
- Acoustic coupling utilizing the call position handset (not headset) as the network interface for transferring information.

The physical interface shall be RJ11, RJ14, RJ45 or equivalent for non-acoustically coupled devices.

3.17.2 Signaling

3.17.2.1 BAUDOT TDD/TTY

At minimum, all TDD/TTY's used in PSAPs must be capable of handling Baudot calls according to EIA PN-1663, Section 4.3. TDD/TTY's must have a default baud rate of 45.5.

3.17.2.2 ASCII (TDD/TTY)

This section covers the signaling used by TDD/TTY's equipped with an ASCII mode option. Most computer modems are also capable of being configured to use this signaling. PSAPs whose emergency

telephone environment is compatible with ASCII must, at minimum, be capable of handling such calls according to EIA PN-1663, Section 4.4. It is desirable that ASCII compatible TDD/TTY's have a default baud rate of 300 with 7 data bits, one parity bit and one or two stop bits. Parity shall be **SPACE** for transmitted characters and shall be ignored for received characters.

Preprogrammed messages shall be sent at an effective baud rate of 75 or less so that the calling party is able to read the scrolling message.

3.17.2.3 ASCII (Computer Modems)

This section covers the signaling used by computer modems and some TDD/TTY's using recent technology. In the future it is expected that modems compatible with the ITU (International Telecommunications Union) recommendations V.18 will be compatible with telephone emergency call handling techniques. Therefore, new system designers shall consider incorporating V.18 technology.

3.17.3 Power

All TDD/TTY devices shall be connected to a UPS or be equipped with internal batteries which are continually charged from the main power. If the device is equipped with internal batteries, the batteries must be capable of powering the equipment for a minimum of 15 minutes.

4 CALL PROGRESS SIGNALS

The E9-1-1 PSAP equipment shall transmit call progress signals to the E9-1-1 tandem switch in accordance with the signaling specifications identified in this section.

The E9-1-1 PSAP equipment shall respond to the call process signals sent from the E9-1-1 tandem switch in accordance with the specifications identified in this section.

4.1 Connection to an E9-1-1 PSAP

4.1.1 E9-1-1 PSAP To Tandem With 7 Digit ANI

MF outpulsing is required to send ANI to an E9-1-1 PSAP. An idle E9-1-1 trunk to the PSAP is seized and an attempt is made to seize and connect an idle MF transmitter to the outgoing 9-1-1 trunk. When an MF transmitter is available, it is seized and connected to an E9-1-1 outgoing trunk to the PSAP. Standard, start-dial timing is done for receipt of the ANI start signal (approximately 250 ± 50 ms wink signal) from the PSAP CPE. There are several failure modes that can occur after the E9-1-1 tandem office seizes a dedicated E9-1-1 outgoing trunk and connects an MF transmitter.

The normal sequence of events that occurs after 9-1-1 trunk seizure is described below. Failure modes are discussed as they are applicable to a particular sequence.

1. The E9-1-1 tandem office sends an off-hook signal to the PSAP indicating 9-1-1 trunk seizure.
2. The E9-1-1 tandem office waits 4 to 20 seconds for receipt of the ANI start pulsing wink signal from the PSAP. The normal call sequence continues if the PSAP returns the start pulsing wink signal. If the start pulsing wink signal is not received within 4 to 20 seconds, the E9-1-1 tandem office puts the trunk on the trunk maintenance list and makes one retry on a different E9-1-1 trunk to the PSAP. In this case, trunk hunting and the connection phase begin again.
3. When the PSAP recognizes the E9-1-1 trunk seizure, it shall return an ANI start pulsing wink signal (250 ± 50 ms Line Reversal) to the E -1-1 tandem office within 4 seconds. After sending the start pulsing wink signal, if the MF pulses are not received in 4 seconds, or garbled pulses are received, the PSAP completes the call as if an ANI failure has occurred. That is, the PSAP CPE shall immediately signal the attendant(s) and return audible ringing to the calling station via the E9-1-1 network. In this case, when the attendant answers, all zeros are displayed on the ANI display. Otherwise, receipt of the start pulsing wink signal typically causes the E9-1-1 tandem office to start MF outpulsing.
4. The MF outpulsing consists of a stream of MF tone pulses, 53 ms to 65 ms duration, separated by silent intervals of 55 ms to 65 ms. The NPD and ANI DN digits are preceded by a KP digit of 115 to 125 ms duration, and followed by an ST digit of 55 to 65 ms duration. (The KP and ST digits are within the family of MF signals.) The E9-1-1 tandem office begins MF outpulsing the ANI information to the PSAP in the form KP-A-NXX-XXXX-ST. The A represents the encoded information digit indicating the NPD and flash calling line display data. The NXX-XXXX is typically the ANI DN of the calling station. The encoded information digit used at the E9-1-1 PSAP is listed in Table 2.

If a valid ANI is not available at the E9-1-1 tandem office, a fictitious NXX-XXXX ANI is sent as either 0-9-1-1-0TTT or 0-9-1-1-0000. The digits TTT indicate the E9-1-1 tandem switch Central Office number associated with the originating office.

0-9-1-1-0TTT is sent due to ANI failures, multiparty or QZ billing lines, and possibly a 9-1-1 call received via a message trunk.

0-9-1-1-0000 is sent when an anonymous call is made to a PSAP. An anonymous call is a 7-digit call (non 9-1-1) to the DN of a PSAP.

Note: *The information digit cannot be displayed if a valid ANI is not available. Also, if an ANI failure occurs between the E9-1-1 Tandem Office and the PSAP, the digits that may be displayed are 0-000-0000.*

Note: *For trouble identification it is desirable that CPE equipment display and make an ALI request using the received "A" information digit (the NPD digit preceding "911-0000") even if it is not a value of "0".*

5. Upon the receipt of the complete ANI information, the PSAP shall signal the attendant(s) and return audible ringing to the calling party. When the call is answered, the PSAP shall disconnect audible ringing, connect the call to the answering attendant, display the appropriate information on the console display, and return an off-hook signal to the E9-1-1 tandem office indicating answer.

6. After the answer is detected, the E9-1-1 tandem office supervises the call for disconnect and a PSAP transfer request.

Digit	*Use*
0	NPA 0 and ANI DN displayed steady
1	NPA 1 and ANI DN displayed steady
2	NPA 2 and ANI DN displayed steady
3	NPA 3 and ANI DN displayed steady
4	NPA 0 and ANI DN displayed flashing
5	NPA 1 and ANI DN displayed flashing
6	NPA 2 and ANI DN displayed flashing
7	NPA 3 and ANI DN displayed flashing
8	For maintenance test call (not presented to calltaker)
9	Not currently used

TABLE 2

ENCODED INFORMATION DIGITS AT THE E9-1-1- PSAP

4.1.2 E9-1-1 PSAP with 10 Digit ANI

Refer to NENA 03-002 NENA Recommendation for the implementation of Enhanced MF Signaling, E9-1-1 Tandem to PSAP.

4.2 Call Disconnect

4.2.1 Disconnect for E9-1-1 Tandem Calls

For an established E9-1-1 tandem call, disconnect supervision is maintained at the E9-1-1 tandem office for the incoming and outgoing E9-1-1 trunks. Disconnect actions depend on whether disconnect is received from the PSAP or local office first. When the PSAP attendant disconnects first, the PSAP shall send an on-hook (disconnect) signal to the E9-1-1 tandem office. The on-hook signal duration must be greater than 1.2 seconds to be interpreted as a disconnect signal. Either the local office returns on-hook within the 4 to 5 second period, or time-out occurs. When either on-hook is received or time-out occurs, the E9-1-1 tandem office disconnects the E9-1-1 tandem call connections, sends on-hook to the PSAP and idles the E9-1-1 trunk to the PSAP.

When the calling party disconnects first, the local office notifies the E9-1-1 tandem office, which disconnects the PSAP. Similarly, a calling party directly connected to the E9-1-1 tandem office will result in disconnect of the PSAP.

4.2.2 E9-1-1 PSAP Central Office Transfer

For E9-1-1 call transfer capability, the PSAP equipment can be arranged to automatically generate and send Speed Calling codes of the form *xx, at a minimum *11 to *69. Call transfer can also be accomplished by having the PSAP attendant dial the Speed Calling codes or the entire DN manually. A request for transfer is recognized when a flash signal (500 ± 50 ms on-hook signal) is received from the PSAP. For E9-1-1 service, there are three types of transfers:

- **Selective Transfer**. With selective transfer, the list of secondary PSAP DN's is used to transfer an E9-1-1 call selectively according to the Emergency Transfer Digit (ETD) received. Selective transfer codes have the form of *1X, where X = 1 to 6.
- **Fixed Transfer**. With fixed transfer, the prefixed 2-digit Speed Calling code has the form of *NX, where N = 2 to 6 and X = 0 to 9.
- **Manual Transfer**. With manual transfer, the attendant manually dials the DN or Speed Calling code.

If the routing DN leads to a secondary E9-1-1 PSAP equipped with E9-1-1 trunks, the 8 or 10 digit ANI sent to the primary PSAP is also sent to the secondary PSAP. If the secondary PSAP has alternate routing (for night service, traffic busy or both) which loops back to the PSAP requesting the transfer, the transfer is blocked and the PSAP attendant receives overflow tone (120 ipm) to indicate that the transfer is not allowed. Once the transfer is complete, all parties are connected via a 3-port conference circuit at the E9-1-1 tandem office until one of the parties disconnects from the call. While all three parties are connected, the primary PSAP can cause the secondary PSAP to be disconnected (forced off) by sending an on-hook flash signal (500 ms ± 50 ms) to the E9-1-1 tandem office. The E9-1-1 tandem office will reestablish the call as a 2-party call between the calling party and the primary PSAP.

Note: *If a selective transfer request is not valid, interrupted high tone (120 ipm) is returned to the PSAP attendant requesting the transfer. An invalid request occurs upon receipt of a selective transfer code (*1X) when no DN is stored in memory at the E9-1-1 tandem office.*

4.2.3 E9-1-1 Call Transfer Sequence

4.2.3.1 Selective or Fixed Transfer

When the PSAP attendant initiates selective or fixed transfer by using transfer keys on an attendant position, the PSAP shall send a flash signal (500 ms ± 50 ms on-hook) to the E9-1-1 tandem office. Otherwise, for a manual transfer, the PSAP attendant causes a timed on-hook flash signal to be generated and sent to the E9-1-1 tandem office.

In either case, when the flash signal is detected, the E9-1-1 tandem office attempts to seize a three-port conference circuit and a DTMF receiver. One of three events can occur:

- If a 3-port conference circuit is not available, the flash signal is ignored.
- If a DTMF receiver is not available within 3 to 4 seconds of receiving the flash signal, the flash signal is ignored. If a DTMF receiver is not immediately available, an attempt is made to queue for a DTMF receiver during the 3 to 4 second interval. However, it may not be possible to queue due to a queue overload.
- If a 3-port conference circuit and DTMF receiver are seized, the calling party, DTMF receiver and 9-1-1 trunk are connected to the 3-port conference circuit (with the calling party split), and dial tone is returned to the PSAP. As soon as dialing is complete all parties are bridged.

Note: *For any type of transfer that terminates to another E9-1-1 PSAP, the original ANI information is sent to the PSAP destination for the transfer call. No matter how many transfers occur and in what order PSAP attendants disconnect, when a transfer is from one E9-1-1 PSAP to another, the original ANI will be passed to the added E9-1-1 PSAP.*

4.2.3.2 Added Party Disconnect First

Upon detection of an on-hook (disconnect) signal from the added party, the E9-1-1 tandem office begins a 10 to 11 second disconnect timing sequence. If the added party is an E9-1-1 PSAP, then after the 10 to 11 second disconnect timing sequence is complete, the added party is disconnected. If an off-hook signal is received before the end of the timing sequence, the 3-party connection is held.

If the added party is other than an E9-1-1 PSAP, upon receipt of an on-hook signal the E9-1-1 tandem office begins 10 to 11 second disconnect timing. One of four events can occur:

- If the added party returns off-hook before time-out occurs, timing is terminated and the added party remains on the 3-party connection.
- 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 the primary PSAP.
- If the primary PSAP sends a timed flash signal before time-out occurs, timing is terminated. 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.

If the calling party or the primary PSAP disconnects before time-out occurs, the disconnect 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.

4.2.3.3 Calling Party Disconnects First

Upon detection of calling party disconnect, the calling party connection is released. However, the 3-port conference circuit is not released. The primary PSAP remains connected via the 3-port conference

circuit to the added party until the added party disconnects, the primary PSAP releases the added party, or the primary PSAP disconnects.

4.3 PSAP Remote Maintenance

The PSAP remote maintenance feature shall allow the maintenance provider to access the PSAP equipment from a remote test center or location to assist in trouble isolation, resolution and fault clearing.

4.3.1 Remote Maintenance Features

The remote maintenance function shall:

- Accumulate statistics on system performance
- Provide automatic remote alarm reporting
- Enable remote or local programming of any function
- Constantly monitor all system functions
- Take corrective action when possible
- Allow system access for alarm reset

4.3.2 Remote Maintenance Interface

The remote maintenance interface shall be compatible with dial up or dedicated line, asynchronous ASCII communications.

4.3.2.1 Dial Up

The remote connection can be achieved through the Public Switched Telephone Network (PSTN, 2-wire).

4.3.2.1.1 Security

WARNING: *Security measures shall be taken to guard against unauthorized access into the PSAP equipment. The maintenance provider along with the vendor shall develop a security plan for PSAP access.*

4.3.2.1.2 Internal/External Modem

In cases where the E9-1-1 Customer Premises Equipment uses internal/external modem, the interface between the modem and the E9-1-1 Customer Premises Equipment shall meet the following specifications:

4.3.2.1.3 Modem Serial Interface

EIA RS-232-C / EIA / TIA 574

Minimum baud rate: 1200 bps
Communication link: Asynchronous Full Duplex

Bits per character:	7 or 8
Parity:	Odd, Even, None
Synchronization:	1 Start bit, 1 or 2 stop bits
Flow Control:	Software and/or Hardware

4.3.2.1.4 Modem Protocol

Hayes compatible (AT command set)
Sending and receiving modems must be compatible to ensure proper functionality.

4.3.2.1.5 Modulation

The following table illustrates some of the types of modulation that a modem shall support for a specified baud rate.

	Baud rate (bps)	***Modulation***
Modems		
	1200	Bell 212A
	2400	Bell 212 A bis
	9600	V.32 or V.32 with TCM
	14400	V.32 bis
	28800	V.34

4.3.2.1.6 Power

It is desirable that the modem be connected to an Uninterruptible Power Source (UPS) and/or powered from the PSAP equipment and this source be capable of powering the modem for a minimum of 15 minutes.

4.3.2.2 Dedicated Line

The remote connection can be achieved through a dedicated data line. (2-wire or 4-wire)

4.3.2.2.1 Internal/External Modem

In cases where the E9-1-1 Customer Premises Equipment uses internal/external modem, the interface between the modem and the E9-1-1 Customer Premises Equipment shall meet the following specifications:

4.3.2.2.2 Modem Serial Interface

- Serial interface: (EIA RS-232C, EIA / TIA 574, ASCII)
- Minimum baud rate: 1200 bps
- Communication link: Asynchronous Full Duplex
- Bits per character: 7 or 8

- Parity: Odd, Even, None
- Synchronization: 1 Start bit, 1 or 2 stop bits
- Flow Control: Software and/or Hardware

4.3.2.2.3 Power

It is desirable that the modem be connected to an Uninterruptible Power Source (UPS) and/or powered from the PSAP equipment and this source be capable of powering the modem for a minimum of 15 minutes.

4.3.3 Trunk Maintenance Test Calls

For an E9-1-1 PSAP equipped with CPE for ANI display, test calls can be made from the E9-1-1 Tandem Office using encoded ANI. The E9-1-1 PSAP CPE shall decode the special ANI as a test call and connect the trunk under test to a test termination facility in the E9-1-1 PSAP CPE. Specifically, when KP-8-ST is outpulsed to the E9-1-1 PSAP, the E9-1-1 trunk under test shall be connected to a permanent busy circuit in the E9-1-1 PSAP CPE. This allows the E9-1-1 tandem office to verify the integrity of the circuit using the trunk diagnostic program. The test call sequence occurs in the following three steps:

1. After seizing the selected idle trunk and receiving the wink start signal prior to time-out, the E9-1-1 tandem office outpulses KP - 8 - ST to the PSAP.
2. The PSAP equipment shall interpret the digit 8 as a maintenance test call and connect the incoming E9-1-1 trunk to an on-hook, permanent busy tone (continuous 60 ipm tone). The tone shall be returned to the E9-1-1 tandem office within 20 seconds after receipt of the wink start pulse; otherwise, the E9-1-1 tandem office would consider the trunk test a failure. The test call shall not be presented to the call taker.
3. Approximately 5 seconds after receiving the 60 ipm tone, the E9-1-1 tandem office disconnects and idles the trunk under test. It is not necessary for the PSAP equipment to do any timing for a maintenance call, but merely to react to the seizure and disconnect from the E9-1-1 tandem office.

4.4 Address Signaling and Transmission Characteristics

4.4.1 Address Signaling

The PSAP will perform Dual Tone Multi-Frequency (DTMF) address signaling in accordance with EIA Recommended Standard RS-478 Multi-line Key Telephone Systems (KTS) for Voice-band Applications.

4.4.2 Transmission Characteristics

The PSAP shall comply with the requirements published in EIA Recommended Standard RS-478 Multi-line KTS for Voice-band Applications for the following transmission characteristics:

- Transmit Response - including frequency response and objective loudness rating
- Receive Response - including frequency response and objective loudness rating
- Sidetone Response - including frequency response and objective loudness rating
- On Hook and Off Hook Noise Generation
- Peak Acoustic Pressure
- Longitudinal Balance

5 PSAP FEATURE REQUIREMENT SPECIFICATIONS

5.1 Attendant Position Compatibility

The E9-1-1 PSAP equipment provider shall provide a list of compatible 1A2 key analog telephones, electronic key telephones, and/or ACDs unless the telephone system is integrated in the PSAP equipment.

5.2 Queuing of 9-1-1 Calls

In an emergency situation it is common for more E9-1-1 calls to appear than can be answered by a PSAP attendant. It is preferable that the E9-1-1 calls be answered according to First-In-First-Out (FIFO) priority. If some type of ACD functionality or queuing function is not included in the E9-1-1 PSAP, then it is desirable for the PSAP to provide some type of call sequence that indicates which call has been in queue the longest.

5.3 Distinctive Ringing

It is desirable that the attendant position advise the E9-1-1 attendant on the nature of the incoming call by providing distinctive ring or zip tones to differentiate E9-1-1 calls from administrative type calls.

5.4 Ring Back

Emergency calls entering a PSAP on direct 9-1-1 trunks from the subscriber class 5 office may be recalled by a direct ring-back signal in the event the calling party hangs up too soon. It is desirable that the attendant position provide an optional "soft key" to perform this function.

Note: *This is not an E9-1-1 feature. See section 3.1.2 for additional information.*

5.5 Hold for Emergency Calls (Key Telephone Systems)

All attendant positions shall provide a key for placing 9-1-1 calls on hold in order to receive any other incoming call. When a 9-1-1 call is retrieved from hold ANI and ALI information shall be automatically displayed to the attendant.

5.5.1 Hold for Emergency Calls (ACD)

All attendant positions shall provide a key for placing a 9-1-1 call on hold. When a 9-1-1 call is retrieved from hold ANI and ALI information shall be automatically displayed to the attendant. See section 5.2 Queuing of 9-1-1 Calls for additional information.

5.6 Hookflash

The attendant position shall provide a key for providing a hookflash where the on hook duration of the hook flash shall be 500 ms ± 50 ms.

5.7 Audio Volume Adjustment

The attendant position shall have a means for the operator to manually control the volume of an incoming call regardless of its source. The volume control may be provided as part of the handset, headset or telephone console.

5.8 Three Way Conferencing / Transfer

The PSAP operator shall have the ability to conference with other PSAP attendants or any other party. The attendant position shall provide a key to perform this function. It is desirable that this feature creates no audible interruption on the line.

5.9 Speed Dial

The attendant position shall have a speed dial library of a minimum of 16 telephone numbers (up to 12 digits each). The attendant position shall provide a key to perform this function.

5.10 Last Number Redial

It is desirable that the attendant position provides a key to speed dial the previous number dialed automatically.

5.11 Trunk or Line Access

The E9-1-1 position access feature shall have the capability to access all 9-1-1 trunks or lines by any attendant position.

5.12 Public Switched Access Line

5.12.1 Voice

The line access feature shall allow access by dialing on a standard access line. The lines shall have the option of being shared as an administrative line.

5.12.2 Remote Data Transfer

The remote data transfer feature shall allow ANI / ALI data transfer to any remote site through the public switched network. The data transfer line may have the option of being shared as an administrative line. See section 3.9 for additional information.

5.13 PSAP Login ID

It is desirable for each operator to be provided with a unique login ID. It is also desirable for the PSAP attendant position to recognize the login ID of the PSAP operator before providing access to the position. Preferably, the system should be able to differentiate two levels of log-on ID codes, with

different sets of system privileges associated with each level (e.g. separate privileges for supervisors and attendants).

5.14 PSAP Status Indicators

The PSAP shall support at a minimum, both visual and audio indicators for:

- Trunk status
- Attendant position status
- Link to ALI database status
- PSAP circuit pack status
- Commercial AC power status
- Reserve power status

5.15 Barge-In

This capability shall be available at all positions; by enacting this function the attendant is able to bridge on and take part in any active 9-1-1 call in the PSAP.

5.16 Silent Barge-In (Monitor)

It is desirable for a supervisor position to bridge on and monitor silently any active 9-1-1 call in their PSAP. The E9-1-1 caller and calltaker should remain unaware of the silent barge-in monitoring.

5.17 Headset/Handset Compatibility

The telephone set must support a minimum of one handset/headset interface. It is desirable to provide two handset/headset interfaces with independent bias circuits. See section 3.14 for interface specifications.

5.18 TDD/TTY Compatibility

The regulation implementing Title II of the American with Disabilities Act (ADA) mandates telephone emergency services to provide direct access for people who use Telecommunications Device for the Deaf /Teletypewriter (TDD/TTY) technologies. Therefore, every answering position shall be equipped with TDD/TTY's.

The TDD/TTY caller shall have direct access to PSAP emergency lines in the same manner as a voice call. "Direct access means that emergency telephone services can directly receive calls from rs without relying on an outside relay service or third party services." When operating in a TDD/TTY mode, each position shall retain all system features available from the existing 9-1-1 system.

Note: *"At present, telephone emergency services must only be compatible with the Baudot format. Until it can be proven that communications in another format can operate in a reliable and compatible manner in a given telephone emergency environment, public entity would not be required to provide direct access to computer modems using formats other than Baudot." ADA Title II Technical Assistance Manual.*

The Handset and/or Headset shall have the capability of a muting feature when in TDD/TTY mode. The mute shall be full on the transmit side and partial or full on the receive side. It is desirable that the receive side be only partially muted in BAUDOT mode. Muting will prevent data corruption and annoying tones to the call taker.

Each emergency answering position shall have the ability to initiate a Baudot query in response to any silent call received on an emergency line. It is preferable that this be a pre-programmed message that can be sent by depressing no more than three keys or buttons. The TDD/TTY equipped emergency position shall have the capability of switching without delay from voice to TDD/TTY mode and back to accommodate various call handling requirements to include Voice Carry Over / Hearing Carry Over (VCO / HCO).

The TDD/TTY terminal shall be capable of reviewing the last 511 characters of the conversation at the answering position. At the time of completion of the TDD/TTY call, a complete TDD/TTY record shall be generated.

5.18.1 Pre-Programmed Messages

The TDD/TTY terminal shall utilize a keyboard for full text interaction with the caller. It is required that the TDD/TTY terminal accommodates a minimum of 8 pre-programmed messages. The minimum capacity for each message shall be at least 32 characters. The pre-programmed message shall be transmitted by depressing no more than three keys or buttons. See section 13.4 for a suggested list of TDD/TTY pre-programmed messages.

5.18.2 Detection Devices

It is required that the PSAP be equipped with a TDD/TTY detection device at each position or on each emergency line that shall provide an audible and/or visual announcement of a TDD/TTY call to the call taker. The detection device shall be able to detect all 45.45 baud Baudot characters (see EIA Standard PN-1663). A sequence of any four Baudot characters within a four second period shall be the maximum required for detection.

5.18.3 TDD/TTY Considerations in the ACD Environment

TDD/TTY capability shall be provided in an ACD environment.
There shall be a Baudot message during ACD queue announcement. One of the following methods of installation should ensure an equitable level of service for TDD/TTY users.

1) TDD/TTY Detectors and Terminals may be incorporated with each attendant position. This method delays the detection of TDD/TTY calls until the call has been answered. A Baudot TDD/TTY message shall be transmitted during the queue announcement by imbedding the TDD/TTY message in the announcement. After the call has been answered, Baudot detection is available and in the case of silent calls further query can be made.

2) TDD/TTY detectors may be connected to each emergency line ahead of the ACD and TDD/TTY Terminals shall be associated with each attendant position. This method allows Baudot TDD/TTY calls

to be identified even during the ACD queue announcement if the caller presses individual keys several times (see section 5.18.2). When Baudot tones are detected, the detector repeatedly provides an indication (i.e. visual or audible) to the attendant identifying the call as a TDD/TTY call so that when the call is answered the answering attendant is immediately aware of the call. The attendant shall then handle the call using their associated TDD/TTY Terminal. When a detector is used, a Baudot message shall not be recorded in the audio portion of the ACD queue announcement since this would cause false activation of the detector. Instead, the detector shall send the Baudot message following the queue announcement. This may be accomplished by recording a DTMF sequence in the audio portion of the ACD queue announcement that instructs the detector to send the Baudot message.

WARNING: *Any TDD/TTY message transmitted by the PSAP while a call is in queue can cause false TDD/TTY detection to occur at other PSAPs that might be trying to transfer a call to the ACD-equipped PSAP. This usually is only an issue for ACD equipped-PSAPs that are both a primary and secondary PSAP. In such situations it is desirable that provisions be made to either disable TDD/TTY detection during initiation of a transfer or disable TDD/TTY message transmission during reception of a transfer.*

If a recorded announcement is played during the ACD queue, it shall be followed by a recorded Baudot message as in the following example:

"You have reached 9-1-1, please hold for the next available call taker. The following tones are for the hearing impaired. (Baudot message) 9-1-1 busy pls hd"

5.19 Management Information System

It is desirable that the PSAP incorporate some type of Management Information System (MIS). The MIS shall track incoming calls and provide PSAP management personnel with real-time information and strategic management reports. It is desirable that programmed outputs include a system summary report that provides information on the following:

- Number of total calls received
- Number of abandoned calls
- Number of calls on a per trunk basis
- Number of calls on a call type basis
- Number of calls transferred
- Number of call on a per position basis
- Average time to answer
- Average length of call
- Average hold time

In addition to the above information, a desirable feature is to create custom reports from the Call Detail Record (CDR) and non 9-1-1 call information. The system shall be flexible to allow a PSAP manager to produce reports on an as needed basis or scheduled for various time periods (per shift, operator, hour, day, week, month, etc.).

5.20 Multiple ALI Databases

For systems that interface to multiple ALI databases, the CPE may route the ALI requests based on the incoming trunk number. This feature may be used to partition remote and local databases. If this feature is implemented the CPE must be equipped with a pair of ALI database interfaces for each database to be accessed (see Section 3.3). As future requirements increase (e.g. Local Number Portability), the usefulness of trunk-based routing may become diminished and additional capabilities within the ALI database may be required.

6 POWER REQUIREMENTS

6.1 Commercial Power

The system shall supply its own internal working voltage from a standard 115 VAC or 230 VAC commercial source. All power sources shall comply with electrical safety standards and applicable building codes, as well as the environmental requirements listed in Section 7.

6.1.1 Common Power Line Problems

The exposure to power line problems will vary by site. The following anomalies represent the most likely power line problems the PSAP may experience.

6.1.1.1 Transients

A transient (sometimes called a spike) is defined as a high rise-time, high-energy impulse of excess electrical energy lasting less than one half of the cycle of the line voltage sine wave (e.g. <8.33 msec for 60 Hz) and of a magnitude far in excess of the nominal line voltage. They are random events, with no predictable pattern. They include unidirectional impulse transients and oscillatory decaying transients.

The number one cause of transients is the switching on and off of electrical motors within a facility. This includes elevators, AC systems, and office equipment such as copy machines. Other internal causes include relay switching, and transformer inductance impulse due to sudden power loss. Sources of impulse transients that originate externally to the facility include direct hits by lightning or distant lightning hits that travel through transmission lines, grid switching by utility power factor correction capacitors, other users on the line adding or removing loads, or brownouts/blackouts which give a drop in line voltage followed by a high recovery transient.

This power quality problem is addressed by Transient Voltage Surge Suppressors (TVSS). See section 6.4.

Additional information can be found in ANSI \ IEEE C.62.41-1991 “IEEE Recommended Practices on Surge Voltage on Low Voltage AC Power Circuits.

6.1.1.2 Surges

Surges are over voltage conditions that last longer than one half the cycle of the sine wave, and typically for several or many cycles. They are at the same frequency as the sinusoidal supplied voltage frequency (i.e. 60 Hz).

Surges are generally caused when load devices on a line that draw large amounts of current suddenly fail or are shut off, or when utilities switch loads off the line.

This power quality problem is addressed by Voltage Regulators. Consult a qualified power conditioning professional for recommendations.

6.1.1.3 Sags

Sags can be thought of as the opposite of surges. They are characterized by a condition where the peak voltage of the sine wave drops to less than it s nominal value for several or many cycles.

Sags can be caused by large current loads being added suddenly to the line, utility failures or equipment failures. Other causes include ground faults or undersized power systems.

This power quality problem is addressed by Voltage Regulators and Uninterruptible Power Supplies (UPS). Consult a qualified power conditioning professional for regulator recommendations and section 6.2 for UPS's.

6.1.1.4 Noise

Noise is a collective term for various kinds of high frequency impulses that ride on the normal sine wave. It can range from a few millivolts to several volts in amplitude.

Noise can be generated by distant lightning, radio transmissions, various power supplies or appliances. Noise can also be coupled through transmission lines that run in close proximity.

This power quality problem is addressed by filters and sound grounding techniques. Consult a qualified power conditioning or grounding professional for recommendations.

6.1.1.5 Brownouts/Blackouts

Brownouts are long term under voltage conditions lasting minutes or even hours, and blackouts are extended outage conditions, typically zero voltage values, for the same duration’s.

They are caused by ground faults, accidents, or overloaded power distribution systems.

This power quality problem is addressed by Uninterruptible Power Supplies (UPS). Consult section 6.2.

6.1.1.6 Harmonic Distortion

Harmonics are multiples of the fundamental (60 Hz) sine wave. When these harmonics are superimposed upon it, the sine wave becomes distorted due to some cancellation of the normal wave. This distortion can be seen as a loss of usable power to equipment fed by the line.

Harmonics are transmitted back into the AC line by non-linear loads (that is loads that don t draw power in regular sine waves such as computers, FAX machines and variable speed motors). These harmonics can disrupt the operation of other devices connected to the AC line, and cause overheating in some transformers and branch circuits.

This power quality problem is addressed by Harmonic Filters, Transformers designed to trap certain harmonics, or enhancements to the building electrical plant (e.g. over sizing of the neutral conductor). Consult a qualified power conditioning professional for recommendations.

6.1.1.7 Summary

In a national study conducted by IBM Systems Development Division in 1974 titled "Monitoring of Computer Installations for Power Line Disturbances" it was discovered that the power line problems discussed occurred in the following proportions:

Voltage Outages:	0.5%
Under/Over voltages:	11.0%
Impulse Transients:	39.5%
Oscillatory Transients:	49.0%

Using existing technology, these power line problems can be addressed and critical equipment can be protected from damaging events as well as being supplied with a clean reliable power supply. The key lies in applying the appropriate measures to the problems presented, and an understanding of effective utilization of available technologies.

6.2 Reserve Power

In addition to the commercial power source, a reserve battery power supply or UPS shall be available to provide a minimum of 15 minutes of emergency power for full functionality of the following listed elements of the E9-1-1 system. In most cases 15 minutes is sufficient time to bring emergency generators on line. However, if budget permits, it is desirable to extend the 15 minutes to as much as 1 hour.

Listed Elements

- E9-1-1 Call Taker equipment
- ANI and ALI controllers
- ALI link modems and Network interfaces
- Telephone common equipment
- Intelligent workstation (IWS) common equipment
- TDD/TTY Devices
- CDR Printer
- PSAP Master Clock

All other devices shall only be powered by the reserve power source provided that the latter is scaled to support this additional equipment.

Additional information on UPS's can be found in section 13.2.

6.3 Emergency Power

In certain situations, there may be prolonged power outages that exceed the back-up time for the UPS at the PSAP. To satisfy prudent contingency planning procedures, it is recommended that the PSAP be equipped with a source for long-term emergency power. This power source may consist of a redundant utility power feed or a generator sized appropriately to pick up the PSAP's critical loads as detailed previously in section 6.2.

It is recommended that the local utility provider and a qualified power conditioning professional be contacted for consultation.

6.4 Transient Voltage Surge Suppression (TVSS)

When looking at complete site protection from transients, it is important to account for all possible entry and exit points of metallic conductors (e.g. AC power or incoming Telephone lines). Transient Voltage Surge Suppression devices are designed to suppress transient impulses and protect critical E9-1-1 equipment from these damaging events.

Transients can carry varying amounts of energy based on peak voltages and currents, duration's, and wave shapes. Exposure to these transients can be either immediately devastating to critical equipment or cause cumulative damage over time.

6.4.1 TVSS for AC Power Circuits:

A TVSS device must be provided at the commercial power input to the PSAP facility. Ideal placement of such a device will be on the output (load side) of the node that switches between commercial and emergency power (e.g. Automatic Transfer Switch) so that critical equipment is protected when powered from either source. Additional protection may be required downline at essential equipment power distribution panels or at the critical equipment power supplies, whichever applies. Refer to section 13.3, and consult a qualified TVSS provider for recommendations.

6.4.2 TVSS for Data, Signal and Telecommunications Circuits:

When data, signal and/or telecommunications connections are made using copper conductors, it is required that TVSS devices be used on these lines to provide the appropriate level of protection. Where utility-provided gas tube or carbon-block primary protectors exist, it is strongly recommended that secondary TVSS protection be provided. Refer to section 13.3, and consult a qualified TVSS provider for recommendations.

When data, signal, and telecommunications connections are made using fiber optic cabling, TVSS is not required for these conductors. However, it is required to properly ground any metallic sheath or strength member for the fiber cables.

Note: *Criteria for selecting appropriate AC Power, Data, Signal and Telecommunications TVSS devices are listed in section 13.3.*

7 PHYSICAL AND ELECTRICAL ENVIRONMENT REQUIREMENTS

These requirements are in all ways compatible with and at least as stringent as the standards presented in Part 1910 - Occupational Safety and Health Standards (Title 29 - Labor, Chapter XVII - OSHA, L Department of Labor).

7.1 Physical Requirements

7.1.1 Scope of Physical Requirements

This section covers requirements and standards for physical design, manufacturing processes and workmanship that can affect the long-term durability of the PSAP in its normal environment. The supplier shall, upon request, provide documentation that describes the supplier's physical design, manufacturing processes and workmanship requirements applicable to a PSAP. Proof of conformance to Bellcore's Technical Reference TR-TSY-00064 "LSSGR" may be substituted for proof of conformance to any of the specifications in this section.

7.1.2 Temperature and Humidity

All equipment shall remain operational at ambient room temperatures of 40° F to 100° F and relative humidity from 20% to 80%.

7.1.2.1 Recommended Temperature and Humidity

The recommended equipment and operations room temperature is 60° F to 80° F and relative humidity from 40% to 60%.

Note: *Humidity levels below 40% increases the chance for static discharge and may create PSAP equipment failures.*

7.1.3 Altitude

All equipment shall remain operational when installed at elevations between 200 feet below sea level and 10,000 feet above sea level.

7.2 Electrical Environment

Equipment shall meet all of the requirements, e.g., function normally in the presence of, or after subjection to, those electrical environmental conditions or stresses which are designated as "normal" in this section. In addition, the equipment shall meet the requirements of section 7.3, in the presence of, or after subjection to, those electrical environmental conditions or stresses which are designated here as "abnormal". This is necessary so that the equipment does not become a potential source of network harm or a hazard to users. Also, it is desirable that the equipment meet all other requirements when subjected to the "abnormal" conditions or stresses contained herein.

7.2.1 Voltages Due to Commercial Power

7.2.1.1 Induction (Normal)

Induction resulting from magnetic fields surrounding power distribution systems can cause the appearance of longitudinal mode voltages (tip and ring to ground) at 60 Hz and/or 180 Hz (in combination with higher 60 Hz harmonics) at amplitudes normally not exceeding 50 volts rms open circuit. Because the induced voltage is in series with and generally distributed along the loop or metallic facility involved, the longitudinal mode voltage will be a function of the far-end termination of the loop as well as the loop characteristics. At the network interface, the source impedance of induced voltages may be lower than 100 ohms, but, for voltages greater than 50 volts rms, the source impedance will normally (i.e., under non-fault conditions) be at least 400 ohms.

7.2.1.2 Power Line Faults and Line Crosses (Abnormal)

Under power line fault conditions, or with a line cross (i.e., metallic contact between commercial power conductors and telephone cables), protectors normally limit potentials appearing between the tip and ring (or to ground) to no more than 600 volts rms. In most cases, power system fault detectors or telephone line protectors will limit the duration of such voltages to a few seconds. However, they could last indefinitely. Such fault conditions can cause a protector to permanently short either the tip or the ring conductor to ground; thus, the power line fault, line cross voltage, or induced voltage may appear as metallic voltages. The source impedance of the power contact voltage may be as low as 3 ohms; the source impedance of the induced voltage is at least 400 ohms.

7.2.1.3 Electromagnetic Interference (Normal)

Under normal operating conditions, equipment may encounter electromagnetic fields with strengths up to 2 volts per meter and frequencies from 10 KHz to 1.0 GHz. In addition, in some customer locations, field strengths up to 20 volts per meter at frequencies up to 1 GHz have been observed (an abnormal condition). If the terminal cannot function normally in the presence of such fields, instructions for the mitigation of resultant problems shall be provided.

7.2.2 Static Discharge (Normal)

The equipment is subjected to static discharges in a controlled environment of less than 20 percent relative humidity, after drying in this environment, for at least one hour. Discharges are made at a rate that avoids damage to the equipment from their cumulative effects. All equipment interface terminals that may have a path to ground for static discharge currents during operation, including power leads, shall be terminated appropriately. The equipment shall function normally after static discharge simulations. In addition, it is desirable that the equipment not change operating states (except for changes which are momentary and self-correcting) as a result of static discharge simulations.

- Apply 25 discharges through a 150 ohm resistor connected to a 150 picofarad capacitor charged to 4 kilovolts, uniformly distributed over all exposed surfaces except resting surfaces, in each operational state.

- Apply 25 discharges through a 150 ohm resistor connected to a 150 picofarad capacitor charged to 15 kilovolts, uniformly distributed over all exposed surfaces except resting surfaces, in each operational state.

Discharges shall be placed directly on those internal points which are likely to be touched during normal usage, adjustment or field repair; the discharges shall not be applied directly to leads on the transmission interfaces. Maintenance information supplied to field personnel shall contain explicit warnings as to procedures to be followed to prevent electrostatic damage during testing, adjustment or field repair.

The specified discharges are considered normal stress conditions.

7.2.3 Dielectrics

With the equipment in any possible operating state, breakdown shall not occur with a 60 Hz voltage applied between points on the equipment, (i.e., points 1-9) for the combinations listed in Table 3. The voltage is gradually increased from zero to the maximum value in Table 3, over a 30-second time interval, and then applied continuously for 1 minute.

Equipment points are as follows:

1. All exposed surfaces of the equipment (exclusive of securely grounded metal surfaces)
2. Commercial AC power terminals (phase and neutral)
3. Call Taker Position connections
4. ALI Database connections
5. ANI connections
6. Terminals:
   a. For connection to non-registered equipment that can connect to commercial AC power
   b. For connection to non-registered equipment which cannot connect to commercial AC power
7. Terminals for connection to the secondary circuits of a power supply that has a direct connection to commercial AC power
8. Green wire ground terminals
9. Exposed surfaces of handsets, earphones, headsets or their associated cords (exclusive of cord armor directly connected to equipment housings)

COMBINATIONS	*POINTS*	*MAXIMUM VOLTAGE (Volts rms)*
A	from (1) to (2), (4), (5) & (6a)	1500
B	from (1) to (3), (6b) & (7)	1000
C	from (2) to (3), (4), (5), (6a), (6b), (7) & (8)	1500
D	from (3) to (6a), (6b) & (8)	1000
E	from (4) to (6a), (6b) & (8)	1000
F	from (5) to (6a), (6b) & (8)	1000
E	from (3) to (9)	2500

TABLE 3

COMBINATIONS OF ELECTRICAL CONNECTIONS FOR DIELECTRIC BREAKDOWN EVALUATIONS

Breakdown is defined as the voltage at which the peak current is 50% or more greater than the peak current that flowed at a voltage 10 percent less in magnitude. However, for applied 60 Hz voltages, the breakdown voltage shall be considered to have been exceeded if the peak current exceeds 10 milliamperes. Where terminals have an intentional conducting path to ground or each other, the criteria apply without the terminals connected to that path.

7.2.4 Telephone Network Continuity (Normal)

DC loop current interruptions and the establishment of momentary transmission path continuity may occur under normal conditions during the course of a call, as demonstrated below.

7.2.4.1 Call Setup

DC loop current interruptions may occur during call setup regardless of whether the equipment is at the originating or terminating end of the call. These interruptions usually occur within 750 milliseconds (switching interval) after the terminating end of the connection goes off-hook (answer).

Note: They are usually no longer than 350 milliseconds in duration.

7.2.4.2 Network Reswitching

PSAP common equipment intended for compatibility with Central Office customer calling features, such as conference service, are subjected to dc loop interruptions (reswitch) from the local serving central office after the end-to-end talking path has been established. From digital offices these reswitch loop interruptions may be up to 20 milliseconds and are normally shorter than 350 milliseconds. Under abnormal traffic conditions the reswitch interruption from a digital office can exceed 350 milliseconds.

7.3 Safety and Protection

7.3.1 Leakage Currents and Voltages on Exposed Surfaces

For AC, DC and combined AC and DC voltages and currents, under all the normal conditions of applied voltages specified in Section 7.2.3, with the exception of surge voltages, the following limits, with any enclosures, apply:

- The current from any 100 cm^2 (15.5 in^2) area or the entire area, whichever is smaller, of exposed surfaces (exclusive of grounded metal surfaces) flowing through a 1.5 KΩ resistive load to ground shall be less than 0.3 milliamperes peak.
- The current from any 1 cm^2 (0.155 in^2) area of exposed surface (exclusive of grounded metal surfaces) flowing through a 10 KΩ resistor to ground shall be less than 0.15 milliamperes peak.
- The current flowing through a 10 KΩ resistor connected between any two areas of exposed surface (exclusive of grounded metal surfaces) of 1 cm^2 (0.155 in^2) each shall be less than 0.15 milliamperes peak.

For the purpose of determining compliance with these criteria, a conducting surface or metal part shall be considered grounded only if it is securely grounded, e.g., to green wire ground, or to external ground connection (in compliance with NIP-74162). If it is not securely grounded, such a conducting surface shall be considered ungrounded.

7.3.2 Mechanical Safety

These criteria are included to help ensure that equipment is constructed such that it is not hazardous to users, installers or repair persons.

7.3.2.1 Construction

The equipment shall not have any sharp edges, etc. that could be hazardous to the user, installer or repair-person. Assemblies, welds, screws, rivets, etc. shall be secure.

7.3.2.2 Surface Temperature

The temperature of conductive exposed surfaces, including metal covered with thin coatings, shall not exceeded 130 F (54.4 C) at the highest operating ambient temperature of the equipment. However, the temperature of the external conductive surfaces of the equipment that must operate in an ambient temperature as high as 130 F (54.4 C) may reach 135 F (57.2 C).

7.3.2.3 Audible Noise Emission

Equipment noise emission shall not subject user to sound levels greater than those allowed in Occupational Safety and Health Acts (OSHA) regulation 1910.95, considering exposure time and place of installation. It is desirable that the noise level of the equipment is limited to 50 dBA continuously, or 75 dBA intermittently (less than a 10 percent duty cycle), at normal distances as measured on the "A"

scale of a standard sound level meter at slow response. In addition, impulse or impact noise shall not exceed 130 dB peak sound pressure level.

7.3.2.4 Toxic Substances

Plastics used in construction internal to the housing (i.e., not an exposed surface), and plastics used for housings exposed to electrical arcing or experiencing surface temperatures under fault conditions in excess of 170 F (77 C) shall have a limiting oxygen index of at least 28, per American Society of Testing Materials (ASTM) Specification D2863-70. Exceptions allowed are small piece parts, such as bearings and dielectric insulators, not exposed to heat sources or electrical arcing.

7.4 Equipment Wiring

7.4.1 Common Equipment

The common equipment shall be space efficient. All connections shall be accessible for service and control.

It is desirable that equipment should be pre-wired and pre-programmed to the users' specifications in order to minimize on-site installation time.

It is desirable that all interconnecting cables be connectorized at both ends.

7.4.2 Call Taker Positions

The system shall accommodate a wiring distance, from equipment room to dispatch room, of up to 150 feet. It is desirable that transmission extenders be available from the vendor in the case that the wiring distance, from equipment room to dispatch room, is greater than 150 feet.

Interconnections from common equipment to attendant positions shall be made with twisted pairs where appropriate. Consult equipment manufacturer for specific cabling recommendations.

7.5 Grounding

7.5.1 Equipment Ground

The E9-1-1 PSAP equipment vendor shall have detailed specifications for the grounding of their equipment to safeguard personnel from electrical shock hazard, to prevent equipment damage and service interruption, and to provide a reliable zero voltage reference for equipment operation.

Each attendant positions frame/chassis ground shall be electrically isolated from the common equipment to eliminate ground loops due to ground potential differences.

7.5.2 Building Ground

The overall grounding scheme for the building that contains the PSAP equipment is very crucial to the reliability of the PSAP equipment during adverse situations that cause power surges in the building ground system and/or the AC power source. Some of the adverse situations are as follows:

- Lightning Strikes in the vicinity of or directly to the building (PSAPs with transmission towers located close by are very susceptible for a lightning strike)
- Surges encountered on AC power lines due to ground faults

There are many other situations that cause these adverse conditions.

A typical measure of the quality of the overall grounding system is its resistance to the surrounding soil. Contributing factors include soil composition, moisture content, integrity of grounding bonds and conductors to name a few. The National Electric Code allows a resistance to earth value of 25 ohms for a building grounding system. While this is adequate to address human safety concerns many grounding professionals and original equipment manufacturers recommend a lower value of 5 ohms or less.

Because of the importance of the overall grounding scheme of the building containing the PSAP equipment it is **strongly recommended** that the services of a professional electrical engineering consulting company be obtained.

8 INSTALLATION, MAINTENANCE AND ADMINISTRATION

8.1 Installation and Acceptance Testing

Each element of the E9-1-1 system shall undergo a power up period and extensive testing before acceptance by a customer. If required, the vendor shall be prepared to provide qualified technicians to install and test all elements of the E9-1-1 System. Vendor technicians shall also be available to witness and facilitate acceptance test procedures performed by the customer or customer's agent.

8.2 Maintenance

The system shall require minimal periodic maintenance. Examples of periodic maintenance may include:

- Filters
- Batteries
- Fans
- Floppy Drives
- Tape Drives
- Printers

An internal maintenance program shall be provided. This program will allow remote access to system maintainers and provide statistics on overall system performance.

The system shall be capable of determining the integrity of its internal software as part of a self-test routine. Upon detection of a defective software block, the unit shall signal the maintenance program and restart without external intervention.

8.3 Technical Support

The maintenance provider shall provide a 24-hour per day, 7 day per week hotline for emergency technical support. Maintenance provider shall have qualified repair technicians available to perform emergency on site PSAP repair.

8.4 System Security

Maintenance and administrative functions shall be protected by means of the requirement of appropriate passwords; this will ensure that system parameters and subscriber data are well protected.

WARNING: *Security measures shall be taken to guard against unauthorized access into the PSAP equipment. The maintenance provider along with the vendor shall develop a security plan for PSAP access.*

8.5 Spares Provisioning

At a minimum, the maintenance provider shall have access to vendor recommended on-site spares for emergency restoral.

Emergency parts turnaround shall be based on agreement between vendor and maintenance provider.

8.6 Training

The vendor / service provider shall provide comprehensive training programs for E9-1-1 system operators, administrators and maintenance personnel.

The system's operation course shall provide the necessary skills for everyday system operation. The administration course shall cover subscriber management, billing, statistics gathering, etc. The maintenance course shall enable technicians to monitor system integrity and enable them to troubleshoot the majority of problems to the level of board replacement.

8.7 Documentation

Suppliers provided documentation shall be organized and at a minimum include the following sections:

- Documentation Index
- Functional Description
- Installation Manual
- Maintenance Manual
- System Administration Manual
- Position Operator Manual
- Acceptance Test Procedure

8.8 Warranty

The PSAP manufacturer's hardware shall be covered for parts and labor under a two year (minimum) warranty.

9 REGISTRATION REQUIREMENTS

9.1 National Recognized Testing Laboratory (NRTL)

All E9-1-1 PSAP equipment shall be listed with any Nationally Recognized Testing Laboratory (NRTL) and meet either of the following requirements:

- UL 1459 Standard for Telephone Equipment (USA)
- CSA Canadian Standards Association (Canada)

9.2 Regulatory Requirements

All E9-1-1 PSAP equipment shall meet the regulatory requirements of:

- FCC Part 15 for Class A Allowable Data Processing Instrument RFI Emission Levels (USA)
- FCC Part 68 Connection of Terminal Equipment to the Telephone Network (USA)
- IC Industry Canada CS-03 (Canada)

10 QUALITY AND RELIABILITY

This section describes the generic quality and reliability requirements that shall be inherent to all PSAP equipment.

10.1 Reliability Objectives

No single point of failure in any hardware or software component of the E9-1-1 PSAP system shall cause more than 50 percent failure of the E9-1-1 PSAP system.

E9-1-1 PSAP components can be defined as follows:

a) Power Supplies
b) Battery Backup
c) CPUs
d) Trunk Circuit Packs/Components/Servers
e) Position or Station Circuit Packs/Components/Workstations
f) System Network Circuit Packs/Components/Servers
g) System Physical Architecture and Distribution
   Wiring
   Back Planes
   Power Buses
   Data Buses
   LAN/WAN
h) Fusing
i) Any electronic element or device within the E9-1-1 system

The minimum acceptable service for an E9-1-1 PSAP system in the event of a single component failure would be as follows:

a) At least 50 percent of the E9-1-1 trunks and 50 percent of the attendant positions shall be operational and have the minimum following functionality:
   - Audible and visual indication of incoming 9-1-1 call
   - Voice communications with the 9-1-1 caller
b) It is desirable for the vendor to provide at least 50 percent of the 9-1-1 trunks and 50 percent of the attendant positions be operational and have the following additional functionality:
   - ANI information
   - ALI information

Protection switching to redundant components may be required to meet the above outage standards. If protection switching of any E9-1-1 PSAP component is utilized, it must be performed on an automatic basis. There shall be no disruption in the minimum functionality of the calls in progress during switch over.

Note: Consult with Vendor(s) for specific operational impact.

10.2 Reliability Predictions

Upon request, the supplier shall provide reliability predictions performed in accordance with the latest issue of TR-NWT-000332 (Reliability prediction procedure for electronic equipment). Additional predictions based upon other methods or on other failure data may also be provided. Such data however, must be accompanied by supporting information explaining how the failure rates were extrapolated.

Reliability predictions shall include:

- Estimates of downtime per year per component of the PSAP system.
- Computation of maintenance parameters. Because these predictions shall include all failures, regardless of whether or not they affect service, parameters such as overall maintenance frequency, failure rates of non-service-affecting elements, and unavailability of maintenance or performance-monitoring functions are examples of maintenance parameters to be included. Estimates of contributions due to causes other than hardware failures shall also be included, if known.
- Steady state failure rates and infant mortality multipliers for each element of PSAP.

Sufficient supporting documentation must be provided to allow independent verification of the reliability prediction results.

Calculations of downtime and maintenance parameters shall be based on a fully equipped hardware configuration. If more than one such configuration is possible, predictions shall be provided for each significantly different configuration. The reliability model developed to estimate downtime and the assumptions used to construct the model shall be provided.

The description shall include the assumed fault coverage (percentage of faults detected automatically by the PSAP controller) and the assumed fault detection and repair times for any non-alarmed failures. These times include both technician dispatch and on-site repair times and should be consistent with the service provider's maintenance history.

System description documents and architecture information shall be provided by the supplier to enable verification of the reliability model. This information shall include descriptions of the interactions between elements, the effect of an element failure on system operation, the fault detection and recovery schemes, and the effect of non-alarmed failures.

10.3 Hardware and Component Reliability

CPE vendors shall be able to demonstrate their active involvement in a hardware and component reliability process aimed at complying with the following Bellcore requirements: TR-NWT-001252, TR-NWT-000078 and TR-NWT-000357.

The E9-1-1 PSAP supplier shall, upon request, provide documentation that describes procedures, controls and standards utilized for component qualification, vendor qualification, incoming inspection, reliability screening, problem feedback and corrective action.

10.4 Software Quality

CPE vendors shall be able to demonstrate their active involvement in a software quality assurance program aimed at complying with the following Bellcore requirements: TA-NWT-000179. The suppliers of the E9-1-1 PSAP equipment shall permit an analysis of their software as compared to TA-NWT-000179.

Suppliers of E9-1-1 PSAP equipment shall be prepared to address the criteria in Bellcore GR-282-CORE. The extent to which these criteria are imposed will be determined and defined during contract negotiations. It should also be noted that software which is modular or flexible in nature presents users/purchasers with the opportunity to have that software grow or change as their needs grow or change. Modularity and flexibility in this context mean that the size or functionality required in a given application can be modified by inputting parameter changes to the software and then down-loading the software into a larger capacity host configuration. While this asset is not a NENA requirement, it will enhance the supplier's product applicability within the NENA network.

10.5 Manufacturing Quality Program

CPE vendors shall be able to demonstrate their active involvement in a manufacturing quality assurance program aimed at complying with the following Bellcore requirements: TR-NWT-001252.

The manufacturing process, the test and inspection procedures, and the quality programs utilized to produce a PSAP system must be adequate to ensure that technical specifications and customer requirements are met on an on-going basis.

The supplier shall, upon request, provide documentation that describes procedures, controls and standards used for manufacture; in-process testing, final inspection, and testing of the product; calibration and maintenance of tools and test sets; control of non-conforming materials and products; periodic product qualification testing and all other aspects of the quality program.

The supplier shall, upon request, allow an on-site analysis to be performed with respect to the aforementioned quality items (refer to TR-NWT-001252). Such an analysis shall be conducted at the facilities where the PSAP elements are manufactured.

10.6 Customer Verification of Quality and Reliability

The supplier shall, upon request, permit an on-site inspection to verify the on going reliability and quality. This inspection can consist of up to four major activities:

- Analysis of supplier's final test and inspection results that demonstrate conformance to the agreed upon requirements. Such data must be made available prior to the shipment of PSAP elements.
- Monitoring of supplier's quality program and process controls to assure implementation of the supplier's documented quality program.
- Inspection and test of samples of products that are ready for shipment. The sample size shall be based upon quality history and quantities submitted. Testing will be performed by the suppliers at their facilities in the presence of authorized personnel.

- Periodic product qualification testing to assure conformance to design requirements not normally tested in a routine quality control evaluation.

A detailed list of the customer implementations and satisfaction levels of other service providers.

11 TECHNICAL REFERENCES

11.1 Telcordia (formerly Bellcore) Technical References

Document Number	*Description*	*Issue Date*
GR-282-CORE	Software Reliability & Quality Acceptance Criteria (SRQAC)	Issue 1, December 1994.
TA-NPL-000912	Description of the Analog Voice-Band Interface Operating Company Network Interface	Issue 1, February 1989
TR-EOP-000063	Network Equipment-Building System (NEBS) Generic Equipment Requirements	Issue 4, July 1991
TR-NWT-000078	Generic Physical Design Requirements for Telecommunications Products and Equipment	Issue 3, December 1991
TR-OPT-000839	Supplier-Provided Training Generic Requirements	Issue 3, December 1991
TR-TSY-000064	LSSGR, Bellcore	1990
TR-TSY-000350	E9-1-1 Public Safety Answering Point: Interface Between a l/lAESS Switch and Customer Premises Equipment	Issue 1, 1987
TR-EOP-000001	Lightning and 60-Hz Disturbances at the Bell Operating Company Network Interface	Issue 2, June 1987
TR-NWT-000179	Software Quality Program Generic Requirements (SQPR) (A Module of RQGR, FR-NWT-000796)	Issue 2, June 1993.
TR-NWT-000332	Reliability Prediction Procedure for Electronic Equipment (A Module of RQGR, FR-NWT-000796)	Issue 4, September 1992.
TR-NWT-000357	Component Reliability Assurance Generic Requirements for Telecommunications Equipment.	Issue 2, October 1993.
TR-NWT-001252	Quality System Generic Requirements for Hardware.	Issue 1, December 1992.
GR-2945-CORE	Year 2000 Generic Requirements: Systems and Interfaces.	

Telcordia Documents are available from:

Telcordia Technologies, Inc.
Direct Sales
8 Corporate Place, PYA 3A-184
Piscataway, NJ 08854-4156

1-800-521-2673
(732) 699-5800

11.2 Other Technical References

Document Number	*Description*	*Issue Date*
ANSI \ IEEE C.62.41-1991	IEEE Recommended Practices on Surge Voltage on Low Voltage AC Power Circuits	
EIA PN-1663	Telecommunications Device for the Deaf Available from Gallaudet University 1-202-651-5257	Draft 9, June 1986
EIA RS-478	Multi-Line Key Telephone Systems (KTS) for Voice-band Applications	July 1981
EIA RS-232-C	Interface Between Data Terminal Equipment and Data Communication Equipment Serial Binary Data Interchange.	June 1981.
EIA RS-487	Line Circuit (Card) for 1A2 Generic Multi-Line Key Telephone Systems.	September 1982.
EIA/TIA-574	9 Position Non-Synchronous Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange.	September 1990.
EIA/TIA-578	Asynchronous Facsimile DCE Control Standard - Service Class 1.	
FCC Docket Number 6787	Use of Recording Devices in Connection with Telephone Service.	1948
CFR 47 (FCC) Part 68,	Connection of Terminal Equipment to the Telephone Network, of the Federal Communications Commissions "Rules and Regulations"	

Document Number	*Description*	*Issue Date*
Industry Canada (IC) CS-03	Standard for Terminal Equipment, Terminal Systems, Network Protection Devices, Connection Arrangements and Hearing Aids Compatibility	
ITU-T V.18	Operational and Interworking Requirements for Modems Operating in the Text Telephone Mode	September 1994
NTR-74325	NYNEX Generic Requirements for E9-1-1 PSAP Equipment	Issue 1, April 1992
Part 1910	Occupational Safety and Health Standards (Title 29 - Labor, Chapter XVII - OSHA, Department of Labor)	
PL 101-336	Americans with Disabilities Act (ADA) Title II Concerns Public Services. Section 35.162 Concerns Telephone Emergency Services. Call the ADA hotline, 1-800-514-0301 for copies of Title II and the Title II Technical Assistance Manual.	

FCC Documents are available from:

The Superintendent of Documents
Government Printing Office
Washington, DC 20402

National Electric Code
National Fire Protection Association

NEC and NFPA Documents are available from:

Batterymarch Park
Quincy, MA 02266

NYNEX Documents are available from

Telesector Resources Group
Technical Information Management
1095 Avenue of the Americas
New York, NY 10605
(212) 395-8017

12 GLOSSARY

Term	*Definition*
1A2	A designation for Key Telephone Systems that utilize an "A" lead for control.
"A" Lead Control	A wire used to control the Key Telephone Unit in a 1A2 type key Telephone System. In Some E9-1-1 systems it is used to identify the position connected to the trunk.
Alternate PSAP	A PSAP designated to receive calls when the primary PSAP is unable to do so.
American Standard Code for Information Interchange (ASCII)	This standard defines the code for a character set to be used for information interchange between equipment of different manufacturers and is a standard for data communications over telephone lines. In the context of TDD/TTY this refers to both a binary code and a modulation method used for 110/300 baud TDD/TTY communications (per EIA PN-1663).
Attendant Position	The Customer Premises Equipment (CPE) at which calls are answered and responded to by the Telecommunicator.
Automatic Call Distributor (ACD)	Equipment that automatically distributes incoming calls to available PSAP attendants in the order the calls are received, or queues calls until an attendant becomes available.
Automatic Location Identification (ALI)	The automatic display at the PSAP of the caller's telephone number, the address/location of the telephone and supplementary emergency services information.
Automatic Location Identification (ALI) Database	The set of ALI records residing on a computer system. See Appendix A for a full description.
Automatic Location Identification (ALI) Multiplexer	A CPE component that performs the function of communicating with the ALI database. An ALI Multiplexer typically works in conjunction with an ANI controller.
Automatic Number Identification (ANI)	Telephone number associated with the access line from which a call originates.

Term	*Definition*
Automatic Number Identification (ANI) Controller	A stand-alone CPE component which provides the ANI decoding and function key control for 9-1-1 service.
Baud Rate	A measure of signaling speed in data communications that specifies the number of signaling elements that can be transmitted each second.
Baudot Code	A five-bit coding scheme that represents text and digits. It is the standard transmission signaling scheme used by TTY (TDD) devices. (per EIA PN-1663).
Bell Operating Company (BOC)	Individual local telephone companies which were part of the Bell System prior to the 1983 divestiture of AT&T.
Call Sequencer	A unit which monitors incoming calls at a PSAP and indicates to the answering positions which of the incoming calls has been unanswered the longest
Cathode Ray Tube (CRT)	Video monitor used for displaying information.
Central Office (CO)	The Local Exchange Carrier facility where access lines are connected to switching equipment for connection to the Public Switched Telephone Network.
Central Processing Unit (CPU)	The part of a computer that performs the logical, computational and decision making functions.
Centrex	A business telephone service offered by some Local Exchange Carriers that provides PBX type features over access lines.
Computer Aided Dispatch (CAD)	A computer based system that aids PSAP attendants by automating selected dispatching and record keeping activities.
Customer Premises Equipment (CPE)	Terminal equipment at a PSAP.
Data Communications Equipment (DCE)	The designation for RS-232 and EIA/TIA-574 serial communication devices such as modems. Data Communications Equipment (DCE) typically connects to Data Terminal Equipment (DTE).
Decaying	Directions from positive to negative, relative to the starting points, whose transient amplitudes decay with time in a ringwave pattern. These transients are typically caused by sources internal to the PSAP (motor, lighting and inductive loads, etc.)

Term	*Definition*
Data Base Management System (DBMS)	A system of manual procedures and computer programs used to create, store and update the data required to provide Selective Routing and/or Automatic Location Identification for 9-1-1 systems.
Data Terminal Equipment (DTE)	The designation for RS-232 and EIA/TIA-574 serial terminal devices such as data terminals or PCs. Data Terminal Equipment (DTE) typically connects to Data Communications Equipment (DCE)
Directory Number (DN)	A dialable 10-digit telephone number associated with a telephone subscriber or call destination.
Disk Operating System (DOS)	A personal computer operating system that manages the computer's resources.
Dual Tone Multi-Frequency (DTMF)	One of the methods used for signaling in the telephone network. Often referred to as TOUCH-TONE™
Electro-Luminescent Display (ELD)	A type of video display which creates images of graphics or text by direct conversion of electrical energy into light. An alternative to the Cathode Ray Tube (CRT).
Electronic Industry Association (EIA)	A trade organization of manufacturers that sets standards for use of its member companies, conducts education programs and lobbies in Washington for its members' collective prosperity. Also associated with the Telecommunications Industry Association (TIA).
Emergency Medical Service (EMS)	Fire, hospital, poison control, etc. response centers.
Enhanced 9-1-1 (E9-1-1) Control Office	The Central Office that provides the tandem switching of 9-1-1 calls. It controls delivery of the voice call with ANI to the PSAP and provides Selective Routing, Speed Calling, Selective Transfer, Fixed Transfer, and certain maintenance functions for each PSAP. Also known as 9-1-1 Selective Routing Tandem or Selective Router.
Hearing Carry Over (HCO)	A method which utilizes both voice and text communications on the same call, allowing a person who is speech impaired to listen to the other party's conversation and respond by typing via a TTY or other means for text communications.
Impulse Transient	A high-energy unidirectional voltage or current impulse resembling a "spike" which is typically caused by sources external to the PSAP (lightning, grid switching, etc.).

Term	*Definition*
Institute of Electrical and Electronic Engineers (IEEE)	A publishing and standards making body responsible for many telecom and computing standards.
Key Service Unit (KSU)	Equipment that provides ringing, lamp voltages, conference, etc. for multi-line key telephone sets.
Key Telephone System (KTS)	A multi-line telephone system comprised of multi-line telephone sets, KTU's and KSU's.
Light Emitting Diode (LED)	Lamps used for display of information. Commonly used on telephone sets to indicate line status.
Liquid Crystal Display (LCD)	A type of video display that creates images of graphics or text by aligning liquid crystals so that they reflect light. An alternative to the Cathode Ray Tube (CRT).
Local Access and Transport Area (LATA)	The geographical areas within which a local telephone company offers telecommunications services.
LATA Switching Systems Generic Requirements. (LSSGR)	A set of Telcordia (formerly Bellcore) specifications defining the requirements of LATA switching systems.
Logging Recorder	A voice-band audio recorder that records to and plays from a permanent storage media such as tape or disk. Logging recorders are typically multi-channel so as to simultaneously record from several sources.
Login	The process of identifying and authenticating oneself to a computer, ACD or E9-1-1 attendant position system.
Loopback	A type of diagnostic test in which a transmitted signal is returned to the transmitting device and then compared to the original signal.
Management Information System (MIS)	A program that collects, stores and collates data into reports enabling interpretation and evaluation of performance, trends, traffic capacities, etc.
Modem	An interface device that allows digital data signals to be transmitted over analog telephone lines.
Multi-Frequency (MF)	A type of signaling used on analog interoffice and 9-1-1 trunks.

Term	*Definition*
Nationally Recognized Testing Laboratory (NRTL)	Any of several testing laboratories recognized in the United States in accordance with industry and municipal standards.
NNX / NXX	A three-digit code in which N is any digit 2 through 9 and X is any digit 0 through 9. They are the second set of three digits in the North American Numbering Plan.
Non-blocking	A switching network designed to complete all call attempts.
Numbering Plan Area (NPA)	An established three-digit area code for a particular calling area. It takes the form of NXX, where N is any digit from 2 through 9 and X is any digit from 0 through 9.
Numbering Plan Digit (NPD)	A component of the traditional 9-1-1 signaling protocol between the 9-1-1 Control Office and the PSAP CPE. Identifies 1 of 4 possible area codes.
NYNEX Information Publication (NIP)	Information published by the NYNEX telephone company (now part of Bell Atlantic).
Oscillatory	A transient comprised of various impulse transients with alternating characteristics.
Primary Public Safety Answering Point (PSAP)	A PSAP to which 9-1-1 calls are routed directly from the 9-1-1 Control Office. (See PSAP)
Private Branch Exchange (PBX)	A private telephone system that is connected to the Public Switched Telephone Network.
Public Safety Answering Point (PSAP)	A facility equipped and staffed to receive 9-1-1 calls. A primary PSAP receives the calls directly. If the call is relayed or transferred, the next receiving PSAP is designated a Secondary PSAP.
Real-Time	The availability of information at the exact time it is occurring.
Recall Recorder	A voice-band audio recorder that records to and plays from a media that may not be permanent (such as tape loop, fixed disk or RAM). Recall recorders are typically associated with each operator position for the purpose of recording and playing back their most recent conversations. Also known as Call Check or Instant Playback Recorder.
Redundancy	Duplication of components, running in parallel, to increase reliability.

Term	Definition
RS-232C	An electrical and mechanical standard for the serial transfer of digital information between digital systems, such as computers, printers or communications equipment.
Secondary PSAP	A PSAP to which 9-1-1 calls are transferred from a Primary PSAP. (See PSAP)
Selective Routing (SR)	The routing of a 9-1-1 call to the proper PSAP based upon the location of the caller. Selective routing is controlled by the ESN that is derived from the customer location.
Tandem Central Office (Tandem CO)	(See E9-1-1 Control Office)
TDD/TTY Detector	Any device that automatically detects TDD/TTY tones and audibly and/or visually notifies the calltaker.
Technical Advisory (TA)	A type of publication relating to the telephone network as published by Telcordia (formerly Bellcore).
Technical Reference (TR)	A type of publication relating to the telephone network as published by Telcordia (formerly Bellcore).
Telecommunications Device for the Deaf (TDD)	Also known as TTY. See Teletypewriter (TTY)
Telecommunications Industry Association (TIA)	A lobbying and trade association, the result of the merger of the USTA (United States Telephone Association) and the EIA (Electronic Industries Association).
Teletypewriter (TTY)	Also known as TDD. A device capable of information interchange between compatible units using a dial up or private-line telephone network connections as the transmission medium. ASCII or Baudot codes are used by these units. (per EIA PN-1663)
Transfer Key	A key that is programmed to dial a telephone number, a selective routing transfer code, or a speed dial code to accomplish the transfer of calls.
Transient	A random disturbance of normal voltage with a very short time duration (<8.3ms) that occurs on the power source or data/signal/telecommunications conductors.
Transient Voltage Surge Suppression (TVSS)	Devices designed to protect critical PSAP equipment from transients induced on powering and data/signal/telecommunications conductors.

Term	*Definition*
Underwriters Laboratories (UL)	One of several nationally recognized testing laboratories (NRTL) whose testing specifications have been adopted as de facto industry standards.
Uninterruptible Power Supply (UPS)	An auxiliary power unit that provides continuous battery backup power in the event of a commercial power failure.
Voice Carry Over (VCO)	A method which utilizes both voice and text communications on the same call, allowing a person who is hearing impaired to speak directly to the other party and receive response via a TTY or other means for text communications.

13 APPENDICES

13.1 Appendix A - Automatic Location Identification And The Data Management System

13.1.1 Introduction

This appendix describes the Automatic Location Identification (ALI) and Data Management System (DMS) that work in conjunction with E9-1-1.

When an emergency call (Police, Fire, EMS, etc.) is originated by use of the E9-1-1 telephone number, it is connected by an ANI trunk to a PSAP. At the PSAP, the line number of the calling subscriber is identified, displayed and transmitted through a data link interface to the E9-1-1 ALI DMS system. Using the subscriber's telephone number and the numbering plan digit as a key, the ALI DMS retrieves the street address and other data on the subscriber and transmits it back to the PSAP location. The data will then be displayed.

The ALI interface is a dedicated data link interface to be negotiated with the data provider.

13.1.2 Current System Overview

Typical Processing of an Emergency Call with ALI

When a call is received at the E9-1-1 Switch Tandem Office from the Central Office serving the calling subscriber, the call is routed through the selective router (SR) system of that office via an ANI trunk to the PSAP attendant. The call is routed to a position at the PSAP, and the calling telephone number and PSAP position number are sent over a data link to the ALI retrieval system.

The ALI system retrieves the street address data and any other pertinent data stored from the ALI database and sends it back to the PSAP where the PSAP equipment routes the information to the proper attendant position where it is displayed.

13.1.3 Automatic Location Identification (ALI)

The ALI provides street address information for 9-1-1 calls to PSAPs.

An integral part of ALI is database management system. The main functions of the database management system are maintenance of the E9-1-1 database information (MSAG) and the processing of customer data for inclusion in the E9-1-1 database.

After the E9-1-1 database has been prepared and loaded into the system, ALI can respond to requests for location information. The requests are made automatically on a call-by-call basis.

When a subscriber dials 9-1-l, the ANI information corresponding to that calling number is routed to the answering PSAP. At the PSAP the ANI information is forwarded over a data link to the ALI retrieval system. The retrieval system looks up the address associated with the ANI number and sends it, along with the ANI, trunk, and attendant numbers, back to the appropriate PSAP. The equipment at the

PSAP then displays the information to the proper attendant. There shall be a button associated with each attendant position that, when operated, will cause the ALI data to be retransmitted.

13.1.4 Data Management System (DMS)

The DMS contains and updates the database containing subscriber data, and is designed to provide all the necessary data to operate an E9-1-1 / ALI completely.

The DMS software generates SR data for the Tandem switch and Directory Number (DN) records. To accomplish these tasks, a Master Street Address Guide (MSAG), which defines the Emergency Service Numbers (ESNs) for each street range is required. An abbreviated table for street name validation and correction is optional.

The DMS takes each input record and arranges it into a standard format. Then, using the MSAG file, the DN and associated ESN can be passed to the Tandem switch to facilitate SR. The remainder of the input data record and the MSAG file data are used to create the ALI records. The DMS software also provides the capability to assign ESNs on a mass basis. For example, it assigns specific Central Office codes to one ESN or uses a tax code to make the assignments, if possible, in the city or county where the system is deployed.

The DMS also provides database listings, initial runs for the customer modifications (initial MSAG run for ESN assignments), manual update programs for all database files, a mass change capability to handle MSAG changes on a large scale, file backup facilities, statistics, SR database regeneration and other internal functions of Local Exchange Carrier (LEC) switch operations.

DMS software typically runs on a minicomputer. The system allows multiple Database Management Center (DMC) terminal activities simultaneously. For example, two or more operators may be updating, correcting files or running DMS tasks at the same time, provided they are not working on the same file.

Data management System Database

The DMS maintains a database of DN data, street address data and certain other data.

13.2 Appendix B - Uninterruptible Power Supply

Uninterruptible Power Supply

An uninterruptible power supply (UPS) provides electrical power to emergency services equipment in the event of a loss of commercial power at the PSAP. The role of the UPS is to maintain operation of critical components of the PSAP equipment long enough for commercial power or auxiliary generators to come on line and become stable.

Essential equipment must be connected to a UPS or be equipped with internal batteries which are continually charged from main power. If the device is equipped with internal batteries, the batteries must be capable of powering the equipment for a minimum of 15 minutes. The determination of whether or not a particular piece of equipment is designated as essential is addressed in section 6.2.

The UPS shall accept a power Input frequency of 60 Hz ± 3 Hz.

The UPS shall provide an alarm contact or data notification signal to alert PSAP personnel of commercial power loss.

If any of the PSAP equipment requires time to perform a graceful shutdown the UPS shall provide an alarm contact to signal a final shutdown warning. Both the UPS and PSAP equipment providers shall be consulted to determine shutdown requirements.

HOW TO SIZE A UPS

1. Make a list of all equipment to be protected by the UPS. Remember to count monitors, terminals, external data storage devices, and any other critical peripherals.
2. Look at the name plate on the back of each device and record its voltage and amperage requirement. Multiply these figures together to get the Volt/Amps (VA) requirement for each device. For instance a monitor that draws 0.6 amps at 120 volts requires 72 VA. Some devices list their power consumption figure in watts. To convert this figure to VA, simply multiply watts by 1.4.
3. Add the VA requirements for all the system components (1000 VA = 1 KVA)
4. Make sure you leave enough capacity for future growth. To calculate a 25 percent growth factor, multiply your VA requirement by 1.25. This will be the total VA requirement for the UPS.
5. Specify a UPS at least as large as the system's total VA requirement and the up time required.
6. Then, pick appropriate UPS from a vendor’s list of standard sizes.

13.3 Appendix C - TVSS Selection Criteria

13.3.1 AC POWER TVSS

Application Size

For proper operation and performance as well as for safety concerns, the TVSS device shall match the application perfectly.

Required information for AC Power Applications

- Voltage configuration
- Voltage magnitude
- Wiring configuration
- Current draw of protected equipment
- Location of protected equipment within the electrical distribution system.

Appropriate Technology

Only the appropriate technology for the application will provide the level of protection desired without causing damaging effects to the PSAP's critical equipment. While several TVSS technology approaches exist, it is desired that the PSAP install TVSS devices that provide non-degrading

protection while optimizing response time and clamping characteristics. Contact a specialized TVSS consultant to determine the best approach for the PSAP.

Field Reparability

Many surge suppression devices need not be removed from their installed locations for service or maintenance. Generally they are designed for rapid field repair including the ability to service the device while maintaining line voltage to the protected equipment, eliminating down time to critical systems. TVSS devices protecting critical load AC power panel boards must be modular in design to allow for field replacement of "failed" suppression modules.

Redundancy

To ensure continuous, fault tolerant operation it is desirable that the AC TVSS device(s) provide both primary and independent secondary suppression stages.

Agency Approval

AC power devices used must be listed and approved as TVSS products as per appropriate regulatory bodies (UL, CUL, CSA).

Alarm Indication

For AC protection devices a dry contact and a local visual indicator shall be provided to indicate a device failure.

Data/Signal/Telecommunications TVSS Application Size

For proper operation and performance as well as for safety concerns, the TVSS device shall match the application perfectly.

Required information for Data/Signal/Telecommunications circuits

Signal voltage levels, operating frequencies, conductor type and method of termination.

Appropriate Technology

Only the appropriate technology for the application will provide the level of protection desired without causing damaging effects to the PSAP's critical equipment. While several TVSS technology approaches exist, it is desired that the PSAP install TVSS devices that provide non-degrading protection while optimizing response time and clamping characteristics. Contact a specialized TVSS consultant to determine the best approach for the PSAP.

13.4 Appendix D - TDD/TTY Pre-Programmed Messages

13.4.1 Introduction

TDD/TTY devices shall be configured with the following set of default pre-programmed messages: The devices shall allow the customer to modify the default pre-programmed messages as appropriate.

13.4.2 Default Pre-Programmed Messages

The following messages are examples provided by a task force within the hearing impaired community in terms of wording that may be understood by the widest range of the Deaf and Hard of Hearing population.

The underline following the "GA" represents a space. Some messages require further inquiry or directive to follow what is pre-programmed, as indicated by "...."

911 WHAT IS YOUR EMERGENCY Q GA_

WHAT IS YOUR PHONE NUMBER Q GA_

WHAT IS YOUR NAME Q GA_

WHAT ADDRESS TO SEND HELP Q GA_

STAY CALM HELP IS ON THE WAY....

STAY NEXT TO YOUR TTY HD....

CALL BEING TRANSFERRED (GIVE-TO)

TO A MEDICAL PLACE HD...(RINGING)...

Note: *Similar messages can be programmed for other public safety agencies*

Optional/Additional Pre-programmed Messages:

Additional or different messages can be tailored to fit individual PSAP needs. The key is to ask one question at a time and keep language as simple as possible. Examples follow:

WHAT IS YOUR HOME ADDRESS Q GA_

WHERE IS THE EMERGENCY NOW Q GA_

IS ANYONE HURT Q GA_

DOES HE OR SHE NEED MEDICAL HELP Q GA_

WHO IS HURT Q GA_

WHAT KIND OF HURT Q GA_

WHERE DOES IT HURT Q GA_

NAME OF HURT PERSON Q GA_

HOW OLD IS HE OR SHE Q GA_

MAN OR WOMAN Q GA_

IS THE HURT PERSON AWAKE Q GA_

WHAT DOES THE RUN-AWAY CAR LOOK LIKE Q GA_

Note: *In this context, "run-away" is used for a "get-away" vehicle. Other concepts may include a hit and run, or car-jacking.*

WHAT KIND OF RUN-AWAY CAR Q FORD Q CHEVY Q OTHER Q GA_

WHAT COLOR IS THE RUN-AWAY CAR Q GA_

IS ANYONE INSIDE THE RUN-AWAY CAR Q GA_

DOES THIS PERSON HAVE GUN, KNIFE, OR OTHER Q GA_

IS THE WHOLE BUILDING ON FIRE Q GA_

IS THE FIRE IN ONE SMALL PLACE IN BUILDING Q GA_

ARE THERE PEOPLE STUCK INSIDE THE BUILDING Q GA_

HOW MANY PEOPLE ARE STUCK INSIDE THE BUILDING Q GA_

DO YOU KNOW HOW THE FIRE STARTED Q GA_

HOW TALL IS THE BUILDING Q GA_

PLEASE HOLD UNTIL POLICE CAR GETS THERE....

IS THERE A FIGHT Q GA_

HOW MANY PEOPLE IN FIGHT Q GA_

ARE YOU ALONE NOW Q GA_

CAN YOU GO TO YOUR NEXT DOOR NEIGHBORS Q GA_

DO YOU HAVE A DOG Q GA_

DOES YOUR DOG BITE Q GA_

CAN YOU WALK Q GA_

FAMILY OR HUSBAND OR WIFE WE CAN CALL FOR YOU Q GA_

WHAT IS THEIR PHONE NUMBER PLS Q GA_

LEAVE NOW SKSK

The potential exists to receive a TTY call from someone typing in another language. You may consider programming messages in another language such as Spanish. For example:

HELP IS ON THE WAY...
AYUDA ESTA EN CAMINO (in Spanish)

STAY ON THE PHONE...
QUEDESE AL TELEFONO (in Spanish)

13.5 EIA DB-25 AND DE-9 LEAD DESIGNATION

13.5.1 DB-25

Lead	*Label*	*DTE*		*DCE*	*Function Name*	*CCITT*	*EIA*
1	FG				Frame Ground	101	AA
2	TD	Output	⇨	Input	Transmit Data	103	BA
3	RD	Input	⇦	Output	Receive Data	104	BB
4	RTS	Output	⇨	Input	Request To Send	105	CA
5	CTS	Input	⇦	Output	Clear To Send	106	CB
6	DSR	Input	⇦	Output	Data Set Ready	107	CC
7	SG				Signal Ground	102	AB
8	CD	Input	⇦	Output	Carrier Detect	109	CF
9		Input	⇦	Output	Positive DC Test Voltage		
10		Input	⇦	Output	Negative DC Test Voltage		
11					Unassigned		
12	(S) CD	Input	⇦	Output	Secondary Carrier Detect	122	SCF
13	(S) CTS	Input	⇦	Output	Secondary Clear To Send	121	SCB
14	(S) TD	Output	⇨	Input	Secondary Transmit Data	118	SBA
15	TXC	Input	⇦	Output	Transmit Clock	114	DB
16	(S) RD	Input	⇦	Output	Secondary Receive Data	119	SBB
17	RXC	Input	⇦	Output	Receive Clock	115	DD
18		Output	⇨	Input	Receiver Dibit Clock		
19	(S) RTS	Output	⇨	Input	Secondary Request To Send	120	SCA
20	DTR	Output	⇨	Input	Data Terminal Ready	108.2	CD
21	SQ	Input	⇦	Output	Signal Quality	110	CG
22	RI	Input	⇦	Output	Ring Indicator	125	CE
23		Output	⇨	Input	Data Rate Select	111/112	CH/CI
24	EXT	Output	⇨	Input	External Transmit Clock	113	DA
25	BO	Output	⇨	Input	Busy		

13.5.2 DE-9

Lead	*Label*	*DTE*		*DCE*	*Function Name*
1	CD	Input	⇦	Output	Carrier Detect
2	RD	Input	⇦	Output	Receive Data
3	TD	Output	⇨	Input	Transmit Data
4	DTR	Output	⇨	Input	Data Terminal Ready
5	SG				Signal Ground
6	DSR	Input	⇦	Output	Data Set Ready
7	RTS	Output	⇨	Input	Request To Send
8	CTS	Input	⇦	Output	Clear To Send
9	RI	Input	⇦	Output	Ring Indicator