NENA Generic E9-1-1 Requirements Technical Information Document (TID)

NENA Generic E9-1-1 Requirements Technical Information Document
Issue 1, July 23, 2004

Prepared by:
National Emergency Number Association (NENA) VoIP E9-1-1 Requirements Working Group

Published by NENA
Printed in USA

NENA
TECHNICAL INFORMATION DOCUMENT

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Acknowledgments:

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1 Executive Overview

1.1 Purpose and Scope of Document

This document is intended to provide a resource that describes the features and functions of the E9-1-1 system that is currently deployed in the United States. These features and functions are a compilation of different regional networks and some may not be present in any particular E9-1-1 network.

1.2 Reason for Issue

This document is issued to serve as a reference for communications service providers that play a role in the processing and/or routing of emergency 9-1-1 calls. This document is intended to provide a starting point, or "check list" of what features and functions need to be addressed to support 9-1-1 calls.

1.3 Reason for Reissue

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

1.4 Recommendation for Standards Development work

This document is intended to be a reference document to existing Standards work that is available. No Standards Development is required in support of this document.

1.5 Costs Factors

Not Applicable.

1.6 Acronyms/Abbreviations

This is not a glossary! See NENA Master Glossary of 9-1-1 Terminology located on the NENA web site for a complete listing of terms used in NENA documents.

The following Acronyms are used in this document:	
ACD	Automatic Call Distribution
ADA	American with Disabilities Act
ALI	Automatic Location Identification
ANI	Automatic Number Identification
ANSI	American National Standards Institute
ATIS	Alliance for Telecommunications Industry Solutions
BRI	Basic Rate Interface
CAD	Computer Aided Dispatch
CAMA	Centralized Automatic Message Accounting
CLEC	Competitive Local Exchange Carrier
CPE	Customer Premises Equipment

The following Acronyms are used in this document:	
CW	Call Waiting
DBMS	Database Management System
DID	Direct Inward Dialing
DN	Directory Number
DOD	Direct Outward Dialing
DP	Dial Pulse
DTMF	Dual Tone Multi-Frequency
E9-1-1	Enhanced 9-1-1
ELIN	Emergency Location Identification Number
ESCO	Emergency Service Central Office
ESN	Emergency Service Number
ESQK	Emergency Services Query Key
ESRD	Emergency Services Routing Digits
ESRK	Emergency Services Routing Key
GIS	Geographic Information Systems
GMLC	Global Mobile Location Center
IAM	Initial Address Message
IN	Intelligent Network
ISDN	Integrated Services Digital Network
MF	Multi-Frequency
MIS	Management Information Systems
MPC	Mobile Position Center
MSAG	Master Street Address Guide
MSC	Mobile Switching Center
NPA	Numbering Plan Area
NPD	Numbering Plan Digit
pANI	Pseudo Automatic Number Identification
PBX	Private Branch Exchange
PRI	Primary Rate Interface
PS/ALI	Private Switch/Automatic Location Identification
PSAP	Public Safety Answering Point
SCP	Service Control Point
SOI	Service Order Input
SRDB	Selective Routing Database
SS7	Signaling System No. 7
SSP	Service Switching Point
TDD/TTY	Telecommunications Device for the Deaf/Teletypewriter
TID	Technical Information Document
TN	Telephone Number
TWC	Three-Way Calling
VoIP	Voice over Internet Protocol
WCM	Wireline Compatibility Mode

The following Acronyms are used in this document:	
WSP	Wireless Service Provider

2 E9-1-1 Generic Features and Functions

2.1 Network Features and Functions

2.1.1 Emergency Call Detection

Emergency Call Detection is the process of determining, based on information received via incoming signaling, that a call should be considered and processed as an Emergency (i.e., 9-1-1) Call. This function will be performed at a number of points in the call path, as described below.

2.1.1.1 Emergency Call Detection at Originating Node

In the current E9-1-1 Service architecture, one point at which Emergency Call Detection will be performed is at the node where the call originates. Emergency Calls are detected at wireline end offices and Mobile Switching Centers (MSCs) based on information received in incoming signaling. For wireline end offices, this information will be in the form of Dual Tone Multi-Frequency (DTMF) digits, Dial Pulse (DP) signaling, information elements in an ISDN SETUP message, parameters in a Signaling System No. 7 (SS7) Initial Address Message (IAM), or incoming Multi-Frequency (MF) signaling. Emergency Call detection at MSCs will be based on information received via the base station over the air interface. If an end office/MSC detects that the called number associated with a call origination consists of the digits "9-1-1," it shall consider the call to be an Emergency Call. Based on translations at the end office/MSC, originating calls placed to specific numbers of the form "NPA-NXX-XXXX" or "NXX-XXXX" may also be treated as Emergency (i.e., 9-1-1) Calls, as determined by the service provider. Upon detecting that an originating call is an Emergency Call, the end office/MSC shall perform preliminary routing, as described in Section 2.1.2.1.

2.1.1.2 Emergency Call Detection at Tandem Node

Although direct trunking between an originating end office/MSC and the node that performs Selective Routing (i.e., E9-1-1 tandem) is preferred, the call connection may include a tandem switch (e.g., Access Tandem) between the end office/MSC and the E9-1-1 tandem. If the connection includes a tandem switch, the tandem switch will identify that the call is an Emergency Call based on the called number received in incoming signaling and/or the incoming trunk group. The tandem switch will be expected to apply normal trunk selection procedures, based on the called number information or the incoming trunk group, and to signal forward to the extent possible, unchanged, any call setup information received in incoming signaling.

2.1.1.3 Emergency Call Detection at Node Performing Selective Routing Functionality

Emergency Calls shall be detected at the node responsible for performing Selective Routing functionality (e.g., E9-1-1 tandem or "Selective Router"), based on information received in the digits "9-1-1" are received as the called number for the call (e.g., via MF signaling, in an SS7 Called Party Number parameter, or via access signaling, for calls originating at the Selective Router), the Selective Router shall treat the call as an Emergency (i.e., 9-1-1) Call. If the call comes into the Selective Router over a dedicated trunk group (where the digits of the called number may be set to "9-1-1," "1-1," "1," or where no digits are present), the Selective Router shall treat the call as an Emergency Call. If the Selective Router receives a called number of the form NPA-NXX-XXXX or NXX-XXXX in incoming call setup signaling, and switch translations at the Selective Router, other information signaled with the call (e.g., SS7 Calling Party's Category), or the incoming trunk group (for certain wireless call scenarios involving dedicated trunk groups, where the cell site/sector information is signaled as the called number) indicate that calls to that number should be treated as 9-1-1 calls, the Selective Router shall consider the call to be an Emergency Call. Once the Selective Router has detected the Emergency Call, it shall apply Selective Routing, as described in Section 2.1.3 below.

2.1.2 Emergency Call Routing

Once an Emergency Call has been detected, call routing procedures will be initiated. If the call has been detected at a wireline end office or MSC, preliminary routing will be performed prior to Selective Routing being applied. If the call has been detected at a Selective Router (e.g., E9-1-1 tandem), Selective Routing will be initiated. As described in Section 2.1.1.2, when an Emergency Call is detected at a tandem switch, normal call routing shall be applied.

2.1.2.1 Preliminary Routing (i.e., Routing to the E9-1-1 Tandem/Selective Router)

Preliminary routing is the set of procedures performed by an originating node (e.g., wireline end office or MSC) to route a call determined to be an emergency call to the network element responsible for performing selective routing on that call (e.g., the E9-1-1 tandem). Today, wireline end offices and MSCs use trunk group translations, based on the dialed/called number to select an outgoing trunk to the E9-1-1 tandem. Implicit in these translations is the logic that associates the originating location of the emergency call with the appropriate E9-1-1 tandem that is responsible for processing calls from that location. Whether implicit in trunk group translations or part of emergency call processing service logic, it is required that emergency calls be routed to the appropriate Selective Router/E9-1-1 tandem, based on the calling number/location of the caller. Today, the trunk group selected for routing 9-1-1 calls from an end office or MSC to an E9-1-1 tandem are typically dedicated MF or SS7-controlled trunk groups. When the emergency call is routed to/toward the Selective Router over a dedicated trunk group, it is expected that the called number, calling number/Emergency Services Routing Key (ESRK) and/or Automatic Number Identification (ANI)/charge number will be signaled with the call. If the ANI/charge number is signaled, MF ANI II digits or an SS7 Originating Line Information Parameter (OLIP) will also be signaled. Location information (consisting of Emergency Services Routing Digits [ESRD]) is also expected to be signaled for 9-1-1 calls that are identified as "wireless." If available for a wireline 9-1-1 call, location information in the form of an Emergency Location Identification Number (ELIN) may also be signaled with

the call. See ANSI T1.628 and GR-2956-CORE for details related to the use of SS7 signaling for 9-1-1 calls.

2.1.2.2 Backup Routing/Diverse Routing Support

NENA strongly recommends the use of alternate or diverse routing and diverse facilities in order to avoid single points of failure. As specified in NENA TID 03-501, Network Quality Assurance, there should be at least two trunks from each end office to the E9-1-1 tandem, and these trunks should be route diverse. If the E9-1-1 Network architecture involves mirrored E9-1-1 tandems, each member of the mirrored pair should be viewed as if it were not in a pair. That is, route diversity is recommended for each E9-1-1 tandem in the mirrored pair. In some existing implementations, if an end office is unable to route a 9-1-1 call to an E9-1-1 tandem over SS7-supported trunk group (e.g., due to signaling failure or trunks being taken out of service), it may attempt to route the call via a backup MF trunk group. Regardless of whether the backup trunk group is MF or SS7-supported, translations in the end office should be set up to select a physically diverse backup trunk group over which to route an Emergency Call if the end office is unable to route the 9-1-1 call to the E9-1-1 tandem over the primary trunk group.

2.1.3 Selective Routing

The process of Selective Routing uses call identification or location information received with the Emergency Call to determine the correct Public Safety Answering Point (PSAP) toward which to route the call, along with other Emergency Service Number (ESN) information (e.g., whether a "flashing ANI display" should be used when the calls are delivered to the PSAP). This determination may be influenced by the time of day at which the Emergency Call is detected. In today's implementations, an E9-1-1 tandem will interact with a Selective Routing Database (SRDB) to selectively route a 9-1-1 call to the correct PSAP. For wireline 9-1-1 calls, the SRDB will use either the calling number or the billing/charge number associated with the call (as specified by the E9-1-1 Network provider) as the key to the Selective Routing data, assuming that no location information has been received by the E9-1-1 tandem with the call.[1] Note that if only one of these pieces of information is available (i.e., charge number or calling number), that number should be used as input to the selective routing process. The same processing applies to calls from wireless networks, where the Wireless Service Provider (WSP) uses the Wireline Compatibility Mode (WCM)[2] approach for wireless Emergency Calls, and an ESRK is signaled as the calling number. For wireless calls, where a calling number and Phase I location information (ESRD) is signaled with the call, or for wireline calls where location information is received in incoming signaling, Selective Routing will be based on the location information. The PSAP destination determined as a result of the Selective Routing process is typically expressed in terms of an ESN.

[1] If location information is included in call setup signaling associated with a wireline call, it is expected that the received location information would be used as the key to the Selective Routing data in the SRDB.

[2] When WCM is used, the signaling associated with the call identifies it as a non-wireless call. The E9-1-1 tandem applies the same processing to these calls as it would to an incoming wireline call from a wireline end office.

2.1.3.1 Default Routing

If the Selective Routing process cannot be performed because sufficient information is not received with the call to support the Selective Routing process (i.e., an ANI failure occurs), the E9-1-1 tandem will route the call based on a default PSAP Directory Number (DN)/Routing Number identified by the E9-1-1 tandem. In today's E9-1-1 implementations, the identification of a default PSAP DN is typically based on the incoming trunk group for the call in ANI failure scenarios. If ANI is available at the E9-1-1 tandem, but selective routing information is not available for the given ANI, the SRDB may determine a default ESN based on other factors, and return this ESN value to the E9-1-1 tandem for use in subsequent emergency call processing.

2.1.3.2 Alternate/Overflow Routing

Alternate/Overflow routing allows an E9-1-1 tandem to temporarily redirect 9-1-1 calls to a pre-designated alternate PSAP when the primary PSAP is not available to take calls (e.g., because it is either traffic busy, or has activated night service), or due to a network failure that impacts connectivity to the PSAP.

Alternate Routing may be invoked/cancelled either by the PSAP that receives the alternate-routed calls, or the PSAP from which calls are to be alternate-routed. In other cases, an authorized PSAP party may call the E9-1-1 Service Provider to have Alternate Routing invoked at the E9-1-1 tandem. Notification that Alternate Routing has been invoked/cancelled is provided to the PSAP from which calls have been redirected. Alternate Routing can only be invoked for a particular PSAP by that PSAP, or by a PSAP that is authorized by previous policy agreements to receive calls for that PSAP. Alternate Routing is cancelled by the affected PSAP, or by the PSAP that has previously invoked it. The way that Alternate PSAPs are identified by the E9-1-1 tandem is currently switch dependent.

Make Busy or Night Service is a sub-feature of alternate routing. Make Busy Routing enables a PSAP to use a two-wire night transfer/alternate answer circuit to reroute 9-1-1 traffic when activated by PSAP personnel, possibly based on a specific schedule. As described in Section 2.0 of NENA-04-001, Night Service is a standard feature available to a PSAP that results in all calls directed to that PSAP being automatically forwarded to an assigned DN associated with a secondary PSAP or other destination.

Redirection of calls from one PSAP to another destination may be invoked implicitly by the E9-1-1 tandem based on certain conditions, e.g., all trunks to the PSAP are busy. This is sometimes referred to as "Overflow Routing." Overflow routing may result in 9-1-1 calls being routed to an administrative line associated with the primary PSAP, rather than to a different PSAP.

2.1.4 Call Delivery to the PSAP

Once a directory/routing number for the target PSAP has been identified, the E9-1-1 tandem shall deliver the voice call to the PSAP, along with the following types of information:

- Callback Information: Callback information may be delivered to the PSAP with the voice call. Today, this information takes the form of an E.164 Callback Number consisting of a

7/10-digit calling number/ANI. For 9-1-1 calls, the calling number/ANI associated with the calling station will be automatically forwarded to the PSAP and shown on a display within the attendant position. If a 7-Digit ANI is delivered with the call, 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. If the interface to the PSAP supports the delivery of a full 10-digit ANI, the NPA-NXX-XXXX of the ANI will be provided to the PSAP. 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 (see description of Special Handling Indication below). (See Section 2.6 of NENA-04-001.)

- Location Query Key: The information delivered to the PSAP with a 9-1-1 call will include a key that can be used by the PSAP to query an Automatic Location Identification (ALI) database. This information may consist of an ESRD, an ESRK, or an Emergency Services Query Key (ESQK). Depending on the type of call, the network interconnection arrangements, and the capabilities of the Network-to-PSAP interface, a Location Query Key may be delivered along with a Callback Number, or without a Callback Number. If only a Location Query Key is provided (i.e., without a Callback Number), it is assumed that callback information will be made available as a result of the location query. It is also possible that a Callback Number will be provided without a separate Location Query Key. When only a Callback Number is provided, it is assumed that the Callback Number will also serve as the Location Query Key.

- Special Handling Indication: Along with an incoming 9-1-1 call, a PSAP may receive an indication that the call requires special handling. This is done today via the ANI I/II digit(s) signaled to the PSAP using MF/Enhanced MF signaling. Today, certain ANI I/II digit values signal to the PSAP CPE that a flashing ANI display should be applied to the incoming call. The inclusion of this information is associated with ESN translations in the E9-1-1 tandem today. A flashing display may be used to indicate special conditions associated with the call (e.g., that alternate routing has been applied).

In addition to the information that is explicitly signaled to the PSAP along with 9-1-1 calls, there is other information that is associated with incoming 9-1-1 calls today, that is based on the incoming trunk group.

- Emergency Call Indication: Although implied by the use of a given 9-1-1 trunk group today, it is necessary that the PSAP be able to identify an incoming call as a 9-1-1 call.

- PSAP Identifier: Successful delivery of the 9-1-1 call requires the identification of the target PSAP for the call. Today, this is accomplished by delivering the call via a certain trunk group.

The number of trunks between each E9-1-1 tandem and each PSAP varies according to traffic volumes and the needs of the E9-1-1 Network provider and the PSAPs being served. NENA recommends that there should be at least one more trunk between the E9-1-1 tandem and the PSAP as there is from the largest end office to the E9-1-1 tandem.

2.1.5 Release of Emergency Calls

It is critical that the connection to the PSAP be released immediately when a PSAP disconnects from a call so that other Emergency Calls can be received. Therefore, when the E9-1-1 tandem receives a disconnect from a PSAP related to an Emergency Call, the E9-1-1 tandem should immediately release the circuit, and pass the appropriate signaling indication in the backward direction. This capability is referred to as Forced Disconnect. Forced Disconnect prevents a calling party, which remains off-hook from indefinitely holding the connection to a PSAP. It allows a PSAP call taker 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. (See Section 2.8 of NENA-04-001.)

2.1.6 Emergency Call Transfer

Central Office Transfer is a standard service available to most PSAPs. This service provides the capability for an established 9-1-1 call to be transferred by the PSAP call taker, via the E9-1-1 tandem, to another destination, such as a PSAP or Poison Control Center. The destination number may be within the E9-1-1 network or part of the PSTN. A call transfer is accomplished at the E9-1-1 tandem via a 3-way conference connection involving the calling party, primary PSAP, and the desired destination. The emergency caller should not be placed on hold while the transfer is being established. If the transfer is to a destination outside of the primary E9-1-1 tandem, the call must carry an indication that it is an Emergency Call, along with the calling number/ANI of the original caller (assuming this information is known by the primary E9-1-1 tandem), and any location information that might have been received by the primary E9-1-1 tandem in incoming call setup signaling.

As described in Section 2.5 of NENA-04-001, three types of Central Office transfer services (selective, fixed, manual) may be available singularly or in combination.

2.1.6.1 Selective Transfer

Selective transfer is a feature of the E9-1-1 network, which allows an established 9-1-1 call to be selectively transferred to a secondary PSAP by the PSAP call taker. This feature allows the call taker to initiate a transfer associated with a particular type of service (such as to Fire, Police, Poison Control, etc) which causes the E9-1-1 tandem to automatically determine the designated secondary PSAP to serve the calling station and affect the transfer to the secondary PSAP. (See Section 2.5.1 of NENA-04-001.)

2.1.6.2 Fixed Transfer

Fixed transfer is a service that allows an established 9-1-1 call to be transferred by the PSAP call-taker to a limited number of destinations (such as Fire, or Animal Control). The destinations are determined by the call-taker, and not a function of the ANI DN. To initiate a Fixed Transfer, the PSAP operates a particular key associated with the desired destination. (See Section 2.5.2 of NENA-04-001.)

2.1.6.3 Manual Transfer

Manual transfer allows the PSAP call taker to manually enter in the DN or Speed Call code of the destination to which the 9-1-1 call will be transferred. (See Section 2.5.3 of NENA-04-001.)

2.1.6.4 Call Bridging/Conferencing

Call Bridging/Conferencing functionality may be invoked in the context of Call Transfer to establish a 3-Way-Call/Transfer with the secondary PSAP or other destination. In addition, conferencing of an incoming call with a language interpretation service may be requested by a PSAP (see Section 2.6.5 for further discussion). Today, Call Bridging/Conferencing functionality resides at the E9-1-1 tandem.

2.2 Network Performance

The E9-1-1 network should be developed with the goal in mind to provide the best service possible to the callers and the PSAPs based on legal, regulatory, and service requirements.

2.2.1 Call Setup Times

Call setup time is a primary concern of both callers and public safety agencies. In panic situations callers have been known to hang up and re-dial, or call other emergency numbers when they feel that their 9-1-1 call is not processing. This is one primary reason why many systems are moving from CAMA signaling toward SS7 signaling (in the end office to router environment), as it reduces call setup time, increases call-through testing capabilities, and decreases incidents where the caller ANI is garbled or lost.

The router-to-PSAP portion of the network is still predominantly a CAMA-like (GR-350-CORE) or Enhanced MF (NENA 03-002, GR-2953-CORE, and GR-2956-CORE) signaling format that takes several seconds to deliver the call to the PSAP. There are no universally available standard alternatives available to deliver calls toward the PSAP with a faster technology at this time. While ISDN is available in some situations, the delivery technique is sometimes proprietary in nature, and not available across all types of selective router platforms.

In the future it is likely that the delivery of a call toward a PSAP may use VoIP type technologies. This could not only reduce call setup time, and decrease reliance on dedicated point-to-point circuits, but it could also increase call throughput in the 9-1-1 network.

2.2.2 Performance Monitoring

As indicated in Section 6.3 of NENA TID 03-501, *Network Quality Assurance*, NENA strongly recommends that all E9-1-1 networks be monitored for proper service levels and allow for proactive steps to be taken in the event of a failure. Procedures should be developed and implemented to monitor all voice and data circuits that support 9-1-1 processing. Each member of the 9-1-1 network should monitor the performance of the network, and resolve issues, or notify other parties of issues for resolution.

In most cases, there are established procedures for PSAPs or callers to report troubles (mis-routes, record not found displays, or circuit troubles) to their E9-1-1 system service provider. Note that as more and more telecommunications providers are part of the system, trouble reports may need to be sent directly to the party who needs to resolve the issue, rather than relying solely on the 9-1-1 service system provider to resolve all issues.

2.3 Network Traffic Management

The E9-1-1 network is a balance of providing services to the public and to the PSAPs taking emergency calls.

2.3.1 Congestion Control

Congestion Control (formerly referred to as "choking") is the concept of sizing the E9-1-1 network for a traffic load that meets expected upper limits, but prevents mass quantities of calls (from a single incident or location) from blocking calls from other areas or telephone switches within the network. Congestion control is described further in NENA 03-006.

2.3.2 Traffic Reporting

Traffic reporting involves the collection of traffic data (e.g., peg count, usage, overflow) relating to such things as trunks, simulated facilities, queues, agents, etc. Counts are typically collected at the selective routing switch, over a specified interval (e.g., 30 minutes, hourly, continuous), and transmitted to the customer premises where they are displayed/recorded. As described in NENA-03-xx, *Generic Requirements for an Enhanced 9-1-1 Selective Routing Switch*, an optional feature at the selective routing switch would be to provide call tracking, which would include reports and call statistics (e.g., when the call was delivered to the PSAP, when the PSAP answered, if/where the call was transferred, when the transferred call was answered, the ANI or ESCO associated with the call, etc.).

2.3.3 Default Routing

Each incoming trunk group to an E9-1-1 Selective Router is defined with a particular "default" PSAP. Calls that are delivered without ANI, or in a way that the selective router cannot determine a correct location for the call would be routed to the PSAP associated with the incoming trunk group that the call arrived on.

Customer or regulatory requirements often dictate from what areas 9-1-1 calls can be delivered over E9-1-1 trunk groups that are installed from wireless carriers or Competitive Local Exchange Carriers (CLECs) with large "service territory footprints" to assist in default routing and congestion control.

2.3.4 Multiple Trunk groups between common endpoints

If customer or regulatory rules govern the system as outlined above, then telecommunications service providers may need to establish multiple (parallel) trunk groups between the same end point switches. This would be necessary if the 9-1-1 system requires the smaller (or more traffic selectivity on a trunk group) so that they reduce or eliminate the risk of being a default location for another 9-1-1 system.

In addition, this method is also used to reduce the size of trunk groups, so that there is more effective congestion control, and there are fewer instances where a single incident from one location will either block calls to the router that would be received by an adjoining system, or would flood the PSAP so that it blocks calls from other offices within their same E9-1-1 system.

2.4 Network Maintenance

The 9-1-1 network has evolved to have a large number of maintenance and testing capabilities. Each telecommunications service provider and PSAP manager should establish practices, and manage the network under their control to maximize the information that they are provided on its integrity.

This includes (but is not limited to) having end offices and selective routers have capabilities to make test calls, trace calls, obtain traffic reports, idle and make trunks busy, remotely test circuits, receive trouble reports and out of service alarms, and monitor traffic over those circuits.

2.4.1 Test Call Capability

One particular network maintenance function has been the ability for a testing person to make an "anonymous" call to a PSAP trunk group or circuit. The 9-1-1 system would deliver a phone number of 911-0000 as the ANI to the PSAP to indicate that this call was delivered through a "back-door" route into the PSAP, and was NOT originated by dialing the code 9-1-1. Unfortunately, with the provision of wireless service, telematics, and other conditions where PSAPs transfer calls from one selective router to another, this has lost its original meaning.

In far too many cases the anonymous call has turned into an alternative method to deliver a 9-1-1 call to a PSAP, and often is used to over-ride congestion control limits, or as an alternative to network survivability planning and implementation. In other cases, sales calls, or even malicious or harassing calls are directed toward the PSAP with this technique.

In most cases, the 9-1-1 service provider can arrange to change, or disallow calls to the anonymous routing numbers, so as to prevent the misuse of this service, which also could block bona-fide 9-1-1 calls over dedicated 9-1-1 facilities from reaching the proper PSAP.

2.4.2 Trouble Reporting

As described in Section 4.2 of NENA 03-xx, *Generic Requirements for an Enhanced 9-1-1 Selective Routing Switch*, a selective router shall be able to generate alarm messages to maintenance personnel to alert them of potential problems, call failures, or routing troubles. These messages shall include sufficient information (e.g., the caller's ANI, the called number, the originating trunk group, the trouble that was encountered) to allow the E9-1-1 system service provider to locate and resolve the problem.

2.5 Reliability and Quality

As described in NENA TID 03-501, *Network Quality Assurance*, single points of failure in the 9-1-1 network are unacceptable, and network and Emergency Services providers are expected to design and deploy fault tolerant systems to eliminate, as much as possible, single points of failure that prevent routing 9-1-1 calls successfully. For example, a selective routing switch should be designed to be sufficiently robust and reliable that a single network component failure does not cause a significant or complete network failure. In addition, alternate or diverse routing and diverse facilities should be used so that the failure of any single network element cannot interrupt E9-1-1 Service to all trunks in a group. There should be at least two trunks from each central office to the selective routing switch, and these trunks must be route diverse. These circuits from the selective routing switch to the serving wire center of the PSAP should also be route diverse, where available. Where each PSAP is connected to two different ALI host computers for diversity and redundancy, one circuit from the PSAP to each ALI host computer is required.

2.5.1 Minimum Quality of Service Standard

NENA TID 03-501 recommends that 9-1-1 trunk groups be designed at a minimum of P.01 Grade of Service (i.e., designed so that only one call out of one hundred will be blocked during the average busy hour).

2.6 PSAP Functions

2.6.1 Automatic Call Distribution

Automatic Call Distribution (ACD) can be premises-based as a software generic for the PSAP call handling Private Branch Exchange, or can be central office-based in the 9-1-1 selective router. ACD allows for an even presentation of calls to the call-takers at the PSAP call center, generally to the most idle station. This feature allows the call center to accurately assess the shift personnel requirements. ACD also enables incoming calls to go into a queue status pending answering. This feature is generally only present in large volume PSAP call centers.

2.6.2 Obtain Call Information (e.g., caller identification, caller location)

Equipment at the PSAP must be capable of decoding the incoming ANI digits and automatically presenting them to the call-taker while also utilizing the digits to query the ALI host for automatic location information that will be presented to the call-taker. Location information received by the PSAP in response to an ALI query shall be MSAG-validated.

2.6.3 Callback

The number presented to the PSAP call-taker, either by the ANI display or embedded within the ALI text, should be a dialable number for the person initiating the call for emergency assistance.

2.6.4 Initiation of Call Transfer

The PSAP should ideally be able to transfer a call with a single push of a button or a click of the mouse on a workstation. This initiation consists of a 500 millisecond flash to the router to establish a central office conference bridge and a speed dial code (selective or fixed transfer code of *xx).

2.6.5 Language Interpretation

The call-taker at the PSAP must be prepared to receive calls from non-English speaking callers. Most PSAPs utilize some sort of language service and include the service as a fixed transfer programmed in the 9-1-1 equipment.

2.6.6 CAD/Mapping Functionality

Computer Aided Dispatch (CAD) and Mapping are optional but most beneficial ancillary services. CAD facilitates the dispatching of physical units to provide emergency assistance. Mapping presents a visual display of caller location on a map. The 9-1-1 equipment must be able to automatically feed location information to these systems for an automatic population of location data.

2.6.7 Fault Reporting

The PSAP requires a 7x24 number to report problems with 9-1-1 CPE.

2.6.8 Performance Monitoring/Data Collection

The optimal 9-1-1 PSAP equipment is equipped with software that tracks call statistics. These ancillary systems are called Management Information Systems (MIS) and are generally available on 9-1-1 CPE utilizing computers as intelligent work stations.

2.6.9 Printing

Often times printouts may be needed. In smaller PSAPs with limited budgets and no CAD or MIS programs, it is often the call printout that serves as historical record of calls.

2.6.10 Called Party Hold/Ringback

Called Party Hold is a network feature provided to a PSAP that maintains the connection associated with a 9-1-1 call between the caller and the PSAP call-taker, even if the caller attempts to disconnect or hang up (i.e., it disables the caller's ability to initiate release of the 9-1-1 call). Support for this capability is a network option.

Ringback is an optional network feature that allows the PSAP to alert the originator of the 9-1-1 call by providing ringing to the originator's telephone, if the telephone is on-hook, or by providing a receiver off-hook tone, if the telephone is not on-hook. Initiation of Ringback requires the prior invocation of Called Party Hold. See ANSI T1.628a-2001 for further details regarding the Called Party Hold capability (referred to in ANSI documentation as ECS call hold) and Ringback capability.

2.6.11 Support for TDD/TTY Functionality

As indicated in NENA-04-001, 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/TTYs, and when operating in TDD/TTY mode, each position shall retain all system features available from the existing 9-1-1 system. See Section 5.18 and Section 3.17 of NENA-04-001 for further details.

2.6.12 Recording

As specified in Section 3.5.1.2 of NENA-04-001, each emergency telephone line or each emergency answering position must be recorded on a logging recorder. Logging and recall recorders are used by the PSAP to record 9-1-1 conversations. It is desirable that the logging recorder be equipped with a backup deck/drive to automatically take over the recording function should one deck/drive become unavailable. The logging recorder should also be connected to an uninterruptible power supply, regardless of whether or not the recorder supports a battery for back-up power.

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

The logging and recall recorders should either be integrated into the telephone set or answering position, or should support one of the following audio interfaces:

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

Regardless of the type of interface connection used, the logging and recall recorders should be capable of satisfactorily reproducing the recorded signals.

See NENA-04-001 for further details regarding the recording capability and associated interfaces.

2.6.13 Call Trace Functionality

The PSAP needs to be able to initiate the proper steps to get a service provider to trace an in progress call. This does not happen often, as it is only required when there is no callback number (ANI) presented to the call-taker, and the person making the emergency call is unable to speak.

When there is ANI failure in a 9-1-1 system using a Selective Routing Tandem, the PSAP is presented with the digits 9-1-1 and the Emergency Services Central Office (ESCO) code of the end office originating the emergency call. The PSAP should have a list of all ESCO codes that

would terminate to their PSAP. This would enable the PSAP to identify the telephone company associated with the subscriber making the emergency call.

Once the PSAP knows which telephone company to call, they must be able to reach trained personnel 7x24x365 so as to initiate a call trace. The telephone company designate to answer these calls must be trained to contact the correct internal department to initiate the trace procedure.

In 9-1-1 systems where the end office is trunked directly the PSAP, the PSAP will know the appropriate end office and telephone company based on the incoming 9-1-1 trunk. Again, the PSAP must have a 7x24x365 number staffed by knowledgeable telephone company personal so as to initiate the trace.

As more 9-1-1 systems rely on SS7 to send 9-1-1 calls from end offices to 9-1-1 selective routers, and the number of 4-party and 8-party lines diminishes, the chances of incoming calls with ANI failures will make the need for trace obsolete. Furthermore, it must be stressed that the only time a trace is required is on the rare ANI failure calls made by callers who cannot speak.

2.7 Database Functions

2.7.1 Routing Database (currently referred to as SRDB)

The Database Management System (DBMS) must be capable of taking Service Order Input (SOI), processing it through various accuracy and validation checks, to match against the Master Street Address Guide (MSAG) so as to be able to match an Emergency Service Number (ESN) to a Telephone Number (TN). This TN-ESN data is then used to route the 9-1-1 call to the appropriate PSAP based on switch route indices assigned to the ESN. The DBMS needs to also be able to automatically create and deliver error files to service providers whose SOI does not pass the accuracy and validation steps. The DBMS should also be able to monitor status of error files.

2.7.1.1 Data Creation/Update/Storage

The DBMS should be able to create SRDB data and deliver it electronically to either the switch (for those 9-1-1 selective routers which use internal SRDB) or to the common pooled SRDB (for those switches that can go “off switch” to query routing databases). The DBMS should ideally be able to update the SRDB throughout the day and not impact the SRDB query functions from the routing switch. The data should be secure.

2.7.1.2 Initial Selective Routing Information Determination (i.e., processing/responding to Selective Routing queries)

The SRDB should respond to TN queries by the 9-1-1 selective routing switch and return the appropriate ESN. Where there is no ESN associated with a TN, then the SRDB should provide an ESN predicated on the programmed default logic. This can vary with each 9-1-1 routing switch.

2.7.1.3 Alternate Routing Information Determination (IN-based implementations)

In IN-based E9-1-1 Service implementations, where a Service Switching Point (SSP) queries a Service Control Point (SCP) for Selective Routing information, the SSP will rely on further interactions with the SCP to determine the alternate PSAP directory number for the call. Based on the procedures described in GR-3017-CORE, when an SCP responds to a Selective Routing query, it will also request that the SSP monitor for certain conditions (i.e., no answer, called party busy, network busy). If one of these conditions is encountered, the SSP informs the SCP. The SCP then provides an alternate routing number for the Emergency Call.

2.7.1.4 Routing Database Availability/Reliability

Currently there are no documented industry standards for selective routing database availability and reliability. Ideally, the database should be available for each and every call and should carry standard telephony reliability numbers of five nines.

Today the telephone companies purchasing the network elements for selective routing databases likely specify reliability numbers when making the purchase of the required component. They most likely demand the same reliability numbers as any other network component they purchase from suppliers.

The availability of the selective routing database should not be compromised by maintenance routines. That is, the act of uploading telephone number routing data or any improvement to the hardware of the selective routing database should not make the database unavailable to any call that is initiated during the upload or maintenance routine.

2.7.1.5 Routing Database Performance (Query Response Times)

Currently there are no documented industry standards for routing database performance with regard to query response times. However, given the fact emergency calls require a high degree of expediency in answering it would be unacceptable to have uncommonly long delays in query response times. All selective routing databases have been designed with time-out parameters that are usually measured in seconds. When the time-out threshold is met then the system invokes a default routing response so as to send the call to a PSAP.

2.7.2 Location Database (i.e., Automatic Location Identification [ALI] Database)

The ALI database houses static location identification information for wireline callers, and houses dynamic location information associated with wireless callers. When requested by the PSAP, the ALI database provides the existing location information for a caller to aid the PSAP agent in handling the call and to facilitate dispatch of emergency personnel to the caller's location. When the ALI database does not have the information requested by the PSAP, but knows of another database that may contain this information, the ALI will route/steer the query to that database. In addition, the ALI database may need to coordinate the information from one or more databases in providing a response to the PSAP query.

ALI databases are entities that are generally thought of as separate from other functional entities in the network, however, in some implementations, the ALI database is co-located with the SRDB. ALI databases are typically implemented in a redundant manner, using mirrored and synchronized databases.

2.7.2.1 Support of Data Creation/Update/Storage (including impact of Local Number Portability)

The ALI database includes features that allow for the information contained within it (i.e., ALI records) to be uploaded from a variety of sources, after having security and integrity checks performed. These sources of information include direct updates by the ALI provider, another network provider, and an enterprise network (known today as Private Switch ALI [PS/ALI]). NENA-02-010 contains the formats for data exchange, and it is assumed that the information in the ALI records is either compatible with or convertible to these standard formats. The information entered into the ALI database must be verified for accuracy, completeness, and consistency. When ALI data is determined to be inaccurate, incomplete, or inconsistent with MSAG data, the affected parties must be notified. Without accurate data, the information available to the PSAP agents may be misleading, if not completely incorrect, resulting in wrong decisions being made with regard to the dispatch of the appropriate emergency service personnel.

Today, it can be up to 24 hours between the time when a service provider's customer provides their new location to the service provider, and when the ALI database is finally updated. Likewise, information updates from Wireless Service Providers (WSPs), such as updates to their 24x7 trace number, can also take up to 24 hours. Reducing the delay in getting updated information into the ALI could result in fewer calls with inaccurate location information (for dispatching purposes). Efforts are underway to address new processes for facilitating prompt user location updates, particularly for enterprise customers, where mobility is more of an issue.

Local Number Portability (LNP), including Wireless LNP, impacts ALI data and data administration. There is a need to be able to identify the facility-based service provider associated with a specific ALI record, along with a 24x7 contact telephone number. To address this need, it should be possible to change the value of the Service Provider field in a specific record, when a number is ported and the user has not moved. It is desirable that the 24x7 contact telephone number be provided to the PSAP when location information is returned.

2.7.2.2 Support of PSAP Queries for Location Information

As described above, the primary function of the Location Database is to respond to queries from PSAPs for location information associated with an emergency caller. Today, when a PSAP launches a location query, it is typically sent to both ALI database systems that comprise the mated pair configuration. Each of the mated ALI databases responds independently to the location queries. The location query may contain one or two 10-digit numbers (e.g., callback number/ESRK, or both callback number and ESRD/ESRK). Based on the information received in the query, the Location Database will determine the

appropriate key to the location data. The Location Database will also determine whether the associated location data is stored at that database, or the query must be steered to another database. If the requested information is stored at the Location Database that received the PSAP query, it should respond immediately to the PSAP. If the requested information is not stored at the Location Database, the database should immediately generate a location steering query to the appropriate system, based on the key received in the query. (See Section 2.7.2.3.)

Location request and response messages are variable in length. Location information returned by the Location Database in a response to a location query will differ, depending on the nature of the call (i.e., wireline vs. wireless). For wireline calls, the location information returned by the Location Database should consist of street address information, whereas for wireless calls, the location information should consist of cell site information (i.e., for Phase I and II), as well as latitude and longitude, the position determination technology used, the time and date when the position was determined, and possibly confidence (uncertainty) information (Phase II). Other information will also be present in the Location Database response, as defined in NENA-02-010.

2.7.2.3 Location Database Steering Capability

Location (i.e., ALI) Database Steering occurs when an ALI database is queried by a PSAP for information it does not have. The ALI database that received the PSAP query steers (or routes) the request to the ALI database of another provider where the relevant information is stored. To do this, the ALI database that received the PSAP query formulates a request and sends it to the other ALI database, based on information received from the initial query. ALI steering allows the querying PSAP to maintain a single ALI database view (in terms of generating the query and receiving a response), even though multiple ALI systems may be involved in providing the requested information.

2.7.2.4 Support of Position Requests

A Location Database should support queries to external databases (e.g., Mobile Position Centers [MPCs]/Global Mobile Location Centers [GMLCs]) to obtain Wireless Phase II location information associated with a wireless emergency call. NENA-05-001 describes alternatives for the data network architecture between the wireless network and the wireline emergency services network to allow a wireless caller's location information to be obtained by a Location Database. It also provides explicit protocols and parameters for the operation of the interface between the Location Database and the MPC/GMLC, referred to in TIA/EIA J-STD-036-A as the E_2 interface. The NENA standard assumes TCP/IP connectivity between network elements, and a TCAP-based application protocol.

2.7.2.5 Location Database Availability/Reliability

Currently there are no documented industry standards for Location (i.e., ALI) Database availability and reliability. As in the case of the SRDB, it is an objective that the Location Database be available 99.999% of the time, with no allowance for "scheduled" or "planned" downtime. Specific reliability requirements will be communicated to suppliers by the entities

purchasing location database systems. It is an objective that location databases be designed and configured such that a single component failure does not disrupt service. In particular, it is desirable that critical components, such as power supplies, central processor, and interfaces, be protected by full redundancy and switch-over mechanisms.

2.7.2.6 Location Database Performance (Query Response Times)

Currently there are no documented industry standards for Location Database performance with regard to query response times. However, given the fact that emergency call processing and dispatch require a high degree of expediency, significant delays in query response times are unacceptable.

2.7.2.7 Trouble Reporting

It is an objective that the location database provider support a mechanism that will allow for location database surveillance and trouble resolution on a 24x7 basis. The location database should log and report system malfunctions, including server malfunctions and communications subsystem failures, according to the schedule specified by the network provider.

2.8 Interfaces

The E9-1-1 network is comprised of many components and interfaces. To make discussion easier, the E9-1-1 network can be broken down into two fundamental layers: the call delivery layer (connecting the caller to the appropriate destination PSAP), and the data delivery layer (delivering data about the call and the caller to the destination PSAP).

2.8.1 PSTN-to-9-1-1 Network

The delivery of calls from the PSTN to the 9-1-1 network can be accomplished over many different interfaces. Calls generally originate over typical end user interfaces (POTS lines, ISDN BRI/PRI circuits, PBX DID/DOD circuits, Mobile Telephone set, etc.) to one of many types of originating telephone offices such as an end office, PBX, or Mobile Switch. Once the call is received by an originating telephone office, calls are generally delivered to the E9-1-1 network using one of two main call setup technologies: MF signaling, or SS7 signaling.

2.8.1.1 MF

MF signaling was the original method to deliver calls from an end office to a selective router. This method transmits phone numbers and call setup digits using the “in-band” call setup technique of transmitting digits in Multi-Frequency (MF) tones over the talk path of the circuit.

The predominant method to deliver these calls is through the use of Centralized Automatic Message Accounting (CAMA) signaling, which sends the called number (9-1-1, 1-1, or 1) to the router in addition to a single information digit, and a 7 digit caller number (ANI). Other conditions (areas where a selective router is not required) allow this signaling to be direct

"trunked" to a PSAP. CAMA signaling is a method that was used to transmit a caller's billing number to a centralized location to assist in billing of local and toll services.

Documentation on CAMA signaling is spread throughout many documents, including LATA Switching Systems Generic Requirements (LSSGR), Telcordia FR-64, J-STD-036 (annex D), and ANSI specification ANSI T1.411-1995. Another summary of CAMA signaling, as it pertains to E9-1-1, was created by the Texas PS/ALI forum Technical Standards Committee report: 9-1-1 CAMA trunking and Database Update for Private Switch/ALI, and its 1993 update by the Texas Advisory Commission on State Emergency Communications. In addition, many 9-1-1 service providers have their own documentation on CAMA trunking for use with Private Switch (PS/ALI) type systems. Any user (telecommunications service provider) should therefore contact the particular E9-1-1 System Service Provider that provides E9-1-1 Service for the particular calling location to obtain CAMA documentation, contract/tariff information, and other interconnection rules for E9-1-1 Service.

In other instances, (although not the norm), the selective router can have certain incoming trunks from other types of special conditions (such as other selective routers) using router to PSAP trunk signaling. These are specialized uses of the Telcordia GR-350-CORE, and the NENA Enhanced MF Signaling specification (NENA 03-002)

A third method is a specialized incoming trunks from wireless carriers that are used to deliver two 10-digit numbers for wireless services. This method (like the second condition) is also dependent on the capabilities of the selective router, and/or policies of the 9-1-1 service system service provider. This signaling option is identified in J-STD-036 (Annex D).

MF signaling is also the predominant method of delivering calls from a selective router to a PSAP. This falls under two main categories: CAMA-like signaling (Telcordia GR-350-CORE), and the NENA Enhanced MF signaling schemes (NENA 03-002). In the first case, the CAMA-like signaling is the original signaling scheme that sends calls to a PSAP using a single area code digit, and is limited to the transmission of up to 4 area codes. This has been modernized through the NENA Enhanced MF signaling standard that allows for true 10-digit signaling to the PSAP, as well as the capability to deliver up to two 10-digit numbers to the PSAP for certain types of wireless calls.

2.8.1.2 SS7

As the telecommunications industry advanced, a second call setup signaling method was developed. This is the use of the Signaling System 7 network that uses "out of band" signaling. In this case, the messages, telephone numbers (called, and calling numbers), and other information about the call are transmitted through a data network that is separate from the call path.

The primary use of SS7 in 9-1-1 call setup establishes 9-1-1 calls between end offices, or mobile switches, to the selective router. SS7 signaling allows for both the delivery of standard calls, as well as wireless calls with two ten-digit numbers to the 9-1-1 network. SS7 signaling standards are identified in Telcordia GR-246-CORE. Calls from Mobile switches

have additional specifications written by NENA (NENA 05-001) that clarify confusing language in the J-STD-036. In addition, each 9-1-1 system service provider may have additional standards, or interconnection documents that further identify SS7 interconnection requirements.

A supplemental use of SS7 signaling allows for the direct routing and transfers of calls between selective routing switches. This falls under the NENA "inter-networking" standards set forth to allow inter-tandem transfers and routing (NENA 03-003).

2.8.2 Data Upload Interface

Within the E9-1-1 network, there are many data interfaces as well. In general, where not identified by NENA recommended standards, these interface specifications are defined through the database vendor, switch, or CPE vendor. The particular 9-1-1 service system provider should be able to assist a telecommunications service provider in obtaining appropriate documentation. These are:

- Each PSAP generally has a data interface to a local or external database used to retrieve the ALI (call record) keyed on the ANI delivered from the 9-1-1 network to the PSAP.
- Each selective router generally has a data interface to a local or external database used to obtain a routing ESN for each call. Note that in some cases, this is also used to transmit information about a 9-1-1 call toward the database (such as a pair of two10-digit numbers) for the creation of a wireless Hybrid ALI record.
- Each 9-1-1 service provider generally has some sort of interface, gateway, or transmission path to the 9-1-1 database to transmit, or upload telephone record or service order activity (such as moves, add, or changes). This includes interfaces, and methods to load telephone records into the database.
- In addition, there may be interfaces that are used to load MSAG ledgers (street names and ranges) into the database prior to the deployment of 9-1-1 services, and/or loading of the database TN records.
- E9-1-1 databases also have begun to have data interfaces to wireless carriers and/or third party providers for transmission, or dynamic updates of wireless call data. In some cases, this data link allows wireless call data to be "pushed" into the 9-1-1 database concurrent with a call happening, while others allow two way communication or data to be pulled from the carrier or third party providers. These are commonly referred to as E2, PAM, or some other type of dedicated data channel.
- In addition to these circuits, there are many data interfaces and links within the wireless network. This allows wireless carriers to determine wireless setup conditions, and/or triangulate or locate a wireless caller.

Each telecommunications carrier or service provider also has many internal data networks and interfaces used to manage service order activity, E9-1-1 database load activity, and error correction procedures.

2.8.2.1 Complete Location Record Creation (Wireline ALI Records)

In addition to providing location information to PSAPs in real-time to support the processing of emergency calls, the ALI database must be able to receive uploads of location data on a non-real-time basis. To support location data uploads for wireline end users today, the ALI database supports interconnection, via a Database Management System (DBMS) to entities such as LEC provisioning systems and Private Branch Exchanges (PBXs). The LEC provisioning systems are the primary source for the address and telephone number information that is ultimately fed into the ALI database. When customers subscribe to telephone service from a LEC, data about the customer flows through the service provider's provisioning system(s). One of the outputs of this process is the communication of customer telephone number and address information to the DBMS that supports the ALI database, sent via data links between the provisioning system and the DBMS. The DBMS also receives wireline customer location data via data links to PBX systems and MSAG databases. PBX s send information about enterprise customers via a Private Switch ALI (PS/ALI) interface to the E9-1-1 service provider network. The data flows between the PS/ALI system and the DBMS, which then updates the ALI databases. The PBX owner is responsible for creating the customer records and initiating the upload via a secure interface. Some implementations support Web-based uploads from PS/ALI customers. MSAG data is also sent via a data link to the DBMS. Data received by the DBMS from the various sources flows into the ALI databases via an internal system interface. Firewalls are employed on data links to the DBMS, where information comes from outside sources, to ensure that the integrity of the E9-1-1 data network is not compromised.

In the future, interconnection with GIS databases may also be necessary to obtain coordinate-based location/routing information. It may also be desirable, in the future, for the ALI DBMS to be capable of receiving automated near real time uploads of location data.

Wireline customer location data is stored in the ALI database as ALI records. The formats used are based on NENA standards for record structure and information storage. NENA 02-010 contains the formats for data exchange. The information stored in the ALI records should either be compatible with or convertible to these standard formats.

2.8.2.2 Shell Record Creation (Wireless ALI record creation)

As discussed above, wireless ALI records are created and updated in several ways.

Each record (pANI) must originally be loaded into the database and validated against an MSAG ledger. Generally, the 9-1-1 customer (PSAP) is required to create the MSAG ledger that the pANI record will validate against. This requires that the customer and the wireless carrier communicate so that both understand the format and structure of the record. In some instances, the 9-1-1 provider, or state regulations allow the wireless carrier or third party provider to create or load the MSAG ledgers into the database. Since this is dependant on state regulations, and/or 9-1-1 service provider rules, each carrier or third party provider should determine what procedures should be followed.

In the case of a pANI being an ESRD (a pANI that specifically identifies a tower or tower face), the MSAG ledger must be specific to that record. In the case of a pANI being an ESRK (a pool of pANIs used to represent a pool of tower faces) a generic MSAG ledger can be used as a "shell" record to store multiple pANI records.

In cases of wireless calls, these records get dynamically updated at the time of the call. This is done with either "push" or "pull" techniques, and the data is transmitted over E2, PAM, or other type of data circuits.

Each 9-1-1 database system manages, and handles the updates, queries, and grooming of those wireless database records.

2.9 Feature Interactions

It is important that carriers take into account interactions between originating and terminating features and 9-1-1 calls. In particular, 9-1-1 calls should not be interrupted by other originating features. GR-529-CORE, *LSSGR: Three-Way Calling, FSD 01-02-1301* and GR-529-CORE, *LSSGR: Public Safety*, specify that flashes should be ignored after a two-way call has been set up to a PSAP attendant. This means that for the duration of a 9-1-1 call, the Three-Way Calling (TWC) feature cannot be activated by the party that originated the 9-1-1 call. However, a customer involved in a two-way call should be allowed to flash and use TWC to add on a PSAP attendant. If an originating customer uses the consultation hold feature of TWC, it is desirable that the original caller be allowed to flash once to establish a TWC connection, however, all subsequent flashes should be ignored, and the PSAP attendant should maintain control of the connection.

Likewise, during an active 9-1-1 call, Call Waiting (CW) service should either be inhibited (i.e., no CW tone), or flashes should not be recognized.

9-1-1 should not be permitted as a "forward to" number for the various subfeatures of the Call Forwarding service (e.g., Call Forwarding Busy Line, Call Forwarding Variable, Call Forward Don't Answer), as described in GR-586-CORE, *LSSGR: Call Forwarding Subfeatures (FSD 01-02-1450)*.

Carriers should also consider interactions between terminating features and 9-1-1 calls to avoid any negative impact on a PSAP's ability to receive and process a 9-1-1 call.

3 References

NENA Source Documents

02-010	Standards for Recommended Formats & Protocols for Data Exchange
02-011	Recommended Data Standards for Local Exchange Carriers, ALI Service Providers & 9-1-1 Jurisdictions
03-001	Networking Quality Assurance
03-002	Recommendations for the implementation of Enhanced MF signaling E911 tandem to PSAP

03-003	Recommendation for the Implementation of Inter-networking E911 Tandem to Tandem
03-004	NENA Recommendation for an E9-1-1 Functional Entity Model
03-006	E9-1-1 Call Congestion Management
03-501	Network Quality Assurance
03-xxx	Generic Requirements for an Enhanced 9-1-1 Selective Routing Switch
04-001	Generic Standards for E911 PSAP Equipment
04-003	Recommended Generic Standards for E911 ISDN PSAP
04-004	Recommended Generic Standards for E911 PSAP Intelligent Workstations
05-001	NENA Standard for the Implementation of Wireless Emergency Service Protocol E2 Interface
07-501	Technical Information Document on future 911 Models

4 Exhibits

Figures 1 through 4 illustrate various architectures that are used today for processing wireline and wireless 9-1-1 calls. Figure 5 illustrates the current data flows that support E9-1-1 Service. These figures are included to assist the reader in understanding how E9-1-1 works today.

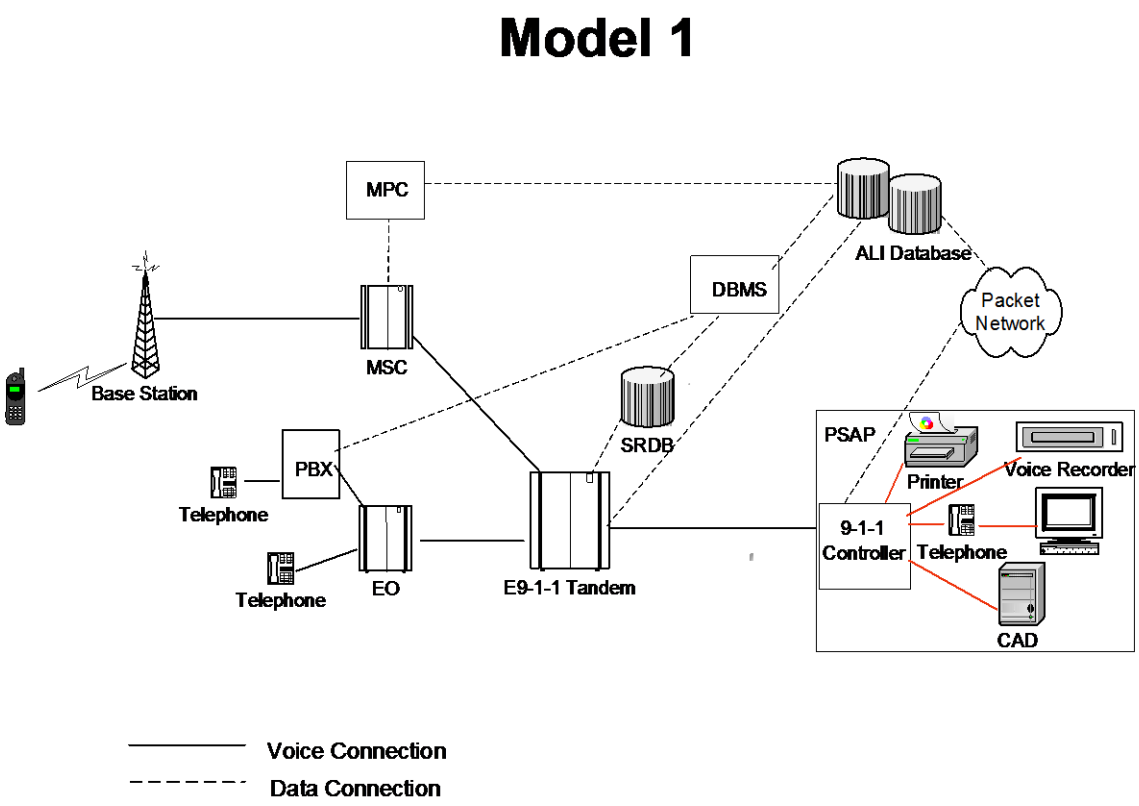

Figure 1: Single E9-1-1 Tandem Architecture

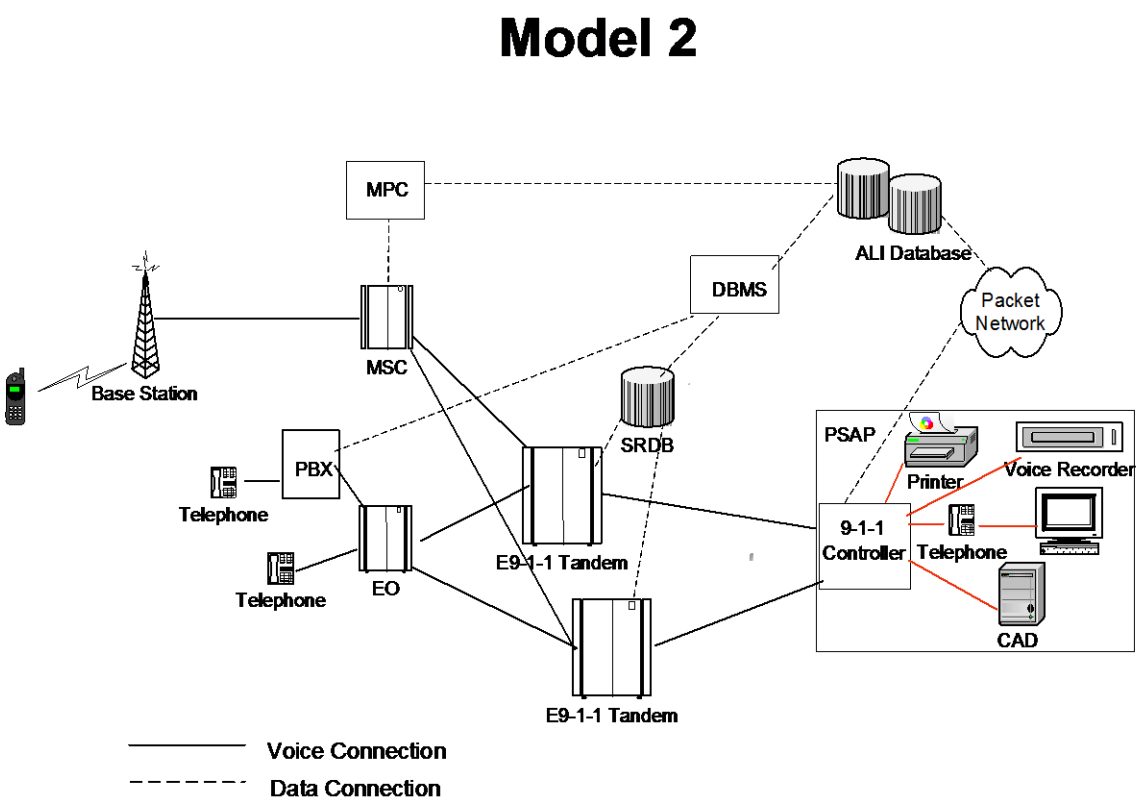

Figure 2: Mated E9-1-1 Tandem Architecture

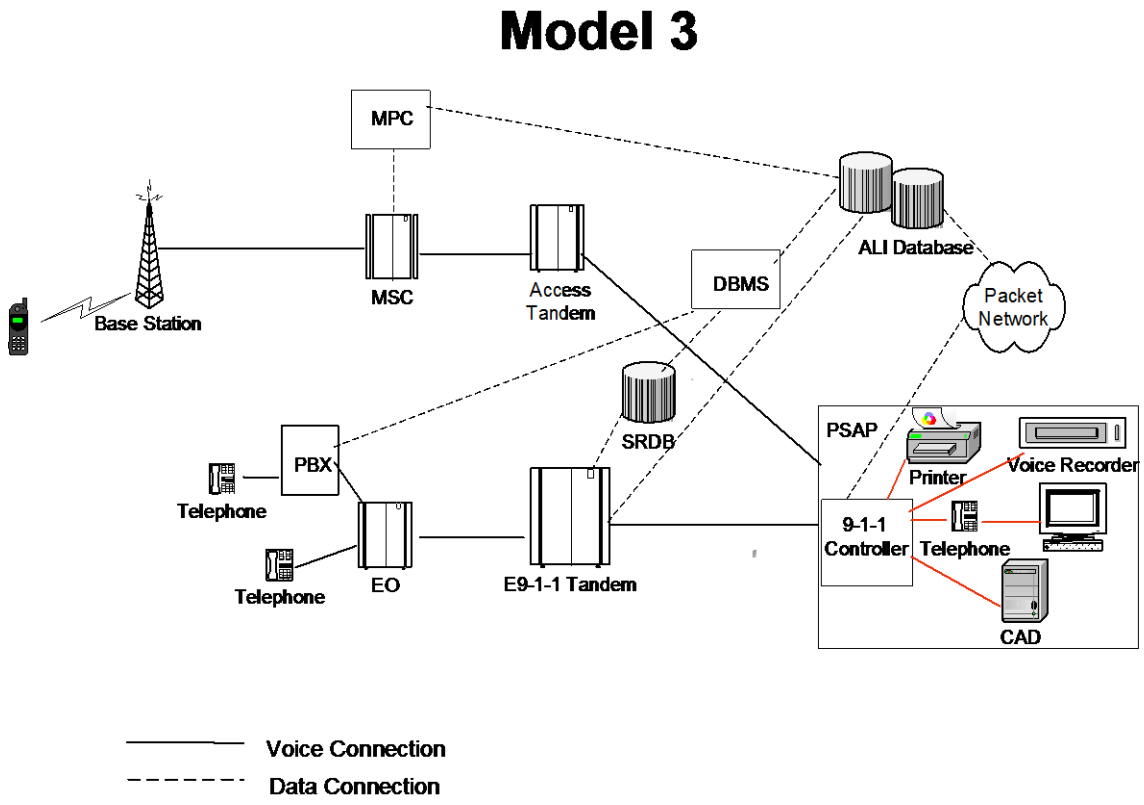

Figure 3: MSC Connects Via Access Tandem to PSAP

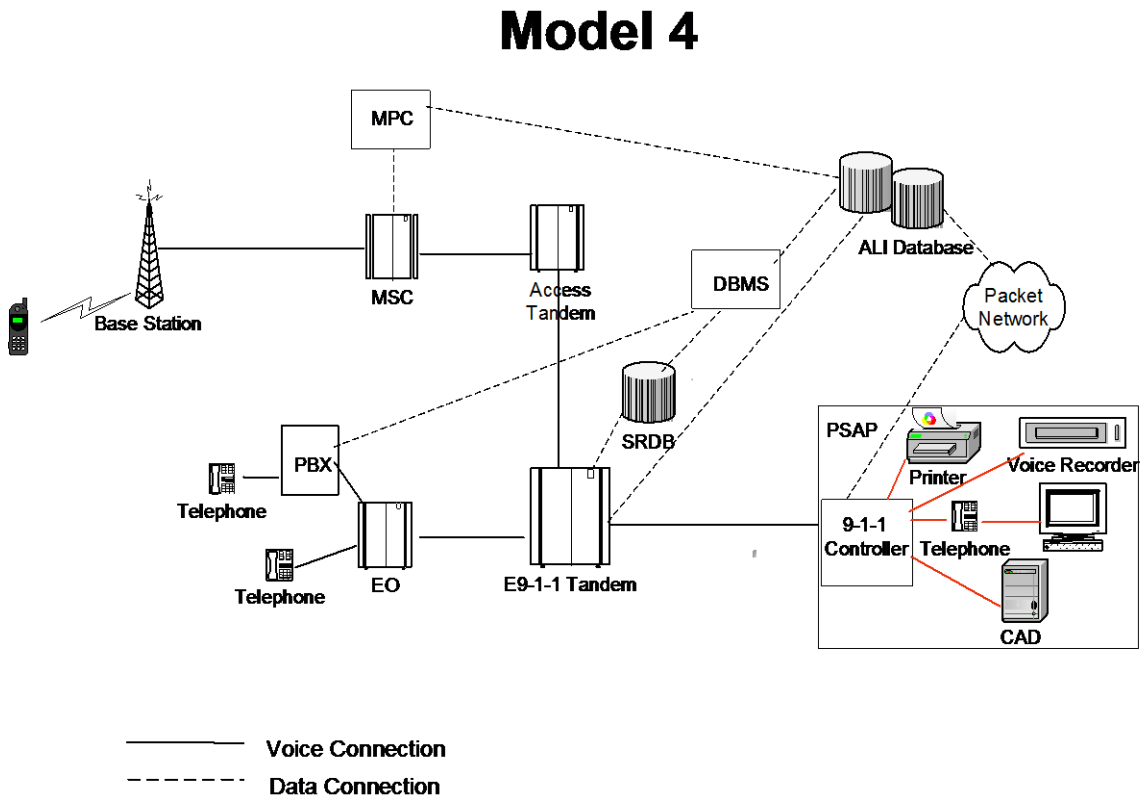

Figure 4: MSC Connects to E9-1-1 Tandem Via Access Tandem

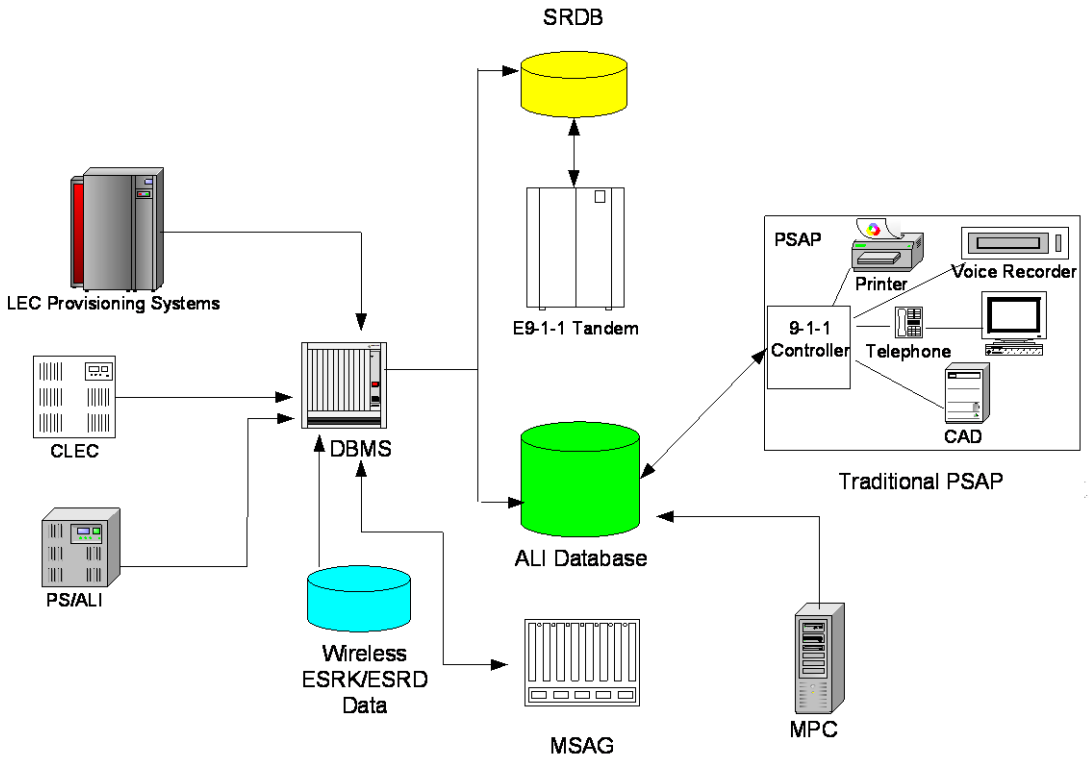

Figure 5: Current Data Flows in Support of E9-1-1 Service