NENA NG9-1-1 Transition Plan Considerations Information Document

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Acknowledgments:

The National Emergency Number Association (NENA) Next Generation 9-1-1Transition Planning Committee (NGTPC) developed this document.

NENA recognizes the following industry experts and their employers for their contributions in development of this document.

Executive Board Approval Date: 11/20/2013

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TABLE OF CONTENTS

TABLE OF FIGURES

1. Executive Overview

The public safety community has recognized the need to evolve legacy emergency services networks to next generation concepts which may facilitate new capabilities and services. As such there are numerous industry associations and Standard Development Organizations (SDOs) that are defining architectures and protocols for these next generation networks. The public safety community desires to take advantage of this work and address the challenge it represents to emergency communications. To this end, work is progressing in other NENA committees to define the specific emergency services architectures and protocols involved. The transition of emergency services addressed by this document relies upon this collective work.

Transition to NG9-1-1 is expected to be an evolutionary process, involving technological, operational, economic, and institutional change. In some cases, the path to NG9-1-1 implementation will depend on the underlying infrastructure of the Public Safety Answering Point (PSAP) and 9-1-1 Authorities involved. The NG9-1-1 environment may differ considerably from the current 9-1-1 environment.

Carriers and PSAPs may migrate independently to a next generation environment. This document addresses four use cases based on the transition status of the originating and terminating entities:

- Carrier served by Selective Router (SR) and PSAP served SR (current methods)
- Carrier served by SR and PSAP served by NG9-1-1 system
- Carrier served by a NG9-1-1 system and PSAP served by SR
- Carrier and PSAP served by a NG9-1-1 system (fully transitioned)

This document describes three transition scenarios. For these scenarios, the Emergency Services IP network (ESInet) and functional elements including the Border Control Function (BCF), Emergency Services Routing Proxy (ESRP), Emergency Call Routing Function (ECRF), and the Location Validation Function (LVF) are put in place prior to the transition. Transition introduces a new functional element called the Legacy SR Gateway (LSRG). This gateway facilitates the routing/transfer of emergency calls between the ESInet and the legacy emergency services network. The LSRG will have to interwork location infrastructure between NG9-1-1 and legacy emergency services environments.

Version 2 of this document focuses on the aspect of transitioning data from the legacy environment to the NG9-1-1 environment. This document assumes that a 9-1-1 Authority is likely starting with an environment consisting of traditional components such as an ALI system, Selective Router(s), a Database Management System (DBMS), tabular MSAG, and a legacy network. It also assumes that the 9-1-1 Authority has developed a set of GIS data to a level that approximates the contents of their MSAG. Each 9-1-1Authority should previously have performed some preliminary reconciliation between their GIS data and their MSAG. The Authority may have also performed further reconciliation work between their GIS and Postal data. If an Authority that provides GIS data for 9-1-1 use has not performed this reconciliation work it should take up the task at the earliest opportunity as such reconciliation is viewed as a first step in NG9-1-1 data transition. Since a 9-1-1 Authority can choose a variety of deployment plans, this document identifies the most common and most likely impacts on 9-1-1 data.

The changes are not limited to standards, technology and operations. Other issues not within the scope of this document include governance, funding, management and operation of the overall system and the delivery of services, both traditional 9-1-1 services along with other new emergency services. The changes affect the entire 9-1-1 and public safety community, including the general public and other emergency services.

The planning and implementation coordination effort must begin with a needs assessment of all operational requirements. This will form an overall picture of system requirements and baseline functionality necessary for any proposed NG9-1-1 solution. The NG9-1-1 system architecture will be designed based on these systems requirements. A system transition plan must be developed to ensure the successful transition from the current 9-1-1 system to the new system that considers the management and operation of the system for optimal capabilities and security.

The recommendations in this Transition Plan Considerations Information Document are intended to assist stakeholders to understand and plan for the transition to NG9-1-1. While this plan deals primarily with existing features and services that will be migrating to a NG9-1-1 environment, it is acknowledged that "new" features and services unique to NG9-1-1 will have operational consequences, and will require a great deal of preparation.

2. Introduction

2.1 Scope

This Information Document is intended to provide NENA's recommendations for transitioning to NG9-1-1. In doing so, this document reflects the definition of NG9-1-1[1] developed by NENA through a separate work effort, and is summarized as follows:

NG9-1-1 is a system comprised of hardware, software, data and operational policies and procedures briefly described below, to:

- process emergency voice and non-voice (multi-media) calls[2]
- acquire and integrate additional data useful to call routing and handling
- deliver the calls/messages and data to the appropriate PSAPs and other appropriate emergency entities
- support data and communications needs for coordinated incident response and management.

The basic building blocks required for NG9-1-1 are:

- Emergency Services IP Network (ESInet)

  An ESInet is a managed IP network that is used for emergency services communications, and which can be shared by all public safety agencies. It provides the IP transport infrastructure upon which independent application platforms and core functional processes can be deployed, including, but not restricted to, those necessary for providing NG9-1-1 services. ESInets may be constructed from a mix of dedicated and shared facilities. ESInets may be interconnected at local, regional, state, federal, national and international levels to form an IP-based inter-network (network of networks).

[1] http://c.ymcdn.com/sites/www.nena.org/resource/resmgr/ng9-1-1_project/whatisng911.pdf

[2] This document uses the word "call" to refer to a communication session established by signaling with two way real-time media and involves a human making a request for help. We sometimes use "voice call", "video call" or "text call" when specific media is of primary importance.

- International Standards Compliant IP Functions
  IETF[3] based IP protocol standards provide the basic functionality of the system. NENA has applied standards from IETF and other SDOs to specific NG9-1-1 requirements. Examples are: Location Validation Function (LVF) and Emergency Call Routing Function (ECRF) and other functions, as defined in NENA 08-003, NENA Functional and Interface Standards for Next Generation 9-1-1 Version 1.0 (i3) [8] .
- Software Services/Applications
  NG9-1-1 uses service oriented architecture, software applications and data content to intelligently manage and control its IP-based processes. NG9-1-1 is software and database driven to enable an exponential increase in available data and information sharing possibilities. It also provides flexibility and individual agency choice to determine information needs based on predetermined business/policy rules.
- Data Bases and Data Management
  NG9-1-1 uses a set of databases to house and provide management of the above data content. Some examples are: validation, routing control, policy/business rules and system-wide detail call records.
- NG9-1-1 provides the mechanisms to access external sources of data, either automatically or manually, via the ESInet, to support more knowledgeable and efficient handling of emergency calls/messages. Examples: telematics/ACN data, hazardous material info, building plans, medical info, etc.
- Security
  NG9-1-1 provides extensive security methods at the hardware and software levels to replicate the privacy and reliability inherent in E9-1-1 services.
- Human Processes
  NG9-1-1 as a service system involves a multitude of human procedures and system operations procedures to control and monitor the functionality and effectiveness of the systems and services that provide NG9-1-1 service. Examples include database establishment and maintenance procedures, IP network operations, security processes, troubleshooting procedures, database auditing and accuracy validation procedures, and many others.

Beyond the definition of NG9-1-1 itself, the scope of the NG9-1-1 Transition Plan is defined by the stakeholders involved, and the nature of their interaction and connectivity. The FCC Network Reliability and Interoperability Council (NRIC) VII Focus Group 1B (FG1B) broadly characterized NG9-1-1 connectivity this way:

> ". . . PSAPs should and will deploy IP networks within the PSAP, between the PSAP and the sources of calls coming into the system and between the PSAP and other responders and emergency service agencies. This communication infrastructure serving the PSAPs will comprise an Inter-network (federation) of managed and secured Emergency Service IP Networks. It is anticipated that such networks will mirror the 9-1-1 system authority level. In

[3] IETF (Internet Engineering Task Force) generates international IP standards for Internet and other applications

> most areas, that would equate to a county or large city, but in some cases it would be an entire state, and in other cases a single large PSAP. The Emergency Services Network should in turn be interconnected to neighboring jurisdictions for mutual aid assistance, and the Inter-network formed by such connections would be aggregated at state or groups of states and further interconnected such that information can be sent reliably between any entities within this Inter-network across the country. National agencies, such as DHS, would connect to this Inter-network and thus would be able to both provide and access information on it. Many of those agencies do not have ready access to the emergency communications systems (E9-1-1 PSAPs) today. Allowing them to join this wider network will bring added value to the common cause of providing the best assistance possible in times of emergencies."[4]

The recommendations in this Information Document are intended to aid stakeholders that have a vested interest in NG9-1-1 in understanding and planning for the transition to NG9-1-1. As described, stakeholders represent entities that offer emergency calls to the emergency services network and entities that are responsible for delivering and responding to the emergency calls within the emergency services network. There is no single best evolution strategy and this document identifies options and provides analysis for those options. While this plan deals primarily with existing features and services that will be migrating to a NG9-1-1 environment, it is acknowledged that "new" features and services unique to NG9-1-1 may have operational consequences, and thus may require some degree of preparation.

2.2 Operational Impacts Summary

The transition to NG9-1-1 has impacts upon operations within all stakeholder organizations. The level of impact may depend upon the responsibility of the entity processing the emergency call. For example, for entities in originating networks it may be as simple as redirecting calls to the NG9-1-1 network. For entities such as 9-1-1 Authorities it may require developing transition plans to upgrade or replace equipment to support the NG9-1-1 services and capabilities. It is expected that NENA's Committees will continue to develop operational standards that will facilitate the introduction of NG9-1-1.

2.3 Technical Impacts Summary

The transition to NG9-1-1 impacts stakeholder organizations as they introduce new technology to support NG9-1-1. New network elements will be introduced that facilitate the transition and eventually provide the new services and capabilities available with NG9-1-1.

2.4 Security Impacts Summary

The introduction of NG9-1-1 has significant impacts to security within all of the stakeholder organizations. From the introduction of Internet Protocol (IP) based networks to the access of supplemental data services by an expanded array of stakeholders with an interest in such data, new

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[4] Focus Group 1B."Long Term Issues for Emergency/E9-1-1 Services: Report 4." FCC NRIC VII. Sept. 2004. 26-27. http://transition.fcc.gov/nric/nric-7/fg1d-report.pdf. FG 1B specifically examined "Long Term Issues" for Enhanced 9-1-1. NRIC is a formal federal advisory committee, with the responsibility to provide recommendations to the FCC and to the communications industry that, if implemented, would assure optimal reliability and interoperability of wireless, wireline, satellite, cable, and public data communication networks. Periodic councils are organized to deal with specific sets of issues or subjects, within a broad charter. This council was the seventh council so organized, and included a significant focus on 9-1-1 matters. FG1B specifically examined "Long Term Issues" for Enhanced 9-1-1.

security processes and procedures are required. This Transition Plan does not specify security procedures in NG9-1-1, but identifies security considerations within the planning process. It may refer to specific NENA or other industry documents which address security.

2.5 Document Terminology

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

2.6 Reason for Issue/Reissue

NENA reserves the right to modify this document. Upon revision, the reason(s) will be provided in the table below.

Doc #	Approval Date	Reason For Changes
NENA 77-501	02/24/2011	First Transition Plan Version
NENA-INF-008.2-2013	11/20/2013	Second version incorporates database transition considerations and processes mainly in section 11. Also adds a check list in appendix C.

2.7 Recommendation for Additional Development Work

This Transition Plan is intended to provide the basis for additional committee work within NENA. In fact, some content within this document is the result of the effort of NENA committees and working groups based upon interactions with the NGTPC.

2.8 Date 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 a date/time change up to 30 years subsequent to the manufacture of the system. This shall include embedded application, computer based or any other type application.

2.9 Anticipated Timeline

The transition to NG9-1-1 is beginning as this Transition Plan is being produced. For example, the prerequisite of deploying IP networks is being done in some areas of North America. Also, some vendors are developing equipment that may be “NG9-1-1 ready”. This implies their equipment <u>will</u> gracefully evolve to NENA’s definition of NG9-1-1. The transition to NG9-1-1 will be a journey that will be realized at different rates within various parts of North America, based upon state/province, local implementation and stakeholder environments.

2.10 Costs Factors

The transition to NG9-1-1 will have cost implications to all of the stakeholders sometime during the transition process. For example, PSAPs, 9-1-1 Authorities, states/provinces, service providers, etc. will be required to purchase/provide new equipment capable of NG9-1-1 capabilities. New services will be developed and introduced that expand beyond what is capable in legacy emergency services networks. It is probable that parallel networks will be in place during some stages of the transition, and some of those will support legacy communication functions. The implication of who bears this transition cost is beyond the scope of this Transition Plan. However, specific transition scenarios imply where costs reside and may play a role in choosing one transition scenario over another.

2.11 Cost Recovery Considerations

While it is assumed that transition to NG9-1-1 will be driven largely by business and service needs and not regulatory mandate (with perhaps some exception), recovering stakeholder costs will occur in an involving and changing funding environment that ultimately will reflect the nature of emerging telecommunications[5] and NG9-1-1. NENA's Next Generation 9-1-1 Partner Program (NGPP) has addressed cost and funding issues related to NG9-1-1, and they are beyond the scope of this Transition Plan.

2.12 Additional Impacts (non cost related)

The transition to NG9-1-1 will have technical and operational impacts upon all of the stakeholders discussed in this document. Many of these are addressed elsewhere within the Transition Plan.

In addition it is anticipated that other NENA committees and working groups will use this Transition Plan as the basis for future activity.

2.13 Intellectual Property Rights Policy

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2.14 Acronyms/Abbreviations, Terms and Definitions

Some acronyms/abbreviations, terms and definitions used in this document may have not yet been included in the master glossary. After initial approval of this document, they will be included. See NENA 00-001 - NENA Master Glossary of 9-1-1 Terminology located on the NENA web site for a complete listing of terms used in NENA documents. All acronyms used in this document are listed below, along with any new or updated terms and definitions.

[5] The term Telecommunications is used in the general sense and is not intended to attach any regulatory or statutory meaning.

The following Acronyms are used in this document:		
Acronym	***Description***	***(N)ew (U)pdate***
LSRG	Legacy Selective Router Gateway	N

The following Terms and Definitions are used in this document:		
Term	*Definition*	***N)ew (U)pdate***
LSRG	The Legacy SR Gateway (LSRG) is a gateway that facilitates the routing/transfer of emergency calls between the ESInet and the legacy emergency services network. The LSRG will have to interwork location infrastructure between NG9-1-1 and legacy emergency services environments.	N

3. Background

The Public Safety industry has recognized the need to evolve legacy emergency services networks to next generation concepts which may facilitate new capabilities and services. As such there are numerous industry associations and Standard Development Organizations (SDOs) defining architectures and protocols for these next generation networks. The transition of emergency services relies upon this work. And in addition, the need for next generation emergency services may impose additional requirements on next generation networks that influence architectures and protocols.

The NG9-1-1 Transition Planning Committee's (TPC) NG9-1-1 Data Transition Working Group defined the database considerations contained within this document. Beyond the NG9-1-1 Transition Planning Committee, NENA's Committees have efforts focused on specific aspects of next generation services. The Migratory Definition Working Group was responsible for defining NENA's i2 standard [7]. The VoIP Location Working Group defines location determination methods [6][14]. NENA VoIP Long Term Definition Working Group has defined requirements for NENA's i3 architecture [5], a functional and interface specification for i3[2] and Detailed Functional and Interface Standards for i3[8]. The NG9-1-1 Data Development Working Group is defining database and database attributes for next generation. The Agency Systems Committee is focusing on the integration of new and existing technologies into the PSAP.

The US Department of Transportation (DOT) undertook a two year program (2007-2008) called the *Next Generation 9-1-1 Initiative*. This program is a DOT research and development project to define system architecture and develop a transition plan that considers responsibilities, costs, schedule and benefits for deploying IP-based emergency services across the Nation. Documents relating to this program may be found at http://www.its.dot.gov/ng911/.

Information regarding other industry associations or SDO involved in defining next generation architectures, services and protocols may be found at the following links.

- Internet Engineering Task Force – IETF (http://www.ietf.org) and specifically, the Emergency Context Resolution with Internet Technologies (ECRIT)[6] and the Geographic Location/Privacy (Geopriv)[7] working groups
- Alliance for Telecommunication and Industry Solutions (www.atis.org), including the Emergency Services Interconnection Forum (ESIF)
- 3rd Generation Partnership Program (http://www.3gpp.org/)
- 3rd Generation Partnership Program 2(http://www.3gpp2.org/)
- Cable Labs (http://www.cablelabs.com/)
- Open Mobile Alliance (http://www.openmobilealliance.org/)
- Broadband Forum (formerly the DSL Forum) (http://www.broadband-forum.org/)

4. NGTPC Process

The NGTPC began the process of developing a transition plan by creating baselines for legacy networks and NG9-1-1 networks. Those baselines may be found in the appendices of this Transition Plan. The legacy baselines are intended to delineate the numerous starting points within the E9-1-1 infrastructure as it exists today. They include starting points of Wireline, Wireless Phase II, etc. The NG9-1-1 baselines are intended to provide the Committee with a common understanding of where emergency services networks are headed. That is, the end point to be attained.

The NGTPC then began to identify the migratory gaps that exist between the starting points and the ending points involved. Each gap was associated with recommendations for mitigation, which in turn represent transition recommendations. The resolution of some gaps was worked within the NGTPC through full committee involvement, formal working groups or small groups with an interest in the specific area. Other gaps were liaised to other NENA committees for resolution. NGTPC tracked the resolution process and included the results in this Transition Plan.

For version 2 of the Transition Plan, the NG9-1-1 Transition Planning Committee organized a Data Transition Working Group. The focus of this working group was specifically targeted at the migration of data elements and processes needed during the migration to NG9-1-1. The results of that working group are included in this version of the Transition Plan.

Therefore the recommendations within this Transition Plan are the culmination of work by NGTPC committee members and input from other NENA committees or working groups.

During the process of developing this Transition Plan, the NGTPC maintained a close liaison with the USDOT transition planning effort. In fact, some of the DOT concepts have been included and/or referenced within this Transition Plan. And, some of the concepts provided within this Transition Plan feed into the DOT NG9-1-1 activity.

5. NG9-1-1 Stakeholders

Focus Group 1D (FG1D) of the FCC NRIC VII referenced above suggested that potential next generation stakeholders extend beyond the traditional public safety community, and include:

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[6] The working group charter can be found at https://datatracker.ietf.org/wg/ecrit/charter/

[7] The working group charter can be found at http://datatracker.ietf.org/wg/geopriv/charter/

- Traditional public safety agencies: law enforcement, fire services, EMS, and 9-1-1 (sic) *centers*
- Citizens and businesses: connections between them and agencies (e.g.; E9-1-1, truck fleet management systems)
- Business safety providers (e.g.; telematics, alarm monitoring systems, hazmat service providers)
- Hospitals/Clinics
- Public health
- Emergency management
- Transportation departments
- Different transportation modes (e.g.; railroads, ports, trucking)
- Non-governmental organizations: Red Cross, Salvation Army, CERT, mountain rescue groups, etc.
- Mental health organizations
- National Guard
- United States Department of Defense (US DoD)
- Utilities, public works, recreation departments
- Media
- Schools
- Critical infrastructure companies[8]

The USDOT in its NG9-1-1 Project agreed. In its Concept of Operations document, USDOT noted that

> "…access to emergency services provided by 9-1-1 in today's world of evolving technology will ultimately occur within a broader array of interconnected networks comprehensively supporting emergency services—from public access to those services, to the facilitation of the services, to the delivery of the emergency information to dispatchers and first responders."[9]

To provide specific transition recommendations this Transition Plan uses the following stakeholder classifications which are defined in the following sub-sections:

- PSAP Oriented Stakeholders
- Commercial Mobile Radio Service Providers
- Wireline Service Providers
- VoIP Service Providers

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[8] NRIC Focus Group 1D. "Focus Group 1D Report–Communication Issues for Emergency Communications Beyond 9-1-1." FCC NRIC VII. Dec. 2004. 22-23. http://transition.fcc.gov/nric/nric-7/fg1d-report.pdf. FG1D specifically examined "Communication Issues for Emergency Communications Beyond 9-1-1," or first responder and downstream emergency communications.

[9] USDOT. "Next Generation 9-1-1 (NG9-1-1) System Initiative: Concept of Operations." Intelligent Transportation Systems. 5. April 2007. 12. http://www.its.dot.gov/ng911/.

- E9-1-1 System Service Providers
- Equipment Vendors
- Enterprises
- Telecommunications Call Centers
- Regulators/Legislators

5.1 PSAP Oriented Stakeholders

In dealing with PSAP oriented stakeholders, this Transition Plan references different types of organizations, including "9-1-1 Authorities" and "PSAP Administrators." Such references are intended to be functional and descriptive, not legal or statutory. Generally, PSAP Administrators are considered units of government with direct operational responsibility for PSAP services. These are not necessarily the PSAPs themselves, but often the host agency for the PSAP; for example, a city, county or other authorities responsible for establishing operational policies for PSAP services. 9-1-1 Authorities are organizations with planning, coordination, support, database management and (usually) funding responsibilities, but generally do not have direct PSAP operational responsibility. Most state 9-1-1 programs also fit this description. While the concept of the 9-1-1 Authority has been around for some time, such institutional arrangements are becoming more important to support the interconnected 9-1-1 environment described above with layered responsibilities and functions.

5.2 Commercial Mobile Radio Service Providers

This category relates to wireless carriers, and their resellers, as defined in 47CFR20.3[10]:
Commercial Mobile Radio Service. A mobile service which is:

(a) (1) provided for profit, i.e., with the intent of receiving compensation or monetary gain;
(2) An interconnected service; and
(3) Available to the public, or to such classes of eligible users as to be effectively available to a substantial portion of the public; or

(b) The functional equivalent of such a mobile service described in paragraph (a) of this section.

Currently these carriers follow the TIA standard J-STD-036C to deliver emergency services to the emergency services network. For discussion within this Transition Plan it is assumed that the wireless carriers are Wireless Phase II compliant. ATIS has an activity, referred to as Issue P0030, that is defining the interactions between an IP Multimedia Subsystem (IMS) originating network and a NG9-1-1 Emergency Services IP Network. This work is aligning 3GPP work with the NENA i3 effort.

5.3 Wireline Service Providers

This category represents Incumbent Local Exchange Carriers (ILECs), Competitive LECs (CLECs), Cable Operators that emulate the wireline service model and other such carriers that provide wireline services within their service area.

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[10] http://edocket.access.gpo.gov/cfr_2004/octqtr/pdf/47cfr20.3.pdf

5.4 VoIP Related Service Providers

This category includes several different types of providers, including, for example:

- Carriers, Cable Operators, resellers and service providers that offer VoIP services (i.e. VoIP Service Providers – [VSPs]) to their customers. These service providers may implement their own network or ride upon other broadband networks or the Internet. These carriers may have implemented NENA's i2 [7] or pre-i2[11] emergency services.
- An **Internet Service Provider** (**ISP**) provides Internet access to other companies and individuals.
- **Access Infrastructure Providers (AIPs)** that provide physical communications access to the subscriber. This access may be provided over telco wire, CATV cable, wireless or other media. Usually, this term is applied to purveyors of broadband internet access but is not exclusive to them.

Some providers fall into more than one category when they provide both access (as an AIP and/or ISP) and, VoIP service.

5.5 E9-1-1 System Service Providers

An E9-1-1 System Service Provider (E9-1-1 SSP) provides systems and support necessary to enable 9-1-1 calling for one or more PSAPs in a specific geographic area. It is typically, but not always, an ILEC.

This includes:

- A method of connectivity for all telecommunications providers including but not limited to the wireline, wireless, and VoIP carriers
- A method and mechanism for routing a 9-1-1 call to the PSAP with no degradation in service regardless of the technology used to originate the call
- Processing and storage of subscriber-based and other data necessary to establish and maintain databases supporting call routing and other E9-1-1 services
- A method to provide accurate location information for an emergency caller to a PSAP and if required, to other emergency response agencies
- Installation of PSAP call handling equipment and training of PSAP personnel when contracted to do so
- Coordinating with PSAP authorities and other telecommunications entities for troubleshooting and on issues involving contingency planning, disaster mitigation and recovery.

5.6 Equipment Vendors

Equipment vendors offer products and support for emergency services. In general, as it relates to emergency services, these vendors have been segmented between Customer Premises Equipment (CPE) and Network. However, vendor offerings may range from discrete products that provide a single function to an array of products offering turnkey solutions. For the focus of this Transition

[11] Pre-i2 is an unofficial but commonly used term referring to existing commercial offerings that do not provide automatic location acquisition and only provide dynamic ALI mechanisms where a pANI is stored in the ALI and an E9-1-1 SSP delivers location at call time.

Plan, product functionality needed to transition from the legacy environment to next generation capabilities is discussed.

5.7 Enterprise

Enterprises use Private Branch eXchange (PBX) equipment (a.k.a. MultiLine Telephone Service [MLTS]) or private networking for their communications needs. Enterprise customers may range from a single PBX site that interconnects directly to the Public Switched Telephone Network (PSTN) to multi-campus businesses with a national or large geographical footprint. For E9-1-1, Enterprise customers may have 1) their main telephone number represent the location of their premises switch, 2) use an offering such as PS-ALI where the TN is stored in the ALI database with the actual location or 3) VoIP pre-i2 dynamic ALI mechanisms where a pANI is stored in the ALI and an E9-1-1 SSP delivers location at call time.

5.8 Telecommunications Call Centers

Telecommunications Call Centers are those entities that triage an emergency call and act as intermediaries between the emergency caller and the PSAP Telecommunicator. These entities include Telecommunications Relay Services (TRS), Video Relay Services (VRS), telematics call centers, and other like services. These call centers may either initiate a conference call to the PSAP administrative line or use a pre-i2 solution to route the calls to PSAPs over 9-1-1 trunks. It has been noted that if an individual is using a 3rd party Internet-based relay services to reach 9-1-1 using text or video, this could lead to a time delay in processing the emergency.

5.9 Regulators/Legislators

This stakeholder community encompasses those policy makers and regulators that may be responsible for establishing laws supporting and/or providing structure around the provision of emergency public safety services, and regulating the provision of telecommunication services that support the request for such services. On the policy side, members of this community range from state and local policy makers (i.e., state legislators, along with county and local elected officials) to their federal counterparts in Congress. Regulators include state utility commission members responsible for monitoring the behavior of companies and the level of competition in the telecommunications industry, along with the Federal Communications Commission (FCC). For additional information see the Next Generation Partner Program's policy brief titled "A Policy Maker Blueprint for Transitioning to the Next Generation 9-1-1 System, on Issues and Recommendations for State and Federal Policy Makers to Enable NG9-1-1: September 2008."

This and other related documents may be found at this link http://www.nena.org/?NGPP_TransPolicy .

6. Assumptions

The following text is extracted from the overview of the DOT transition plan [1].

> "Transition to NG9-1-1 is expected to be an evolutionary process, involving technological, economic, and institutional change. In some cases, the path to NG9-1-1 implementation will depend on the underlying infrastructure involved and the characteristics of the PSAP and 9-1-1 Authorities in a defined geographic area. In other cases, the transition to NG9-

1-1 may depend more on the ability of originating service networks to deliver NG9-1-1 calls via native IP-based infrastructure to jurisdictions that are prepared to receive those calls. Regardless of the specific evolutionary steps, it is expected that NG9-1-1 system implementation will stem from a combination of the two general deployment environments described below, which reflect two extremes in existing institutional and service delivery arrangements around the country:

- **Coordinated, Intergovernmental Approach**: Planned and coordinated deployments of NG9-1-1 capabilities that are governed by statewide 9-1-1 Authorities, regional Authorities, or informal mechanisms that enable a cooperative deployment.
- **Independent, Unilateral Approach**: Decentralized deployments of NG9-1-1 capabilities by local jurisdictions through independent initiatives.

…While there is no single best approach to coordinating NG9-1-1 implementation at the local, state, or national level, stakeholders within each 9-1-1 community will need to weigh options to meet that jurisdiction's specific needs and unique circumstances."

This Transition Plan recommendations address both the "Coordinated, Intergovernmental Approach" (top down) and the "Independent, Unilateral Approach" (bottom up). There is no single approach that is "best" across North America. It is assumed that the transition to NG9-1-1 will be driven by the business and service needs of the stakeholders and federal or state/province level leadership. Therefore the industry can expect to see Requests for Proposals (RFPs) from the users (PSAPs, 9-1-1 Authorities, states/provinces, etc.) requesting NG9-1-1 functionality. The vendor community is expected to offer NG9-1-1 functionality through presentations and product positioning, and responses to the RFPs.

It is unlikely that PSAPs can introduce NG9-1-1 in a single phase. This is due to the tight linkage among the PSAP's capability, the emergency services network's capability and the capabilities of originating networks (wireline, wireless, etc.) as well as the desire for both carriers and PSAPs to control their transition schedules independently. Therefore there are likely stages that would be required that incrementally progress toward the final vision of NG9-1-1.

There needs to be a minimum set of service definitions and NG9-1-1 requirements and capabilities in place to facilitate transition.

7. Requirements

This section provides requirements that must be met during the stages of transition. Some of the requirements are universal, e.g. the ability to maintain functionality through a transition stage. Other may be unique to specific stages or scenarios.

7.1 General Requirements

REQ.0100.0100 Existing capabilities must be maintained through each stage of the transition, limited by the ultimate NG9-1-1 functionality.

REQ.0200.0100 Transitioning PSAPs must develop standard operating procedures to properly handle various NG9-1-1 media including incoming and originating phone calls, video, images, and text.

REQ.0300.0100 It is desirable for the transition to full NG9-1-1 (i3) capabilities to be implemented in phases.

REQ.0400.0100 Requirement removed.

REQ.0500.0100 Documents must be created which advise authorities how to design the ESInets, the core NG9-1-1 infrastructure and the connectivity between networks. (Supporting document [17])

REQ.0600.0100 Governance agreements and shared service arrangements should be established prior to, or during the implementation of each NG9-1-1 implementation phase to support and maintain the phase being implemented.

REQ.0700.0100 Adoption, support and implementation of call routing rules and procedures affecting multiple PSAPs must be collaboratively developed and change procedures adopted and implemented by the affected PSAPs prior to their usage in NG9-1-1. (Supporting document [18])

> REQ.0700.0101 It is desirable to develop various levels of collaborative business rules within and between PSAPs affected by the NG9-1-1 transition for handling calls for service routing, incident data, dispatch information, security, confidentiality, and other NG9-1-1 specific procedures and information.
>
> REQ.0700.0102 Procedures and appropriate governance measures must be adopted for updating calls for service routing rules, data confidentiality, data sharing, data security, and other NG9-1-1 specific procedures for data and information processing.
>
> REQ.0700.0103 Contingency plans and policy rules will have to be developed and implemented for routing calls for service in case one or more PSAPs are overloaded or inoperable.
>
> REQ.0700.0104 The relevant authority for a transitioning PSAP must develop governance and maintenance procedures for supporting the core NG9-1-1 infrastructure, ESInet and IP capable PSAP equipment. For example, procedures and responsibility must be established for the timely replacement of broken or outdated equipment.

REQ.0800.100 Adoption, support, and implementation of changes in call termination points, call routing rules and procedures affecting origination networks must be collaboratively developed and change procedures adopted and implemented by the affected networks and PSAPs prior to their usage in NG9-1-1.

REQ.0900.100 Appropriate training must be provided to affected Telecommunicators, emergency responders, and administrators on the functions, capabilities, and requirements of NG9-1-1 equipment and data prior to the cutover to live operations of any NG9-1-1 implementation phase within an affected geographic area.

REQ.1000.0100 For any call handled by an i3 Emergency Services Routing Proxy (ESRP), routing Policies will have to be provisioned, tested and implemented for use by the ESInet's Policy Routing Function (PRF) including routing policies for legacy PSAPs.

REQ.1100.0100 The 9-1-1 Authority for transitioning PSAPs must have the appropriate Geographic Information System (GIS) data including address information, streets, responder boundaries, and other data required for proper validation and routing within the core NG9-1-1 infrastructure and affected PSAPs. (Supporting document [20])

REQ.1200.0100 The 9-1-1 Authority must develop procedures to reconcile legacy location validation and routing databases (e.g., MSAG, ALI and SRDB) to NG9-1-1 GIS-based databases. (Supporting document [19])

REQ.1300.0100 The 9-1-1 Authority for transitioning PSAPs must have procedures in place for the timely update and maintenance of GIS data including new address information, new or changed streets, responder boundaries, and other data required for proper validation and routing within the NG9-1-1 system and affected PSAPs.

REQ.1400.0100 Governance and procedures must be in place and utilized for identifying and correcting NG9-1-1 geographic data discrepancies at local, regional, state, and national levels. For example, procedures and responsibilities must be implemented for identifying gaps and overlaps in geographic boundaries along with effective and timely correction of the identified problems.

REQ.1500.0100 All data in NG9-1-1 networks shall be replicated and geographically distributed. Policies, procedures, and agreements for such replication and distribution must be developed

REQ.1600.0100 Geographic routing and location validation databases must meet appropriate NENA standards.

REQ.1700.0100 Geospatial data must meet quality assurance standards before it can be used in NG9-1-1.

REQ.1800.0100 PSAPs that want to take advantage of NG9-1-1 logging capabilities must upgrade their logging equipment to be NG9-1-1 compliant including CPEs, logging recorders, and other relevant equipment.

REQ.1900.0100 PSAPs that want to take advantage of NG9-1-1 capabilities may have to upgrade their time synchronization equipment.

REQ.2000.0100 The capabilities of downstream systems including Computer Aided Dispatch (CAD), radio, mobile data, and records management systems must be evaluated for compatibility with NG9-1-1 enhanced capabilities and to plan for evolving such systems to take advantage of the additional data available.

REQ.2100.0100 Security and privacy policies must be created to effectively use NG9-1-1 standardized security and policy mechanisms. (Supporting documents [12], [13])

REQ.2200.0100 Network wide policies must be created to synchronize time across the entire NG9-1-1 core infrastructure and IP-capable PSAP.

REQ.2300.0100 9-1-1 authorities must coordinate their activities with public education efforts to take advantage of enhanced NG9-1-1 capabilities.

REQ.2400.0100 Affected PSAPs should develop, test, and implement rules and procedures for the transmission of NG9-1-1 information to appropriate data users.

REQ.2500.0100 The provisioning of critical NG9-1-1 data such as GIS, rules and policies must be in place that includes the required information along with quality control and assurance procedures in order to facilitate transition.

REQ.2600.0100 The 9-1-1 Authority must conduct an environment assessment as a beginning transition planning step and then develop risk mitigation strategies resulting in the development of a complete transition plan that is compatible with other transitioning agencies.

REQ.2700.0100 Transition planning at all 9-1-1 Authority levels (national, state, regional, and local) must be in place, covering every PSAP, and the plans must be coordinated to handle all contingencies of various levels of transition.

REQ.2800.0100 PSAP Call Control features[12] such as Called Party Hold, Enhanced Called Party Hold, Ringback, switch-hook Status and Forced Disconnect shall be supported in transition where originating and intermediary networks currently support them and PSAPs already, or plan to, utilize them.

8. Reference Model and Transitioning Scenarios

Figure 8-1illustrates the reference model that can be used for discussion of the transition scenarios. For all three scenarios the i3 components of the Border Control Function (BCF), LNG, ESRP, ECRF and NG9-1-1 PSAP CPE are put in place prior to the transition. The LNG location server/database (referred to as the Location Database (LDB] in this document) is populated with location information prior to transition. A new functional element is introduced called the LSRG. The function of the LSRG is to provide the interworking between the NG9-1-1 system and the legacy Emergency Services Network for routing and bridging. It inherits much of the functionality of the LNG and LPG defined in the i3 specification. This and additional functionality will be discussed in later sections. Certainly pre cutover testing would have to take place prior to the transition, but is considered complete for this discussion.

In Scenario 1 (Tandem to Tandem), emergency calls ingress to the SR and are directed over Tandem to Tandem trunks[13] to the LSRG in the NG9-1-1 system. And there may be a need to transfer/bridge calls between the two networks using the Tandem to Tandem capabilities. In Scenario 2 (Migration of SR Trunks to LNG Trunks) calls are migrated from the SR trunks to the LNG trunks. In Scenario 3 (Dual Mode PSAP) the Dual Mode PSAP has connections to both the ESRP and the SR. Calls that ingress through the SR are delivered to the PSAP via the legacy TDM trunks. The PSAP must query the ALI for location information. Calls that enter through the ESInet are routed using location and the calls are delivered to the PSAP via the IP connectivity, including location.

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[12] Some of those features are described in NENA 03-005 – Generic Requirements for an Enhanced 9-1-1 Selective Routing Switch [9]

[13] These Tandem to Tandem trunks are expected to be SS7/ISUP supported trunks. MF trunks can be used, but are not the most desirable choice. These trunks are “dedicated” to only 9-1-1 traffic.

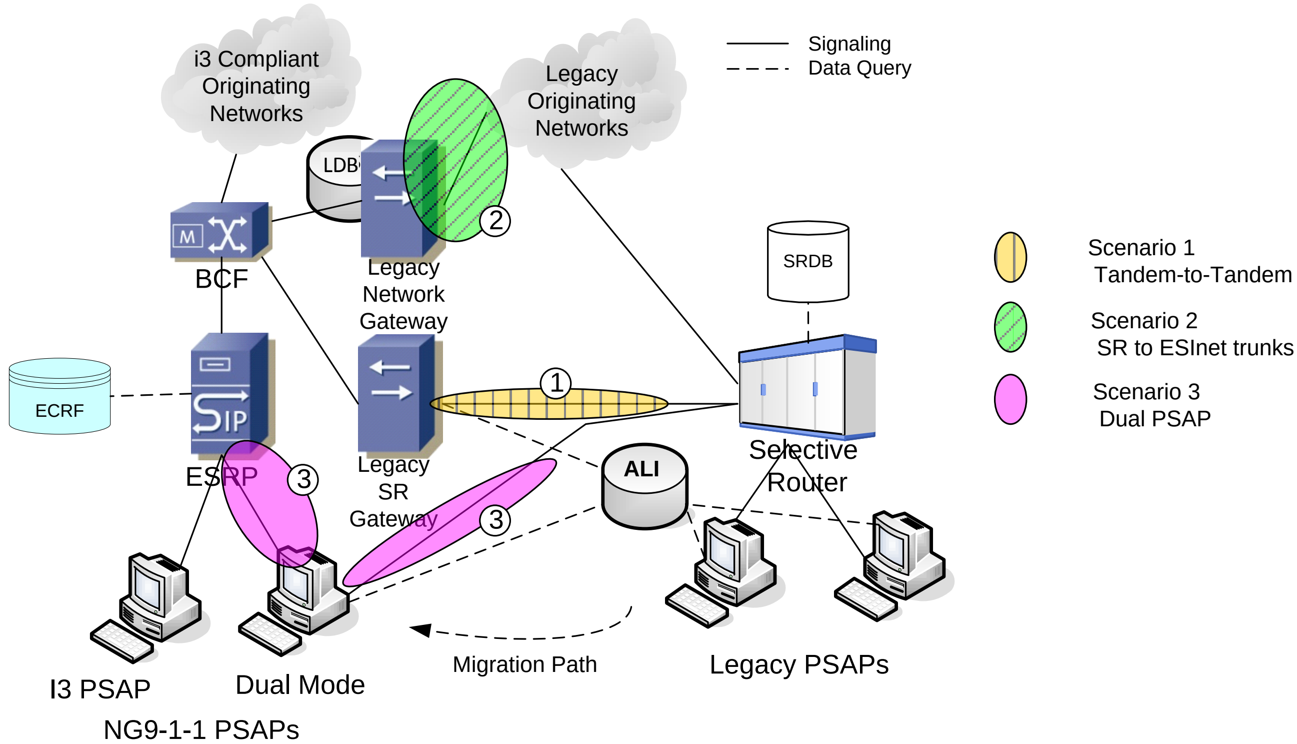

Figure 8-1 Transition Reference Model

8.1 Scenario 1 – Transitioning Via Tandem to Tandem Capabilities

Using Tandem to Tandem capabilities requires routing changes in the SR that would allow 911 calls destined to NG9-1-1 PSAP to be "Tandem to Tandem" routed to the ESInet. NENA's 03-003[14] specification should be used as a guideline for performing the routing. NENA's 03-003 specification defines two types of interfaces: dedicated and non-dedicated trunks. This transition scenario should use the dedicated trunk interface. Also NENA's 03-003 defines two types of routing: *Direct Routing/Transfer to 2nd Tandem*[15] and *Selective Routing at the 2nd Tandem*[16]. The preferred routing method for initially routed calls destined for NG9-1-1 PSAPs is *Selective Routing at the 2nd Tandem*. In this scenario the LSRG between the E9-1-1 SR and the NG9-1-1 system appears to the E9-1-1 SR as another SR connected via SS7 signaling.

In order to support PSAP Call Control features in a Tandem to Tandem environment, it is recommended that the SR and the LSRG implement Connection Hold network capabilities.

[14] NENA 03-003, NENA Recommendation for the Implementation of Inter-Networking, E9-1-1 Tandem to Tandem, February 2000.

[15] The type of call where the initial E9-1-1 Tandem has determined that the call needs to be sent to a second E9-1-1 Tandem and the destination for the call has been pre-determined.

[16] The type of call where the selective routing of a call should be done in another E9-1-1 Tandem. In this case, the first tandem has determined that it is not the proper E9-1-1 Tandem to selectively route the call.

8.1.1 Routing Initial Calls from Legacy Emergency Networks to the NG9-1-1 System

The following mechanism may be used to direct the call to the NG9-1-1 system. When NG9-1-1 PSAP is ready to take calls, the ESN in the SR that formerly pointed to the CAMA trunks of the legacy PSAP now points to the Tandem to Tandem trunks to the LSRG.

Then the call flow would be as shown in Figure 8-2[17]. The legacy wireline subscriber would initiate a 9-1-1 call and the End Office (or wireless subscriber from MSC, etc.) would route the call to the SR①. The SR would look up the TN (or ESRK or ESQK) in the SRDB to obtain the ESN②. Since the ESN has been reconfigured, it would point to the Tandem to Tandem trunks and the SR would route the call to the LSRG③. The SR would pass "911" in the Called Party parameter and the ANI (TN, ESRK or ESQK) in the Calling Party parameter. The Legacy SR Gateway would acquire location from the ALI using existing ALI query protocols ④ and route the call to the ESRP by querying the ECRF with the location to obtain the URI of the ESRP (not shown). Once the call is received by the ESRP, normal i3 routing would occur where the ESRP queries the ECRF with this location⑤, receives the PSAP routing information and delivers the call to the PSAP⑥.

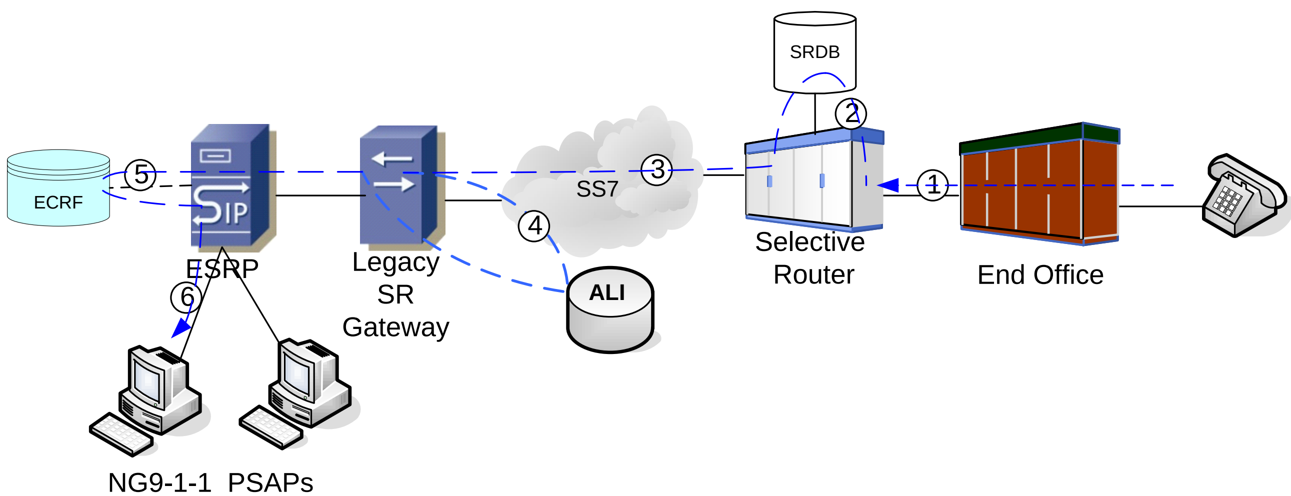

Figure 8-2 Wireline Call Transiting Selective Router to NG9-1-1 System

[17] This figure illustrates the wireline case. Wireless and VoIP call flows can be extrapolated from it.

8.1.2 Routing Initial Calls from NG9-1-1 System to the Legacy Emergency Network

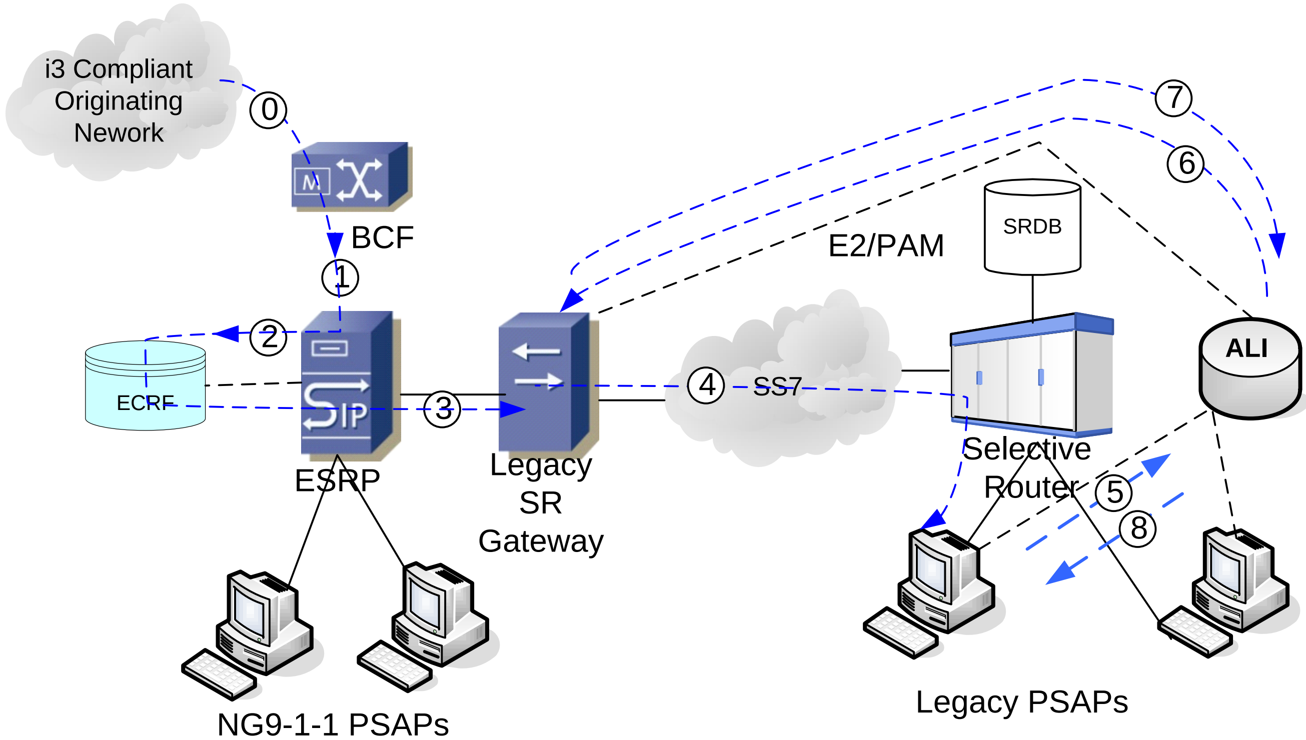

Figure 8-3 illustrates the corollary to the last call flow in that the call enters the ESInet and must be routed to the Legacy PSAP homed on the SR. This may apply when all calls are routed to the ESInet and the ESInet contains the logic as to when to route calls back to the legacy PSAP. The legacy PSAP has its normal connections to the SR and to the ALI.

For this scenario the caller's location, in the form of value or reference, is included in the call request from the originating network to the ESInet. However, due to the limits of the legacy network the location information cannot be passed in the call set up to the legacy PSAP. The recommended approach is to send a pseudo ANI to the legacy PSAP and have the legacy PSAP query the LSRG (through the ALI) for location information and Callback. That is, the LSRG caches the location information, allocates a pANI and sends that to the PSAP (through the SR) in the call request. This method is similar to the methods used for wireless and VoIP. The legacy PSAP then queries its ALI which steers the request to the LSRG. The location and Callback Number are provided in the response. That option is illustrated below.

The call enters the ESInet via the Border Control Function (BCF) ⓪. It includes the caller's location in the form of value for the location. The BCF forwards the call to the ESRP ①. The ESRP then queries the ECRF with the location information to obtain routing instructions ②. The ECRF determines that the destination is a legacy PSAP and returns that routing URI that resolves to the LSRG to the ESRP. The ESRP routes the call to the LSRG ③. Once the LSRG receives the call request it caches the location information and allocates a pANI from a pool associated with the PSAP. The LSRG then forwards the call request to the Selective Router ④ and the Selective Router routes the call, with the pANI, to the PSAP. When the legacy PSAP receives the call, it queries the ALI query using the pANI ⑤. The ALI steers the query to the LSRG passing the pANI ⑥ and the LSRG returns the Callback Number and the location information ⑦. For an E2 response the ALI combines the information received with a shell record before returning location information and

Callback information to the legacy PSAP ⑧. For a PAM[18] response, the received information is just formatted by the ALI and returned to legacy PSAP.

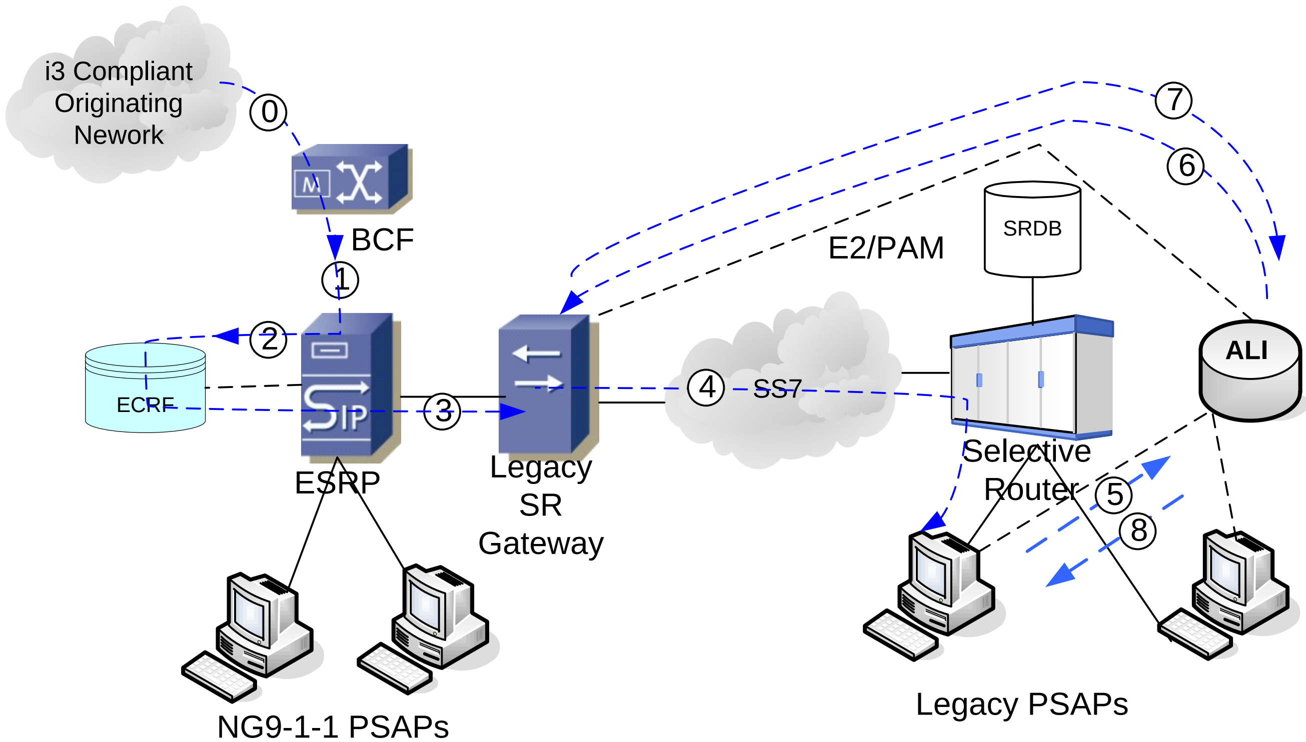

Figure 8-3 Wireline Call Transiting NG9-1-1 Network to Selective Router

8.1.3 Bridging Using Tandem to Tandem Capabilities

It may be necessary to transfer/bridge 9-1-1 calls between a legacy PSAP and an NG9-1-1 PSAP. The Tandem to Tandem function defined in NENA 03-003 may be used for describing the method of transferring the call.

One significant difference between initially routed calls and bridged calls is that bridged calls cannot be routed based upon location. That is, when a call arrives at a PSAP and that PSAP decides to bridge on another party, that party may not have any significance to the caller's location[19]. When the Legacy PSAP needs to transfer/bridge the call to an NG9-1-1 PSAP then the *Direct Routing/Transfer at 2nd Tandem* method must be used. In this method the SR determines the destination PSAP address either directly from the dialed digits or internal translations (e.g. one button calling to TN). That flow is shown Figure 8-4. The PSAP Telecommunicator keys in the manual transfer number (or uses one button transfer) and the SR sends the call toward the LSRG trunks. ① For this method, the Called Party parameter would contain a 10 digit number of the NG9-1-1 PSAP (or a number that can be translated into a URI used by the LSRG and the ESRP to route

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[18] PSAP to ALI Message specification

[19] The subsequent destination may not always be a PSAP in the traditional sense of the term. It may be another emergency services related entity such as, but not limited to poison control, NORAD, Coast Guard, DHS, etc.

the call to the i3 PSAP) and the Calling Party parameter would contain the ANI (TN, ESRK, or ESQK). Since the legacy Selective Router only deals with the E.164 domain, a 10 digit number is needed to identify the destination PSAP. The LSRG could query the ALI for location ② and then the ALI would return it ③. The LSRG queries the ALI to obtain the location information to pass to the PSAP, but does not use that location information for routing. The NG9-1-1 system should use destination routing (using the TN in the Called Party parameter), rather than query the ECRF for location based routing, to route the call to the destination PSAP. Therefore, the LSRG determines the routing and forwards the call to the ESRP ④ and the ESRP delivers the call to the PSAP ⑤, including location.

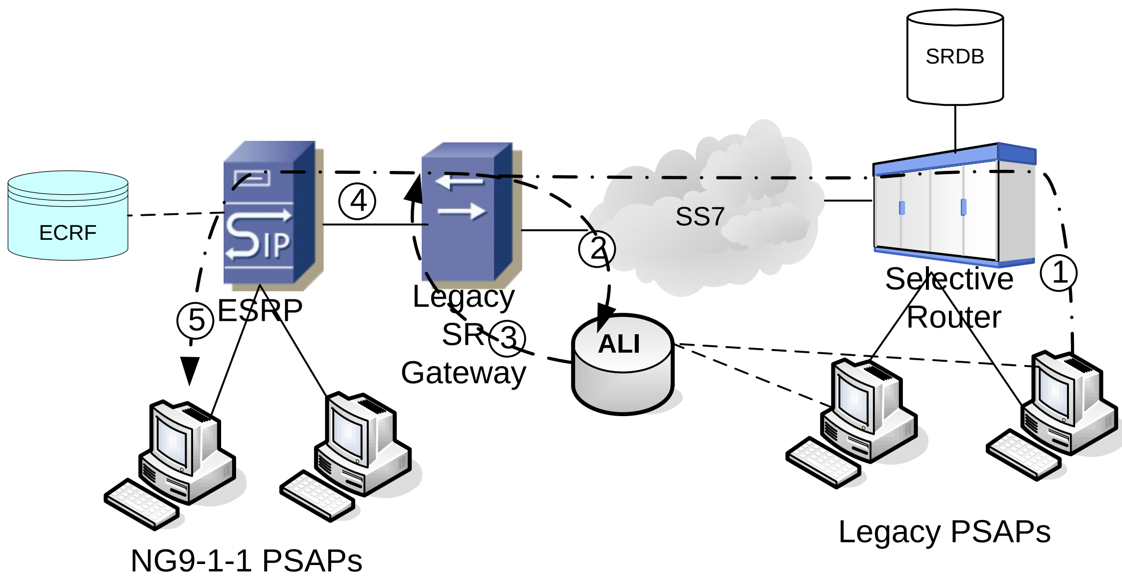

Figure 8-4 Bridge – Legacy PSAP to NG9-1-1 PSAP

Figure 8-5 illustrates the corollary to the last call flow in that now the NG9-1-1 PSAP bridges a call to the Legacy PSAP. The legacy PSAP has its normal connections to the SR and to the ALI. Again NENA 03-003 can be used as a guide for the method to transfer the call. For this scenario the NG9-1-1 PSAP has the caller's location information and additional data. However, due to the limits of the legacy network it cannot be passed in the call set up. One option would be to bridge the call with only the Callback Number. This might result in a "No Record Found" in the ALI query. However the recommended approach is to provide a pseudo ANI to the legacy PSAP and have the legacy PSAP query the LSRG for location information and Callback. That is, the LSRG caches the location information, creates a pANI and provides that to the legacy PSAP in the call request. This method is similar to the methods used for wireless and VoIP. The legacy PSAP then queries its ALI which steers the request to the LSRG. The location and Callback Number are provided in the response. That option is illustrated below.

The LSRG must use the Direct Routing/Transfer at 2nd Tandem method. That is, the NG9-1-1 PSAP must address the PSAP directly using its 10-digit number as shown in Figure 8-5. The NG9-1-1 PSAP may obtain this number from the LoST database or have it pre-programmed. Once the LSRG receives the call request it caches the location information and determines a pANI from a pool associated with the PSAP. The LSRG then forwards the call request across the Tandem to Tandem Trunks to the legacy PSAP ②. When the legacy PSAP receives the call it will do an ALI query using the pANI ③. The ALI steers the query to the LSRG passing the pANI ④ and the LSRG returns the Callback Number and the location information ⑤. For an E2 response the ALI combines the information received with a shell record before returning location information and Callback information to the legacy PSAP ⑥. For a PAM response, the received information is just formatted by the ALI and returned legacy PSAP.

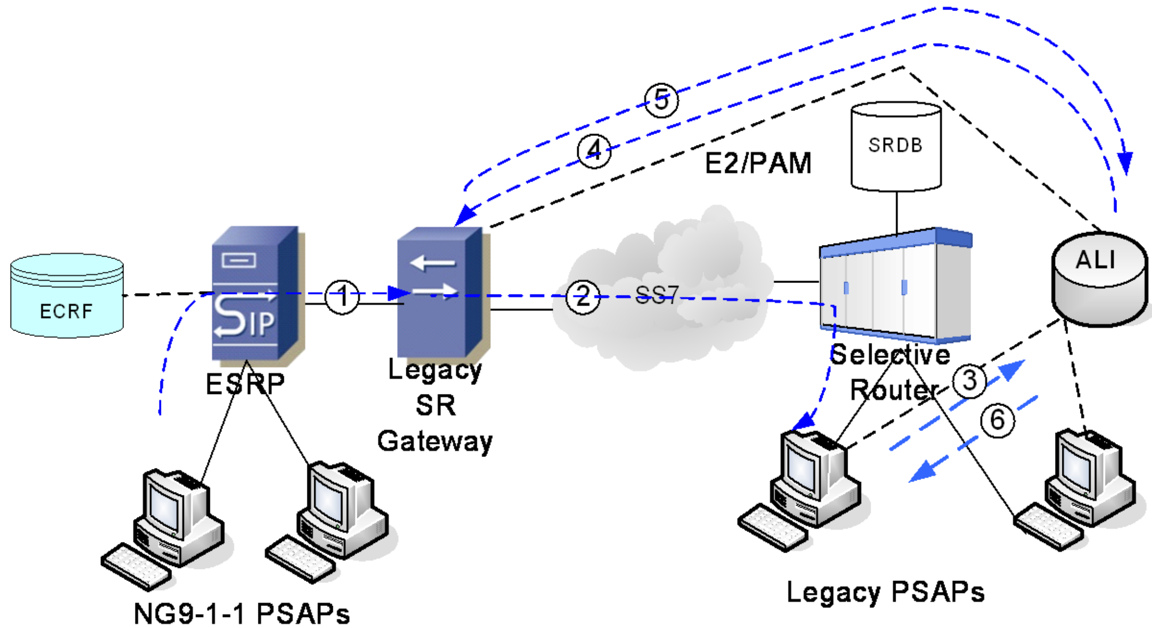

Figure 8-5 Bridge – NG9-1-1 PSAP to Legacy PSAP

8.1.4 Network Element Redundancy Considerations

For improved reliability, the LSRG may be redundant. Then the SR would have Tandem to Tandem trunks to each of the LSRG network elements.

Some existing emergency services network incorporate dual SRs to provide redundancy. Then, for example, each End Office may have trunks to both SRs and the SRs may have independent trunks to the PSAP. In this implementation each SR would have Tandem to Tandem trunks to the Legacy SR Gateway(s).

8.1.5 Error Conditions

Two error conditions should be considered for calls entering the legacy emergency service network: no ANI received with the call and No Record Found (NRF) in the SRDB. Under normal default routing conditions in the legacy emergency services network, the call would be default routed based upon the incoming trunk or other criteria. If trunk routing is used, it is possible that routing could point to the Tandem to Tandem trunks of the LSRG. However, the ESInet will not have sufficient information to route the call and would have to default route it. It is left up to policy as to whether default routed calls are handled by the legacy E9-1-1 SSP or routed to the NG9-1-1 system.

There is a corollary for calls entering the NG9-1-1 system for which a URI cannot be mapped to a DN that is associated with a PSAP in the legacy emergency services network. It is left up to policy as to whether default routed calls are handled by the NG9-1-1 system or routed to the legacy E9-1-1 SSP.

8.2 Scenario 2 – Migrating Emergency Services Calls from SR Trunks to LNG Trunks

Figure 8-6 may be used to illustrate the Scenario 2 where calls from originating networks are migrated from trunks to the SR to trunks to the LNG. This scenario may be used when wireline services areas align with jurisdiction boundaries. It may also be used when wireless or VoIP calls are migrated from the SR to the NG9-1-1 system. And it may be a follow on step to Scenario 1 when all calls from originating networks originate within the NG9-1-1 PSAP service boundary. PSAP Call Control features, if supported by the originating and intermediary networks and the PSAP, will continue to be supported during such transition since the required TDM-SIP interworking will be implemented at all points where TDM to SIP and SIP to TDM conversions are necessary (i.e., the LPG and the LNG).

The NG9-1-1 system network elements are put in place and tested. The LNG's LDB is populated with appropriate location data. The OSP installs new trunks to the LNG, while, potentially, maintaining connections between the end office and SR, until such time as the new trunks can be thoroughly tested. At that point, traffic can be moved off of the "EO to SR" trunks and onto the direct circuits between originating switch and the LNG.

Then the switching elements in the originating network (e.g. End Offices, MSCs, etc.) reroute emergency calls to the trunks on the LNG. In order to do transfers between the ESInet and the legacy SR, Scenario 1 (the Tandem to Tandem) capabilities are required as described above.

As mentioned in section 9.4, one option for migrating calls from a VSP network to the NG9-1-1 system would be to add trunks from the VSP ESGW to the LNG. However this is inefficient from a voice quality standpoint. That is, the voice which carried in Real Time Protocol (RTP) packets would have to be converted into TDM and reconverted to RTP at the LNG. The recommended approach is to egress from the VSP network using native SIP/RTP through a BCF to the LNG. The LNG would receive native SIP and process the call request as already discussed. RTP would be negotiated between the VSP network and the NG9-1-1 system and no conversion is required.

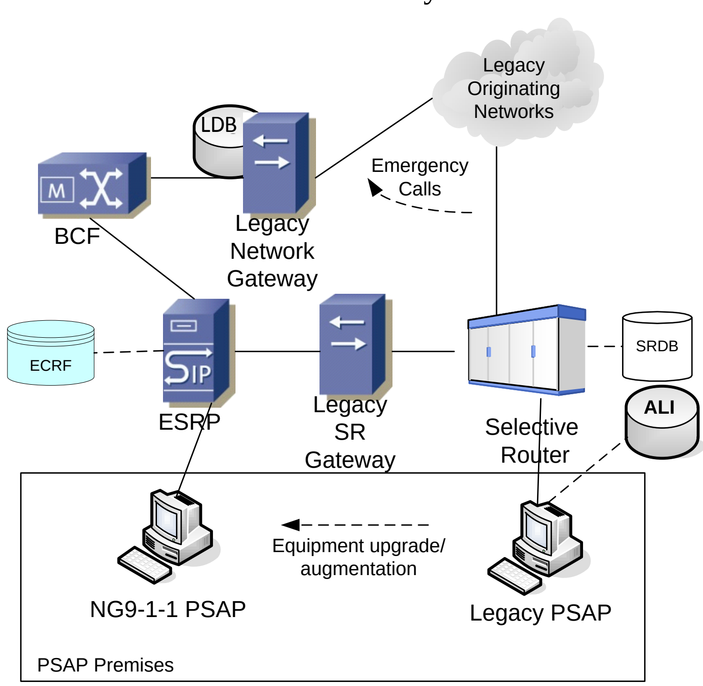

Figure 8-6 Migrating Calls from SR to Legacy Network Gateway

8.3 Scenario 3 – Dual Mode PSAPs

Figure 8-7 may be used to demonstrate the Dual Mode PSAP scenario. PSAP CPE may be upgraded to support i3 compliant emergency services calls simultaneously with receiving emergency services calls from the SR. Calls coming into the SR are routed using the SRDB and delivered to the PSAP. The PSAP then queries for ALI. Calls from the NG9-1-1 system are routed based upon location and delivered to the PSAP across IP connections. The location may be delivered with the call or a location reference is contained in the call request.

Since emergency services calls come into the PSAP from two sources the PSAP CPE must implement procedures to deliver them to the Telecommunicators. In order to do transfers between the ESInet and the legacy SR, Figure 8-5 (the Tandem to Tandem) capabilities are required as described above.

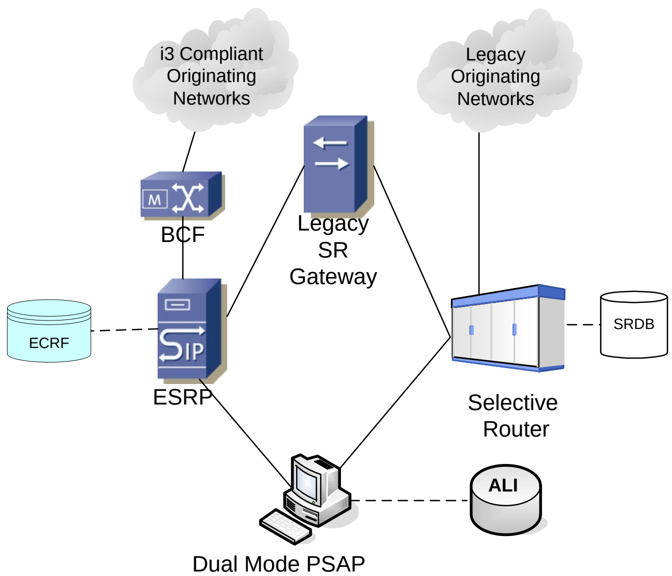

Figure 8-7 Dual Mode PSAP

9. Transition Considerations for Stakeholders

9.1 PSAP-Oriented Stakeholders

The NG9-1-1 environment will differ considerably from the current 9-1-1 environment. As discussed in Section 6, the changes are not limited to standards and technology. They include the governance, management and operation of the system and the delivery of services, both traditional 9-1-1 services along with other new emergency services. The changes affect the entire 9-1-1 community, including the general public and other emergency services. The planning and transition to an NG9-1-1 System will be an extensive, multi-year effort.

PSAP-oriented stakeholders must first consider the deployment approach for the transition. The USDOT NG9-1-1 System Initiative's *NG9-1-1 Transition Plan* describes two frameworks of deployment.

- Coordinated, Intergovernmental Approach: Planned and coordinated deployments of NG9-1-1 capabilities that are governed by statewide 9-1-1 Authorities, regional Authorities, or informal mechanisms that enable a cooperative deployment.

- Independent, Unilateral Approach: Decentralized deployments of NG9-1-1 capabilities by local jurisdictions through independent initiatives.

The deployment approach will determine the PSAP-oriented stakeholder's alignment with the proposed regulation for the E9-1-1 Grant Program authorized under the Ensuring Needed Help Arrives Near Callers Employing 9-1-1 (ENHANCE 911) Act of 2004 and the 9-1-1 Authorities and its relationship (or lack thereof) with the E9-1-1 Implementation Coordination Office (ICO). The deployment framework will also determine the type of planning and implementation coordinating body for the deployment and operation of the NG9-1-1 System. The planning and implementation coordination body may be a single state 9-1-1 Authority, regional authorities without a statewide authority or any informal mechanism to carry out a locally initiated endeavor.

The planning and implementation coordinating body must begin with a needs assessment to determine the operational requirements to form an overall picture of system requirements and baseline functionality necessary for any proposed NG9-1-1 solution. NG9-1-1 systems architecture will be designed based on these systems requirements. A transition plan must be developed to ensure the successful transition from the current 9-1-1 system to the new system and the management and operation of the system for optimal health and security. The individual transition plan must include the following:

- Consideration of the issues identified in the USDOT NG9-1-1 System Initiative's *NG9-1-1 Transition Plan,* NENA's Next Generation Partner Program's *A Policy Maker Blueprint for Transitioning to the Next Generation 9-1-1 System* and this *Transition Plan Considerations document*;
- Identification of all stakeholders that will be involved and impacted by the transition;
- Risk assessment to develop a risk management plan to ensure the successful transition to, and continued management and operations of, the current and future 9-1-1 systems. The risk management plan must be updated based on regular risk assessments;
- Opportunity assessment to identify the benefits associated with the development of new services or service improvements to existing services and the resulting benefits for various 911 stakeholders.
- Development of the readiness criteria for PSAPs and ESInets to interconnect;
- Identification operational issues and define the governance/management necessary for the optimal health and security of the system; and
- Identification the logistics of the transition by stakeholder groups

The planning and implementation coordinating body must ensure the active engagement of PSAP oriented stakeholders in the development of the transition plan that charts the course of initiatives and activities of the transition.

Some PSAPs currently utilize a set of features of the legacy networks enabling enhanced control over call disposition. Those PSAPs have policies and procedures designed to take advantage of those capabilities. Transition must ensure that those capabilities will continue to provide the same functionality.

9.1.1 Governance, Funding, Legal and Regulatory

The governance of the NG9-1-1 System applies the principle of statewide coordination and planning under the auspices of a designated state-level entity, which is articulated in the Wireless

Communications and Public Safety Act of 1999 and reinforced in the ENHANCE 911 Act of 2004. In support of statewide coordination and planning, NENA's Next Generation Partner Program's *A Policy Maker Blueprint for Transitioning to the Next Generation 9-1-1 System, NG9-1-1 Transition Policy Brief #1*, underscores that "Many key features and functions of NG9-1-1 will require an effective state-level leadership and coordination mechanism to be in place." It is also aligned with the U.S. Department of Transportation (USDOT) NG9-1-1 System Initiative's Concept of Operations and Transition Plan and other NG Partner Program's Policy Briefs.

The roles and responsibilities of the planning and implementation coordinating body and their PSAP-oriented stakeholders from PSAPs to state government is unclear and will likely evolve as NG9-1-1 matures. The definition of roles and responsibilities of local, regional and state government with effective stakeholder involvement is necessary to ensure an effective and seamless deployment and operation of the NG9-1-1 System, and to provide guidance and accountability.

Current funding for 9-1-1 and other emergency communications functions may be provided by different and disparate funding sources. The NG9-1-1 System will be a shared system comprised of multiple entities and components, of which 9-1-1 is one of several emergency services. A change to the funding structure will require a coordinated funding approach to support this shared system. This will lead to economies of scale that will enable parity of emergency services capabilities, interoperability, increased efficiency or cost savings within all aspects of emergency communications.

The existing legal and regulatory environment will also have to change. Existing laws and regulations must be reviewed and revised to allow for 1) architecture and technology neutrality, 2) the delivery of new and emerging services by non-Local Exchange Carrier service providers or service providers with new technologies, 3) the extension of liability protection laws to current and future service providers and 4) the alignment of new and existing service arrangements, costs and funding mechanisms with NG9-1-1. With the availability of more data associated with the 9-1-1 caller and his/her location, the confidentiality of personally identifiable information (PII) will have to be examined and protected.[20]

9.1.2 Acquisition and Implementation

The planning and implementation coordinating body, on behalf of the PSAP-oriented stakeholders, is responsible for the acquisition and implementation of the NG System, primarily the ESInet backbone, its core functions and services, and NG9-1-1 databases. Consideration must be given to interstate/interregional connectivity and support for interoperability with other public safety needs such as public safety radio interoperability.

[20] In some cases, that process has already begun, though that change has not always simplified the environment involved. As many states have moved away from regulating IP based services, or, at least questioned their authority to do so, IP based emergency services has been left in the void. This may ultimately be an issue for Congress to help clarify. Note, for example, the FCC's 2013 Report to Congress (Legal and Regulatory Framework for NG911 Services Report to Congress). Recommendation 4.1.2.2 (2) states "To address instances where states lack authority under state law to regulate certain elements of NG911 service or otherwise choose not to exercise such authority, Congress should consider enacting legislation creating a federal regulatory "backstop" to ensure that there is no gap between federal and state authority (or the exercise thereof) over NG911."

Consideration must also be given to how the NG9-1-1 core functions and services and NG9-1-1 database management services will be acquired (e.g. locally managed services, vendor managed services, tariff services). The functional requirements of the NG9-1-1 core functions and services must be defined in collaboration with 9-1-1 entities and in adherence to appropriate standards.

The relevant terms of connectivity to the ESInets and other PSAPs must be collaboratively developed and established. PSAPs and regional NG9-1-1 infrastructures will have to meet established requirements and adhere to appropriate standards, in order to interconnect at each level.

9.1.3 System Management and Operations

The NG9-1-1 System will be a more comprehensive emergency communications system with enhanced capabilities that allows for greater situational intelligence than today's 9-1-1 system. NG9-1-1 services are expected to expand beyond the 9-1-1 services of today and require higher levels of interaction and coordinated response among a wider base of stakeholders both vertically and horizontally. An NG9-1-1 system will incorporate other emergency services stakeholders beyond the boundary of the PSAP.

The planning and implementation coordinating body must facilitate the participation of PSAP-oriented stakeholders in the effort to:

- Prepare and train Telecommunicators to work in a multimedia environment, and handle increased quantity and quality of information available with the call;
- Prepare themselves and PSAP Administrators to handle contingency planning without geographic constraints. This involves developing up front agreements with other authorities, PSAPs and 9-1-1 entities on the relevant terms of cooperation;
- Prepare for the responsibility of deployment, maintenance, upkeep and oversight for their regional infrastructure; and
- Prepare themselves and NG9-1-1 data administrators to handle widely dispersed and highly replicated databases inherent in the NG9-1-1 System;

Processes and procedures must also be developed collaboratively for the following:

- resolving and escalating contract and service issues;
- data quality assurance; and
- security and data rights management.

9.1.4 Public Education

The planning and implementation coordinating body must facilitate and coordinate public education efforts with PSAP-oriented stakeholder to identify the core message to the public and deliver that message in a timely and effective manner. The phased deployment of the NG9-1-1 System will require the general public to be aware of where, when, what and how NG9-1-1 services are available. New communications options for the elderly, deaf, deaf-blind, hard of hearing or have speech disability, disabled, and non-English speaking populations will also need to be addressed in the effort to manage the public's expectation. When new services are added and announced to the public, care should be exercised to make sure that the public is aware of the specific areas where the new services are available, and not generate the belief that the services are generally available across the country.

9.2 Wireless Service Providers

The majority of Wireless Service Providers (WSPs) in the U. S. operate in the Wireline Compatibility Mode[21] for delivery of emergency calls to the 9-1-1 system and then to the PSAP. The WSPs may have direct trunking from their Mobile Switching Centers (MSCs) to the Selective Router (SR) to support a group of PSAPs homed on that SR. The trunks from the MSC to the SR are generally diverse. The WSP establishes these trunks to the SR as locally required or as agreed with the 9-1-1 Authority. From the SR there is trunking to each PSAP being supported by the SR. The trunks from the SR to the PSAPs may be separate and diverse to support each service type (wireline and wireless) or calls may be combined on a single trunk group to support all carriers.

The call routing to the PSAP is pre-determined by the WSP based upon negotiation with the PSAP or 9-1-1 Authority. Each PSAP is identified by a set of Emergency Service Routing Keys (ESRKs) to help ensure calls are routed correctly. In setting up the platform it is critical that these ESRKs are loaded in the WSP's platforms (the MPC/GMLC and MSC), the SR and in the ALI system to ensure calls are routed to the correct PSAP and ensure the required data is delivered with the call to facilitate the query for location and Callback Number.

When a wireless 9-1-1 call is originated in the WSP's networks, the WSP, or its 3rd party MPC/GMLC partner, identifies routing typically based upon the cell and/or sector. An appropriate ESRK is selected, the MSC selects the assigned trunk group and the call is routed to the SR. The SR uses the ESRK to identify the PSAP, selects the assigned trunk and delivers the voice portion of the call to the PSAP. The ESRK is used to query the ALI system for location information and Callback Number to be delivered with the 9-1-1 call. The initial PSAP query goes to a regional ALI system with links to the WSP's MPC/GMLC (or to an MPC/GMLC provided by 3rd party partner). When queried, the MPC/GMLC returns the Callback Number and cell site address location to the ALI system, which forwards them to the PSAP at the time of the call. If the PSAP wishes more accurate location information on a caller, the PSAP will perform a re-bid and the same process of request through the ALI system is used to obtain the caller latitude/longitude location. The WSP will utilize one of a variety of location determination systems (Assisted Global Positioning System [GPS], Time Difference of Arrival, etc.) to gather measurements used in the calculation of a more precise location estimate of the caller.

Legacy routing determination is a cooperative effort between the WSP, or its 3rd party MPC/GMLC partner, and the 9-1-1 Authority. The baseline process is to obtain the accurate PSAP boundaries from the 9-1-1 Authority. The WSP, or its 3rd party partner, then negotiate with the 9-1-1 Authorities to identify the PSAP which will accept wireless calls. Once the PSAP is identified based upon cell site coverage, then the parties will determine and agree on a cell site and/or sector routing. The WSP, or its 3rd party partner, will then identify and allocate ESRKs to the appropriate PSAP. During the deployment process, these ESRKs will be loaded in the appropriate security, cross reference and steering tables to ensure the required databases, MPC/GMLC, MSC, SR and ALI system are provisioned and operational at the time of implementation.

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[21] The Wireline Compatibility Mode allows wireless calls to be routed just as wireline calls are. A pseudo ANI (i.e. the ESRK) is delivered to the PSAP in the call request. The PSAP may then query the MPC/GMLC through the regional ALI system with this ESRK to obtain the Callback Number and Location Information. For further information on Wireline Compatibility Mode, see TIA/EIA J-STD-036B.

Three main transition scenarios are described in Section 8 which are applicable to WSPs. They are Scenario 1 , Tandem to Tandem (see Section 8.1); Scenario 2 , SR Trunks to LNG (see section 8.2) and Scenario 3 , Dual-mode PSAP (see Section 8.3).

Under Scenario 1 , where calls are routed through the SR to the NG9-1-1 system via an LSRG, there is no impact on WSPs. WSP migration will follow the Selective Router migration path. Eventually calls may be migrated to Scenario 2 when all PSAPs have migrated off of the Selective Router.

For Scenario 2 new trunks would have to be installed from the MSC to the LNG and tested with the NG9-1-1 operator. It is possible that the existing ESRK pool can be used. If not a new ESRK pool would have to be created for the NG9-1-1 PSAP. In either case the MSC would be reconfigured so that the ESRKs point to the trunk group associated with the LNG.

For Scenario 3 , there would be no changes since the WSP would continue to route calls to the SR. Eventually calls may be migrated to Scenario 3 when all PSAPs have migrated off of the SR.

In the long term, WSPs are planning migrations to IP Multimedia System (IMS)[22] or Long Term Evolution (LTE)[23] where the core network is IP-based. Regardless, the latitude/longitude location information may not be available at call set up and cell site address still will have to be relied upon for routing. Since wireless calls are considered mobile, the PSAP will have to query for location updates. Considerations must also be given that a PSTN call delivery to an administrative line at a PSAP remains as a backup in a case where normal call delivery cannot be completed.

9.3 Wireline Service Providers

This section describes the architecture/transition of connecting legacy wireline service provider trunking networks (e.g. ILEC, CLEC) to the NG9-1-1 system. It is expected that as NG9-1-1 systems are deployed, there will continue to be legacy wireline networks that will need to interconnect with the ESInet.

When a legacy wireline end user dials “9-1-1,” the end office recognizes the call to be an emergency call and prepares to route the call. In a traditional E9-1-1 network, the end office has dedicated MF or SS7 signaling trunks to the SR and routes all calls from the end office over the dedicated facilities to the SR. As legacy Emergency Services Networks evolve to NG9-1-1, it is expected that the SR will no longer be the element to which the legacy end offices route wireline emergency calls.

In the context of the NG9-1-1 System, functionality previously provided by the SR is distributed among various NG9-1-1 network elements. It is expected that the LNG will be the element to which an end office routes emergency calls. The end office will have dedicated facilities to the LNG and will route all 9-1-1 calls generated at the end office to the LNG.

The LNG has distinct functions to perform:

- To provide the protocol interworking from the SS7 or MF signaling that it will receive from the end office to the SIP signaling that is used in the NG9-1-1 system. The LNG receives the telephone number (TN) (i.e., calling number or Automatic Number Identification [ANI]) of the 9-1-1 caller from the end office.

[22] IMS is defined by 3GPP

[23] LTE is defined by 3GPP

- To use this information to query a location database/server for provisioned location information, typically in the form of a civic address, associated with the TN.
- To route the 9-1-1 call to the appropriate ESRP on the ESInet.

The transition of E9-1-1 trunking from end office-to-SR to LNG will need to be carefully planned, coordinated and executed. The number of dedicated E9-1-1 trunks from the end offices to SRs will need to be emulated/exceeded for end offices to the LNG to maintain current E9-1-1 equivalent grade of service (GOS) during transition. Additionally, the E9-1-1 trunking must ride logically and physically diverse transport facilities to eliminate single points of failure.

The transition steps may be different if the change from E9-1-1 to NG9-1-1 is within the same E9-1-1 SSP. In that case it is akin to other technology changes implemented over the years within the E9-1-1 SSP's tenure, and it minimizes the number of steps that would otherwise need to be taken if the change is between a legacy E9-1-1 SSP and a new NG9-1-1 operator.

The sections below will address transition from these two different situations.

Some wireline networks support a set of features enabling enhanced control over call disposition by the PSAPs. Those PSAPs have policies and procedures designed to take advantage of those capabilities. Transition must ensure that those capabilities will continue to provide the same functionality.

9.3.1 Transition is Within the Same E9-1-1 SSP:

An upgrade of an E9-1-1 system to an NG 9-1-1 system will have an impact on legacy providers, but the impact will be less if the NG9-1-1 system is provided by the E9-1-1 SSP that already provides service to the legacy provider. If the NG9-1-1 system is provided by a different E9-1-1 SSP, the legacy provider will experience additional impacts including new database loads, the creation of new duplicate trunk groups, and support of a significant call-through test period.

There are two likely options:

1) A flash cut where the E9-1-1 System Provider swings the existing "EO to SR" type circuits into the to the LNG, and the wireline provider has little to do, or
2) The Wireline provider is asked to install new trunks to the LNG, while maintaining connections between the end office and SR, until such time as the new trunks can be thoroughly tested. At that point, traffic can be moved off of the "EO to SR" trunks and onto the direct circuits between the end office and the LNG.

Another longer-term scenario is where the end office evolves to become i3-capable and comes into the ESInet via a Border Control Function (BCF) using IP connections.

The first several conversions will probably follow option 2 above. The E9-1-1 SSP would need to work with its ILEC division to pre-install to the new "replacement" network and pre-test the new design. This would allow the staging of cutover dates and the ability to swing back to the legacy network in cases where a rollback of service is required.

One benefit of an existing E9-1-1 SSP doing the network modification is that wireline division will be sending data to the same E9-1-1 SSP that they are today, and that they won't need to duplicate that portion of their service.

As the E9-1-1 SSP becomes more practiced at the network changes it could do a flash cut (option 1) and "swing" the wireline provider's circuits off of the existing network, and onto the ESInet. That would reduce the costs of the duplicate trunks to the wireline carrier, and reduce the costs that they would have to add to the billing of the 9-1-1 system for that change.

When the ILEC is also the SSP it may have the same (parent) company. For the purposes of discussion here, those two entities should be considered to be separate companies. In the role of the E9-1-1 SSP they have incoming calls from more than just their own parent company. They have incoming calls from numerous other originating service providers in their serving area as well. Therefore, each originating service provider should be considered a separate entity, aside from the role of the E9-1-1 SSP. And, each originating service provider will have duplicate responsibilities as outlined for the "legacy" wireline system providers here.

Other aspects inherent to E9-1-1 that must be addressed during transition (and afterward) are default routing, congestion control, and conference and transfer features between other 9-1-1 systems served by the same E9-1-1 SSP to interface early adopter and non-early adopter PSAPs etc. Legacy E9-1-1 SSPs might accomplish this through the use or establishment of links between their legacy and NG9-1-1 systems. See Section 10 for further discussion.

9.3.2 Transition Involves a New NG9-1-1 Operator:

If the wireline originating service provider is not the same entity as the NG9-1-1 provider, or the originating service provider is a CLEC, then options 1 and 2 described above still apply for transitioning. Early transition activity will most likely follow option 2: install new trunks to the LNG while maintaining existing trunking to the SR.

Therefore, the NG9-1-1 operator would need each legacy ILEC, CLEC and even PS/ALI customers that trunk directly into the legacy network to pre-install to the new "replacement" network and pre-test the new design. This would allow the staging of cutover dates and the ability to swing back to the legacy network in cases where a rollback of service is required.

As the NG9-1-1 operator becomes more practiced at the network changes, the originating service provider could do a flash cut (option 1) and “swing” the wireline provider's circuits off of the existing network and onto the ESInet. That would reduce the costs of the duplicate trunks to/from the wireline carrier, and reduce the costs that they would have to add to the billing of the 9-1-1 system for that change.

As opposed to the case where the wireline service provider and the E9-1-1 SSP are the same entity, the wireline service provider may have to send its data through existing channels and to the operator responsible for the location database associated with the LNG.

9.4 VoIP Service Providers

Today, VoIP Service Providers (VSPs) sometimes outsource their 9-1-1 processing to third parties for location validation and routing determination. These services operate in either a pre-i2 or i2 environment. A VSP may contract with a single 3rd party or multiple 3rd parties. Third parties provide services for multiple VSPs.

For location validation these 3rd parties offer a national Validation Database (VDB) service. The MSAG is received periodically from E9-1-1 SSPs and entered into the VDB. For pre-i2 offerings the VSP sends the subscriber location to the VDB, the VDB validates it, geocodes it, and stores it internally. For an i2 solution the VSP pre-validates the locations against the VDB and store them in their Location Information Server (LIS).

For call routing, the VSP interrogates the 3rd party’s VoIP Positioning Center (VPC) to determine routing information (e.g. Emergency Services Routing Number [ESRN] for pre-i2 and Emergency

Routing Tuple [ERT] for i2) and ESQK). In the pre-i2, offering the VSP sends the call to the 3rd party, the 3rd party determines the routing information, and either returns the call request to the VSP or routes the call through its Peering Network to an Emergency Services Gateway (ESGW). For an i2 solution the VSP interrogates the VPC and then routes the call through its network to an ESGW. The ESGWs have trunks to the appropriate Selective Routers. For the case where a Peering Network is used, multiple VSP traffic is carried across the trunks to the Selective Routers.

To determine the impact on VSPs and their 3rd parties of transitioning to NG9-1-1 the scenarios described in Section 10 may be used. Three main transition scenarios are described in Section 10 which are applicable to VSPs. They are Scenario 1 (Tandem to Tandem) (see Section 8.1), Scenario 2 (SR Trunks to LNG Trunks) (see section 8.2) and Scenario 3 (Dual-mode PSAP) (see Section 8.3).

For Scenario 1 where the PSAP on ESInet and Carrier on SR, there is no impact to the VSP or their 3rd party partners. The emergency calls may continue to be delivered to the SR and the SR will route the calls to the NG9-1-1 network.

For Scenario 2 , trunks from the ESGW to the Legacy Network Gateway must be put in place and tested with the NG9-1-1 operator. A common ESQK pool would have to be allocated and provisioned in the VPC and the ESGW. When the NG9-1-1 PSAP turns up service for VoIP, the VPC would be reconfigured to retrieve an ESQK from the new pool. The call would then be routed across the new ESGW trunk group to the LNG. Note that since the common trunk groups may service multiple VSP, each VSP's traffic would be migrated at the same time. The implication for media in this scenario is that the media would be converted from RTP to TDM at the ESGW and passed to the ESInet Legacy Network Gateway. At the LNG, the media would be converted back to RTP.

For Scenario 3 there is no impact to the VSP since all calls would continue to be sent to the Selective Router.

There is a fourth scenario which requires the Legacy Network Gateway to accept native SIP calls from the VSP. This requires no signaling or media conversion. This scenario assumes that rather routing the call to the ESGW, the call goes native SIP from the VSP network to Legacy Network Gateway through the Border Control Function. The LNG would receive the SIP call request from the VSP network, query for location information from the VSP's VPC using the v-E2 protocol, formulate a SIP message that would include the location (i.e. PIDF-LO)[24] in the message and forward it for processing. The media would be negotiated such that RTP would be passed between the VSP network and the NG9-1-1 system.

At some point the VSPs and/or their 3rd party partners may migrate their services to support the i3 specification. At that point traffic would be migrated to the Border Control Function (BCF) of the ESInet and signaling would comply with the i3 specification.

For data transition considerations, as long as the MSAG is available from the E9-1-1 SSPs, the 3rd parties can use that to populate their VDB. The 3rd parties would use the LVF when the PSAPs transition.

Some VSPs support a set of features enabling enhanced control over call disposition by the PSAPs. Those PSAPs have policies and procedures designed to take advantage of those capabilities. Transition must ensure that those capabilities will continue to provide the same functionality.

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24 The PIDF-LO specifications are defined by the IETF. See RFC 4119, 5139 and 5491.

9.5 Legacy E9-1-1 System Service Providers

Legacy E9-1-1 System Service Providers offer data management and routing services that validate location data and route the 911 calls to the appropriate PSAP. In many cases the E9-1-1 SSP is the primary conduit to the PSAP. That is, it obtains the Street Address Guide from the PSAP and creates the Master Street Address Guide (MSAG) that is used to validate addresses. It manages any data fallouts at the behest of the PSAP. For example, if there is a “no record found” response from the ALI, the PSAP will notify the E9-1-1 SSP and the E9-1-1 SSP will research and correct the error.

E9-1-1 SSPs offer data validation services to originating network providers such as wireline ILEC (which may be the same entity), CLECs, MLTS operators and other carriers. These carriers query the Database Management System (DBMS) for validation. In some cases this validation is returned to the carrier and in some cases the validated address is populated in the E9-1-1 SSP’s Automatic Location Identification (ALI) system.

From the call routing perspective, the Legacy E9-1-1 SSP’s SR receives 9-1-1 calls from originating carriers (wireline, wireless, VoIP, MLTS, etc.), determines the appropriate PSAP by querying a Selective Router Database (SRDB) and routes the call to the appropriate PSAP over CAMA or Time Division Multiplex (TDM) trunks. The SR handles alternate routing where the 911 call cannot be delivered to the primary PSAP due to an “all trunks busy” or other conditions. The SR then invokes alternate routing procedures and an alternate PSAP is chosen. The SR handles default routing when there is insufficient information to determine the appropriate PSAP. Default routing treatment may direct the 911 call to a default PSAP.

During the transition to NG9-1-1 there needs to be consideration given to how all of the current services provided by the E9-1-1 SSPs are migrated to an NG9-1-1 environment. And, it is most likely that the legacy data and call routing processes will be maintained in parallel with the introduction of NG9-1-1 databases and routing services for a period of time.

Some legacy E9-1-1 SSPs support a set of features enabling enhanced control over call disposition by the PSAPs. Those PSAPs have policies and procedures designed to take advantage of those capabilities. Transition must ensure that those capabilities will continue to provide the same functionality.

9.5.1 General topics

The operator of the NG9-1-1 system may be the existing E9-1-1 SSP or a new operator deploying an NG9-1-1 infrastructure. If the transition from a legacy emergency services system to an NG9-1-1 system is handled by the same E9-1-1 SSP, that E9-1-1 SSP will likely manage the transition as they would any other upgrade of services for the 9-1-1 system. The transition steps are a bit more challenging when there is a transition between providers. In such a case considerations expand to include things such as how to interconnect to the adjoining providers, how to handle conferences and transfers, etc. There will likely be modifications (and duplications) to everyone's methods of creating, updating and maintaining the databases, as well as the duplication of the network during the installation, testing, and cutover phases. This document addresses both situations.

9.5.1.1 Transition Within the E9-1-1 SSP

At the high level, the responsibilities of an E9-1-1 SSP migrating from an E9-1-1 network to an NG9-1-1 ESInet would be quite similar to previous network evolutions, such as the changing of an

E9-1-1 network from a Alcatel-Lucent 1AESS™ based platform to a Alcatel-Lucent 5ESS® or Nortel DMS™ based platform.

Things that must be considered are:

- Provide extensive upfront planning.
- Design it right so that it works, both for what the new customer needs, but also have bridges to existing 9-1-1 customers of the same E9-1-1 SSP.
- Install and test it extensively before cut the new system into service.
- Manage the cutover in a way that has stopping points, and methods to do the transition that prevent calls from being dropped, lost, or delivered with lower quality service.
- Follow and abide by any local regulations and laws, including filing appropriate documentation with any regulatory body and have their concurrence before transitioning.
- Make sure that the other participants in the network (CLECs, other ILECs, WSPs, VSPs, and PS/ALI customers) are considered, and if they have concerns, work with them to identify a way to handle those concerns (to the extent possible).
- Make sure that the database systems can be maintained, and that no changes to procedures are required for those participants who send data to the E9-1-1 SSP.

9.5.1.2 Transitions Between the E9-1-1 SSP and a New NG9-1-1 Operator

If the transition from a legacy emergency services network to NG9-1-1 is going to a new NG9-1-1 system provider, then the Legacy E91-1-SSP has responsibilities such as:

- The Legacy E9-1-1 SSP shall maintain the E9-1-1 system until the PSAPs and originating carriers migrate to NG9-1-1. If requested by the Public Safety Agencies, the legacy provider may need to keep its system active for a period of time as a backup or back-out plan if there are troubles with the transition to the new ESInet.
- The Legacy E9-1-1 SSP, and all other service providers in the service area, should let each PSAP customer know how things (such as rates, routing, data reports, or surcharge remittance, etc.) will change with a transition to the new provider.
- In order to reduce recurring costs to Public Safety agencies, the E9-1-1 SSP will work with other service providers to plan for removal of network and/or databases as quickly as possible once a successful transition to the new NG9-1-1 system has completed.
- The Legacy E9-1-1 SSP shall work with new NG9-1-1 operator to establish connectivity as needed to handle routing between systems for such things as split exchanges. The legacy E9-1-1 SSP may also need to develop methods for conferences and transfers between the different providers should the PSAP customers deem them appropriate or necessary.

9.5.2 Network and Operations Considerations

Section 10 (Legacy Emergency Call Transition Considerations) provides options for transitioning legacy 911 calls (wireline, wireless, VoIP, etc.) to an NG9-1-1 environment. Some of the options require cooperation between the E9-1-1 SSP and the NG9-1-1 system operator, where others may be transparent to the E9-1-1 SSP operation. For example if calls from originating networks are migrated from the SR trunks to the NG9-1-1 LNG, the only impact to the E9-1-1 SSP is to turn down the trunks. In the option where 9-1-1 calls are trunked through the SR to the Legacy SR Gateway

(LSRG) the E9-1-1 SSP is required to implement and manage the Tandem to Tandem trunks. If the PSAP implements dual-mode CPE then the Legacy E9-1-1 SSP must continue to maintain the legacy CAMA or TDM trunks until the transition is complete.

If applicable, to ensure that the NG9-1-1 system is engineered to meet local calling demands, engineering applied to the legacy network may need to be applied to the ESInet (e.g. capacity). That may mean that the engineering characteristics of the legacy provider service arrangements might need to be communicated to the NG9-1-1 system provider. If so, this would require cooperation between both stakeholders (could be the same provider, but might also be different).

The NG9-1-1 system, including the ESInet must be engineered to meet local calling demands (e.g. capacity), to maintain current E9-1-1 equivalent grade of service during transition. This will require working with the E9-1-1 SSP regarding considerations for bandwidth within the IP network paths based upon anticipated traffic.

9.5.3 Data Management Considerations

Section 11discusses the database transition in detail. This section introduces the functional elements and their usage. In the legacy environment, there are primarily four databases that allow Enhanced 9-1-1 to function.

MSAG (Master Street Address Guide) – A tabular database within the 9-1-1 Database Management System (DBMS) that contains all street ranges within a specific 9-1-1 jurisdiction.

TN (Telephone Number) Database – A database within the 9-1-1 DBMS that contains all telephone number (TN) subscriber records that have validated against the MSAG or any special tables that may have been built.

ALI (Automatic Location Identification) – A database that is updated from the 9-1-1 DBMS which when queried during a 9-1-1 call, or manually, will display to the PSAP elements such as the customer name, location, class of service, originating carrier name, Emergency Services Number and English Language Translations (ELTs). For NG9-1-1 the ALI may be queried by the LSRG to provide location information used for routing within the NG9-1-1 system.

SRDB (Selective Router Database) – A database that is updated from the 9-1-1 DBMS for selective routing purposes and identifies every TN, PSAP and Emergency Services Number (ESN), and is used by the SR to route a 9-1-1 call to the trunk associated with the appropriate PSAP.

For NG9-1-1 there are two database functions that enable validation and routing of 9-1-1 calls. The following definitions are from the NENA Functional and Interface Standards for Next Generation 9-1-1 Version 1.0 (i3) NENA 08-002 Version 1.0[2].

"**Location Validation Function (LVF)** – The LVF is used for the validation of civic address-based location information against an authoritative GIS database containing only valid civic addresses obtained from 9-1-1 Authorities. Pre-validation of the location information ensures that the calls can be routed to the appropriate PSAP and that emergency services can be dispatched to the correct location.

"**Emergency Call Routing Function (ECRF)** – The ECRF receives location information (either civic address or geo-coordinates) as input and uses this information to provide a URI that can be used to route an emergency call toward the appropriate PSAP for the caller's location. Depending on the identity and credentials of the entity requesting the routing information, the response may identify the PSAP, or an Emergency Services Routing Proxy (ESRP) that acts on behalf of the PSAP to provide final routing to the PSAP itself. The same database that is used to route a call to the correct PSAP may also be used to subsequently route the call to the correct responder, e.g., to support selective transfer capabilities."

With the implementation of NG9-1-1, all local jurisdictional GIS data must be uploaded to the LVF/ECRF. The NENA NG9-1-1 ECRF/LVF working group is writing requirements to describe how geospatial layers/files are uploaded to the databases. The GIS data that is uploaded will determine if a location is valid for 9-1-1 routing and is able to determine the proper routing to the correct PSAP/emergency responder for handling. This process replaces the MSAG and SRDB functionality in legacy E9-1-1.

In order to prepare the GIS data for NG9-1-1 implementation, the local 9-1-1 Authority, in cooperation with the E9-1-1 SSP, should conduct a synchronization of GIS, MSAG and ALI data to ensure accuracy. Once the databases are in synch, the 9-1-1 Authority must ensure that daily processes and procedures maintain the synchronization of all databases until the full transition to NG9-1-1 is complete. Additional information on the synchronization process may be found in [19].

In NG9-1-1, all location records must be pre-validated against the LVF (and stored in a LIS if appropriate to the network implementation) to ensure that when an actual 911 call occurs; the location information is valid and will route to the appropriate Telecommunicator/emergency responder in a timely manner. Therefore carriers may be migrating their validation requests from the E9-1-1 SSP to these NG9-1-1 databases.

In networks that implement LISs, the LIS should contain a record for all active valid locations. In theory, legacy ALI databases (minus certain data elements) could become the NG9-1-1 LIS databases for wireline. And in fact during transition NG9-1-1 network elements may query the ALI to obtain location that can be used for routing.

The following are topics that must be considered and are discussed in detail in Section 11.

- If requested by a new NG9-1-1 system provider, the E9-1-1 SSP may provide a onetime extract of applicable information in ALI database records. However, on an on-going basis, each "dial tone[25]" service provider is responsible for sending updates for their own subscribers to the appropriate NG9-1-1 DB provider. This may require that service order data be sent to two or more 9-1-1 databases.
- Once the E9-1-1 SSP has provided an initial load of all applicable information in ALI database records, the function of providing ongoing updates will become the responsibility of each dial tone service provider. Each dial tone service provider will provide daily updates of their subscriber data to the new ESInet operator. These updates should continue to be MSAG valid and scrubbed against the MSAG.
- The E9-1-1 SSP, and each service provider, will need to obtain MSAG updates (in NENA2[26] format) either from the jurisdiction or the new NG9-1-1 system operator to maintain their tabular MSAG to properly manage jurisdictional boundary issues.

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[25] The term "dial tone" as used here indicates any form of service that allows the customer to initiate calls, which would include calls to 911.

[26] NENA 02-010, Data Formats for ALI, MSAG and GIS, June 10, 2008

- While it is generally desirable for the E9-1-1 SSP to delete other provider's subscriber data from their own internal database for those jurisdictions being served by the new ESInet operator, there are probably cases where some of the subscriber records need to be maintained in both the legacy databases and the new databases. This may be required in order to facilitate routing from the E9-1-1 SSP to the NG9-1-1 system operator (or vice versa) when one provider needs to hand off traffic to the other. This is commonly done when a telephone exchange overlaps different 9-1-1 system jurisdictions that are each served by a different E9-1-1 SSP. The first E9-1-1 SSP needs data for the entire exchange, to route the call either to a PSAP that they serve, or to the second E9-1-1 SSP. The second E9-1-1 SSP needs customer data for the subscribers within their 9-1-1 system in order to route the call to a PSAP within their service area. Caller data for the area served by the second E9-1-1 SSP is duplicated within both operators' systems, and is used so that each can properly route the call within their portion of the network. This is an area that needs to be resolved with impacted 9-1-1 jurisdictions and the E9-1-1 SSPs on a case by case basis.

9.5.4 Policy Routing Function

Policies to support legacy routing will be replaced by the NG9-1-1 Policy Routing Function. Local 9-1-1 Authorities will access the "policy store" where business rules/policies will be maintained, indicating how call routing is to be done in their jurisdiction. It is anticipated there will be a Graphical User Interface (GUI) interface to the policy store, which will allow the 9-1-1 Authority to create business rules via selection menus. The 9-1-1 Authority will have to work with the E9-1-1 SSP where the legacy policies for alternate routing and default routing are to be migrated to the NG9-1-1 system.

In NG9-1-1, Rules/policies may be written to cover hours of operation, alternate routing, default routing, routing to specific Telecommunicator or emergency responder, and many other existing or new routing and call handling cases. In some instances, the 9-1-1 Authority may use resources of the E9-1-1 SSP to develop and refine business rules.

9.6 NG9-1-1 System Implementation and Management Considerations

Deploying NG9-1-1 will most likely be the responsibility of a state or local 9-1-1 Authority or groups of 9-1-1 Authorities acting together through an established intergovernmental arrangement.[27] In light of the "systems of systems" or layered nature of NG9-1-1, deployment may occur at all institutional levels; from local, to regional, to state. How those arrangements will occur will depend upon state and local institutional factors within state statutory and legal environments.[28]

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[27] NENA's "Master Glossary of 9-1-1 Terminology" defines "9-1-1 Authority" as "[t]he organization having administrative jurisdiction over a particular 9-1-1 system. This could be a county/parish or city government, a special 9-1-1 or Emergency Communications District, a Council of Governments or other similar body." Pg. 12, Version 13a, June 3, 2010.

[28] Roles and responsibilities among 9-1-1 Authorities will vary depending upon the nature of interconnected ESInets. The responsibility of higher level 9-1-1 Authorities may be more focused on specific functions associated with the interconnection involved.

While 9-1-1 Authorities may have options in how they acquire and deploy functions and services, their provisioning may be provided by third party vendors acting under contract to the 9-1-1 Authorities or their governing entities.[29] Operational responsibility would then be shared between the 9-1-1 Authority(s) and the contracted vendors involved.

There is a distinction between an emergency services IP network (i.e. ESInet) shared by emergency service agencies and the specific service environment that supports the delivery of a request for emergency services. The ESInet will provide connectivity and interoperability with emergency response and other critical stakeholders involved in incident management that goes beyond the delivery and processing of an emergency service request. NG9-1-1 includes a specific service environment defined by NENA standards riding on that ESInet. Other service environments will also ride on the ESInet including emergency response, incident management and similar functions (e.g., CAD, radio interoperability, responder communications, etc.). With that in mind, roles and responsibilities, along with the vendors involved, may well vary.

Some PSAPs currently utilize a set of features of the legacy networks enabling enhanced control over call disposition. Those PSAPs have policies and procedures designed to take advantage of those capabilities. Transition must ensure that those capabilities will continue to provide the same functionality. It will be the role of the 9-1-1 authorities to establish the applicable requirements to enable access to those capabilities by their PSAPs during and after transition. Table 1 below depicts the various transition states in which support of those capabilities will be required.

Origination	Intermediaries			PSAP	Reference	Remarks
EO	LNG	→	LPG	Legacy PSAP	Section 10.1.3	Core network transitioned first
EO	SR	LSRG	LPG	Legacy PSAP	Section 10.1.1	
EO	SR	LSRG	→	i3 PSAP	Section 10.1.1	
EO	LNG	LSRG	SR	Legacy PSAP	Section 10.1.2	
EO	LNG	→	→	i3 PSAP	Section 10.1.3	After transition
VSP	→	→	LPG	Legacy PSAP	Section 10.1.2	
VSP	→	LSRG	SR	Legacy PSAP	Section 10.1.2	
VSP	→	→	→	i3 PSAP	Section 10.1.3	After transition

Table 1 Transition States

This Transition Plan speaks specifically to a NG9-1-1 system comprised of both service environments and the underlying ESInet. References to the system administrator/operator below refer to the combination of the 9-1-1 Authority (and potentially its contractors) responsible for that system.

The transition of a 9-1-1 system from one provider to another, whether legacy to legacy, or legacy to Next Generation 9-1-1 type services entails tasks that are similar to the installation of an original

[29] That may range from a comprehensive hosted solution, to multiple vendors provisioning distinctive NG9-1-1 functions.

system. The new system provider(s) may be tasked to establish a network, and/or relationships with the service providers currently operating within the geographic area serviced by the new ESInet and NG9-1-1 service environments involved. This will include various wireless, VoIP, ILEC, CLEC, and MLTS customers (or their agents). The new system provider(s) may need to develop relationships with the applicable GIS authorities maintaining the geographic area covered by the new system for the provisioning of the LVF and ECRF validation and routing databases.

Initial testing will have to occur to insure that the results obtained by the new LVFs and ECRFs meet or exceed the accuracy of the validation and routing tools currently being used. Routing business rules must be tested to assure all contingencies are covered. The relationship will have to include an ongoing process (procedures to be followed, roles, and responsibilities) that enables the timely update of these and other required databases. There may be some overlap between legacy procedures and NG9-1-1 procedures. This could entail the need for various origination networks, e.g. ILECs/CLECs , Wireless service providers, VoIP service providers, and/or MLTS customers to continue to send initial load files to the existing 9-1-1 SSP, and may be required to provide duplicate service order activity updates to the new system provider for a short period of time during the transition.

The new ESInet will need to establish network connectivity to:

- the PSAPs as they transition[30]
- the existing originating networks as they transition[31] and
- existing state, local, or regional ESInets
- existing emergency service network[32].

The NG9-1-1 system operator may need to work with regulatory agencies to insure that the deployment of an NG9-1-1 system meets any local, state, or regional requirements. This may require the NG9-1-1 system provider to file tariffs, apply for ILEC/CLEC status or 9-1-1 service provider authority, etc.; collect or remit surcharge funds; or meet other regulatory condition. These conditions may vary depending on state, community, or regional area. System operators will need to work with adjoining agencies to establish the ability to receive originating calls, conference calls or transfers calls. In some cases, where the conference/transfer feature involves different legacy E9-1-1 system providers, additional work or efforts that are not existing in a single 9-1-1 System Service Provider environment may be required to enable conference/transfer.

9.7 NG9-1-1 Transition Planning for Enterprise Multi-Line Telephone Systems

The section identifies support of 9-1-1 calling within current Enterprise Multi-Line Telephone Systems (MLTS) architectures and provides recommendations and guidelines for supporting transition to NG9-1-1.

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[30] Legacy PSAP will be connected to the NG9-1-1 system via the Legacy PSAP Gateway and i3 PSAPs will be directly connected.

[31] Legacy originating networks will be connected to the ESInet via the Legacy Network Gateway and i3 capable origination networks will be directly connected.

[32] The connection between the ESInet and the legacy emergency service network may be via the Legacy SR Gateway.

When a jurisdiction migrates to NG9-1-1 it must consider how to manage caller location from existing MLTS customers. The MLTS functionality must be a consideration in its requests for proposals. MLTS customers may have to incorporate a new architecture (e.g. a LIS and other NG9-1-1 functions) and egress calls to an NG9-1-1 system. The i3 Legacy Network Gateway may have to incorporate a provisioning interface to emulate the current PS-ALI functionality.

Assumptions:

- An Enterprise that participates in determining caller location and updates the ALI database via their E9-1-1 SSP is considered to be using a "PS-ALI" service (including a pre-i2 type service).
- "Legacy" is used in this section to imply signaling such as circuit-switched or analog (non-VoIP).
- Point of Presence (POP) defines the demarcation between the Enterprise and the E9-1-1 System Service Provider used for external (to the Enterprise) traffic.
- Dynamic Calling Party Number (D-CPN) trunks include analog CAMA, ISDN (BRI/PRI), and Feature Group D (FGD).

These assumptions are based upon expectations that the E9-1-1 SSP remains the same after the transition to a NG9-1-1 system. If not, it is likely that the MLTS customer may have to make changes to comply with the new service providers service offerings. A MLTS customer may have to incorporate a LIS or contract with a 3rd party service provides that manages a LIS.

Table 2 below includes 12 use cases where the MLTS system is a legacy system and 30 use cases where the MLTS is a VoIP system. For each use case, 1) consideration was given to the type of trunks the MLTS employs, 2) if there is a subscription to a PS-ALI service, 3) if the MLTS is deployed in single or multi sites, and 4) whether the MLTS deploys a single or multiple POPs.

In examining the use cases in the context of the Public Safety jurisdiction transitioning to NG9-1-1, the requirement is to identify issues that would cause change to the MLTS. In that regard, the use cases can be grouped to defined categories that are affected similarly during transition. Example: all MLTS's that do not subscribe to a PS-ALI service are obviously relying on the E9-1-1 SSP to route 9-1-1 calls and maintain the ALI database. This group will be treated similarly during transition.

Since the requirement is to identify issues that would cause change to the MLTS, the categories of service are defined as:

A. The MLTS operator does not subscribe to PS-ALI service, i.e., the E9-1-1 SSP provides 911 call routing and ALI database service.
B. The MLTS operator does subscribe to PS-ALI service and utilizes their normal outbound trunks for 911 calls, i.e., ISDN, FGD, VoIP.
C. The MLTS operator does subscribe to PS-ALI service and utilizes dedicated legacy trunks for 9-1-1 calls, i.e., ISDN, CAMA, FGD.
D. The MLTS operator does subscribe to i2 type service and utilizes dedicated VoIP trunks for 911 calls, i.e., an i2 SP.
E. The MLTS operator does subscribe to PS-ALI service from one SP and utilizes dedicated trunks to the Selective Router via a different SP.

The results of categorizing the use cases are:

A. Applies to use cases 1-3, 13-18

B. Applies to use cases 4-6, 19-24
C. Applies to use cases 7-9, 25-27, 34-36
D. Applies to use cases 28-33
E. Applies to use cases 10-12, 37-42

Below is a summary of the transition impacts to each category of use cases.

A. The MLTS operator has subscribed to "POTS-like" service with the expectation their E9-1-1 SSP will both route 911 calls and maintain the ALI database included with the service offering. The transition of the Public Safety jurisdiction to NG9-1-1 will have impact on the SP, but not direct impact on the MLTS. It is assumed the SP will continue to offer the same service to the MLTS operator, route calls and deliver the ALI information to the PSAP.

B. The MLTS operator has subscribed to PS-ALI service and utilizes normal Class 5 trunks for 911 calls. The MLTS operator is responsible for maintenance of the ALI records via the E9-1-1 SSP's PS-ALI service. The transition of the Public Safety jurisdiction to NG9-1-1 will impact the E9-1-1 SSP, but not directly impact the MLTS operation. This assumes the E9-1-1 SSP will continue to offer the same PS-ALI service as pre-transition.

C. The MLTS operator has subscribed to PS-ALI service and utilizes dedicated trunks for 911 calls using the same E9-1-1 SSP. The MLTS operator is responsible for maintenance of the ALI records via the E9-1-1 SSP's PS-ALI service. The transition of the Public Safety jurisdiction to NG9-1-1 will impact the E9-1-1 SSP, but not directly impact the MLTS operation. This assumes the E9-1-1 SSP will continue to offer legacy trunk service (via a legacy network gateway, as an example) for 911 calls post transition.

D. The MLTS operator has subscribed to i2 type service. The MLTS utilizes dedicated VoIP trunks for 911 calls. The MLTS operator is responsible for maintenance of the ALI records via the i2 E9-1-1 SSP PS-ALI like service. The transition of the Public Safety jurisdiction to NG9-1-1 will impact the i2 SP, but not directly impact the MLTS operation. This assumes the i2 SP will continue to offer i2 type service for 9-1-1 calls post transition.

E. The MLTS operator has subscribed to PS-ALI service from SP "A". The MLTS utilizes dedicated trunks for 911 calls going to SSP "B"s Selective Router. The MLTS operator is responsible for maintenance of the ALI records via the SP 'A' PS-ALI service. The transition of the Public Safety jurisdiction to NG9-1-1 will impact both SPs, but not directly impact the MLTS operation. This assumes the E9-1-1 SSP will continue to offer legacy trunk service, via a LNG, for 911 calls post transition. This also assumes the SP "A" and SSP "B" will coordinate between the ALI db and the LNG post transition.

Table 2 – Enterprise MLTS Use Cases

	Use Case	Legacy Trunks to Class 5	Legacy Trunks to SR	VoIP Trunks for Normal Traffic	VoIP Trunks to i2 SP	PS-ALI Service	No PS-ALI Service	Trunk Provider different than PS-ALI Provider	Single Site	Multi Site	Single POP	Multi POP
Legacy MLTS												
	1	X					X		X		X	
	2	X					X			X	X	
	3	X					X			X		X
	4	X				X			X		X	
	5	X				X				X	X	
	6	X				X				X		X
	7	X	X			X			X		X	
	8	X	X			X				X	X	
	9	X	X			X				X		X
	10	X	X			X		X	X		X	
	11	X	X			X		X		X	X	
	12	X	X			X		X		X		X
VoIP MLTS												
	13	X					X		X		X	
	14	X					X			X	X	
	15	X					X			X		X
	16			X			X		X		X	
	17			X			X			X	X	
	18			X			X			X		X
	19	X				X			X		X	
	20	X				X				X	X	
	21	X				X				X		X

	Use Case	Legacy Trunks to Class 5	Legacy Trunks to SR	VoIP Trunks for Normal Traffic	VoIP Trunks to i2 SP	PS-ALI Service	No PS-ALI Service	Trunk Provider different than PS-ALI Provider	Single Site	Multi Site	Single POP	Multi POP
	22			X		X			X		X	
	23			X		X				X	X	
	24			X		X				X		X
	25	X	X			X			X		X	
	26	X	X			X				X	X	
	27	X	X			X				X		X
	28	X			X	X			X		X	
	29	X			X	X				X	X	
	30	X			X	X				X		X
	31			X	X	X			X		X	
	32			X	X	X				X	X	
	33			X	X	X				X		X
	34		X	X		X			X		X	
	35		X	X		X				X	X	
	36		X	X		X				X		X
	37	X	X			X		X	X		X	
	38	X	X			X		X		X	X	
	39	X	X			X		X		X		X
	40		X	X		X		X	X		X	
	41		X	X		X		X		X	X	
	42		X	X		X		X		X		X

10.Legacy Emergency Call Transition Considerations

This section discusses potential transition options from a technical standpoint. With originating carriers and PSAPs independently migrating from the SR to the NG9-1-1 system there are four cases to consider.

- Carrier served by SR and PSAP served by SR (current methods)
- Carrier served by SR and PSAP served by NG9-1-1 system
- Carrier served by NG9-1-1 System and PSAP served by SR
- Carrier and PSAP served by NG9-1-1 system (fully transitioned)

The first case is the current legacy environment and is not addressed in this document. The last case is after transition is complete and is address in the NENA i3 specifications [2][5][8]. The following subsections describe the last three cases.

10.1.1 Carrier Served by SR and PSAP Served by NG9-1-1 System

This section addresses the situation where the originating carrier delivers emergency calls to the SR and the PSAP is hosted on the ESInet. Calls need to be passed from the legacy emergency services network to the ESInet.

For wireline calls, the LSRG will receive calls from a carrier through the SR destined to a PSAP on the ESInet. The LSRG will query the ALI using the TN of the caller and get location. It will normally supply the location (Location by Value [LbyV]) to the PSAP on the ESInet. The non-location information in the ALI response will be retained by the LSRG and will be supplied to the PSAP in reply to a request for additional data. PSAP Call Control features may be invoked by the PSAP, if supported by the originating and intermediary networks. TDM-SIP interworking will be applied by the LSRG and will be used to support PSAP Call Control features on an end-to-end basis[33].

When the call is from a legacy wireless carrier, the SR routes the call to the LSRG. The LSRG queries the ALI with the ESRK and the ALI forwards the query to the MPC/GMLC. The MPC/GMLC returns, initially, the cell information which is passed to the LSRG where it is retained. The LSRG constructs a Location by Reference (LbyR) message which points to itself and typically contains the ESRK, e.g. sip:esrk@lsrgw.net. The call request is delivered to the NG9-1-1 PSAP with a location reference. The PSAP then dereferences the location reference by querying the LSRG. The LSRG responds with the retained location. Subsequent location update dereferences follow the same path: when the LSRG gets the request it queries the ALI, which in turn queries the MPC/GMLC. The final location is returned.

10.1.2 Carrier Served by NG9-1-1 and PSAP Served by SR

This section addresses the situation where the originating carrier delivers emergency calls to the NG9-1-1 system and the PSAP is hosted on the Selective Router. Calls need to be passed from NG9-1-1 system to the legacy emergency services network.

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[33] For legacy PSAPs that interconnect to the NG9-1-1 system via a Legacy PSAP Gateway (LPG), the LPG will also be expected to support SIP-TDM interworking for call delivery as well for other PSAP features, including PSAP Call Control Features.

For a legacy wireline call origination, a legacy PSAP on the SR receives a call from a carrier connecting to the NG9-1-1 system via the LSRG. The location is received by the LSRG with the call signaling and the location will be retained by the LSRG for subsequent ALI responses. The LSRG will allocate and provide a pANI in the request towards the SR for the call. Once the PSAP receives the call it must query for location. The query by the PSAP, using the pANI, will steer from the ALI to the LSRG. The LSRG responds immediately with the location. PSAP Call Control features may be invoked by the PSAP, if supported by the originating and intermediary networks. TDM-SIP interworking to support PSAP Call Control features end-to-end will be performed at the LNG and the LSRG.

For legacy wireless calls, calls from carriers are routed through the LSRG to the SR and on to the legacy PSAP. The location information received by the LSRG with the call signaling is location reference URI, e.g. the ESRK in the format of sip:esrk@lng.net. The URI will be retained by the LSRG for use in the subsequent ALI responses. The LSRG will allocate and provide a pANI (different from the ESRK) in the request towards the SR for the call. Once the PSAP receives the call it must query for location. The query by the PSAP, using the pANI, will steer from the ALI to the LSRG. Since the location reference was provided, the gateway must query the Legacy Network Gateway with the original ESRK (e.g. sip:esrk@lng .net). The LNG will query the MPC/GMLC for location and the results will be passed to the PSAP.

For emergency call originations from i3-compliant origination networks that are routed via the ESInet to a PSAP that is served by an SR, the location received by the LSRG in incoming SIP signaling may be in the form of an LbyV or an LbyR. The location received by the LSRG in incoming call signaling will be retained by the LSRG for subsequent ALI responses. The LSRG will allocate and provide a pANI in the request towards the SR for the call. Once the PSAP receives the call it must query the ALI system for location using the pANI. The query by the PSAP will steer from the ALI system to the LSRG. If the location provided to the LSRG in incoming SIP signaling is in the form of an LbyV, the LSRG responds immediately to the ALI system, which passes the information to the PSAP. If the location provided to the LSRG in incoming SIP signaling is in the form of an LbyR, the LSRG must query a Location Information Server (LIS) using the reference URI provided in incoming SIP signaling, The LIS will return the location value to the LSRG, which will return it to the ALI system. The ALI system will then pass the location information to the PSAP. PSAP Call Control features may be invoked by the PSAP, if supported by the originating and intermediary networks. TDM-SIP interworking to support PSAP Call Control features on and end-to-end basis will be performed at the LSRG.

For PSAPs served by the SR, the LSRG needs a pool of pANIs. The originating carrier must coordinate with the LSRG operator to assure that sufficient pANI pools and associated shell records are provided. When a carrier transitions away from the SR to the ESInet via a LNG it must remove the ALI records for its subscribers, replacing them with records in the LNG.

10.1.3 Carrier and PSAP Served by NG9-1-1 System

This section addresses the option where both the originating carrier (i.e. via the LNG) and PSAP have transitioned.

A NG9-1-1 PSAP answering a call from a transitioned wireline carrier would normally get location provided by the LNG, which would have obtained the location from its associated location server/database. PSAP Call Control features may be invoked by the PSAP, if supported by the originating and intermediary networks. TDM-SIP interworking to support PSAP Call Control features end-to-end will be performed at the LNG. If a legacy PSAP is involved, the LPG will perform some TDM-SIP interworking as well. For a wireless call the NG9-1-1 PSAP will receive the location reference and will have to dereference this through the LNG which will query the appropriate MPC/GMLC for location. As above the legacy wireline carrier (or wireless carrier), as it made its transition, would have removed its ALI record (or shell record) and populated its LNG location server/database records.

Three scenarios will be discussed and the scenarios apply to all call types (wireline, wireless and VoIP). Scenario 1 makes use of the Tandem to Tandem capability defined in NENA 03-003 [16]. In this scenario all legacy calls (wireline, wireless and VoIP) ingress into the SR and the SR routes calls destined to a NG9-1-1 PSAP across the Tandem to Tandem trunks. In addition, if a call is to be bridged between a legacy PSAP and a NG9-1-1 PSAP, Tandem to Tandem trunks are used. Scenario 2 illustrates the ability to migrate the originating office (wireline Central Office, wireless MSC or VoIP Peering Network) trunks to the LNG of the ESInet. This scenario may be applicable when service boundaries match jurisdiction boundaries. It may also be used as a next step after the first scenario when all PSAPs associated with the originating calls have migrated to NG9-1-1. Scenario 3 illustrates a dual mode PSAP which has legacy trunks to the SR and IP connections to the NG9-1-1 system. These scenarios assume that the NG9-1-1 provider and legacy Emergency Services provider are different entities. If they are the same, some simplifying assumptions may be made.

10.2 Legacy SR Gateway Considerations

The LSRG technical standard may be found in Reference [10].

The Legacy SR Gateway is a signaling and media connection point between the legacy SR and the NG9-1-1 system. The LSRG inherits capabilities from the LNG described in Section 7.1 of the Detailed Functional and Interface Specification for the NENA i3 Solution – Stage 3 [8] and the LPG described in Section 7.2 of the Detailed Functional and Interface Specification for the NENA i3 Solution – Stage 3 [8]. In addition the LSRG has unique characteristics based upon its need to interact with the legacy Selective Router.

From the LNG, the LSRG takes the ability to receive a call from TDM signaling and convert that to IP signaling. Unlike the LNG, the LSRG must convert IP signaling to TDM in order to deliver emergency call originations from legacy and i3-compliant origination networks that are routed via the ESInet as well as bridge calls from the NG9-1-1 PSAP to a legacy PSAP homed on a SR.

Like the LNG, the LSRG must obtain location information when it receives a call from the SR. The call can then be delivered to the NG9-1-1 PSAP with that location. For initial calls the LSRG will query the ECRF to route calls to the ESRP. Unlike the LNG, the LSRG does not query the ECRF with that location to route transferred calls to the ESRP that are initiated by a PSAP that is served by the SR. That is, destination routing is used to route a transferred call to the specified PSAP.

From the LPG, the LSRG inherits the capability to cache the location information obtained from a SIP call request (i.e. PIDF-LO and additional data), assign a pANI that is delivered to the SR with the call and to return the location information and Callback Number to the PSAP upon query. However, in this instance the LSRG uses either E2 or PAM to process location requests from ALI systems. This is illustrated in the flow of Figure 8-5. The LPG may also have to query for additional data associated with the call (e.g. class of service, caller name, etc.)

Capability	Legacy Network GW	Legacy PSAP GW	Legacy SR GW	Comments
TDM to SIP conversion	X		X	○ Legacy SR GW – from SR to NG9-1-1 system ○ LNG – from originating network to ESInet
SIP to TDM conversion		X	X	○ LSRG – from NG9-1-1 system to SR ○ Legacy PSAP GW – from NG9-1-1 system to PSAP
Obtain Location from location database/server	X		X	
Query ECRF to support call routing	X	X	X	○ LSRG ○ routes initial call via location. ○ Routes bridged call on destination. ○ LPG ○ May query ECRF to support emergency call transfer
Query for Additional Data	X	X	X	
PSAP Call Control features	X	X	X	TDM-SIP interworking for end-to-end features support

Table 3 Parallels with i3 Gateways

10.3 IP Selective Router Functionality Evolution

As described in ATIS-05000019, an Internet Protocol Selective Router (IPSR) function (Figure 10-1) is an IP-based Selective Router that that provides E9-1-1 functionality while incorporating the ability to receive native SIP emergency calls and delivering emergency calls to RFAI PSAPs. It uses legacy routing techniques by determining the appropriate PSAP based upon TN/ESRK/ESQK.

Legacy wireline, wireless and pre-i2 VoIP calls ingress to the IPSR via TDM trunks. The IPSR uses the TN/ESRK/ESQK to determine if a call is to be routed to a legacy PSAP or an RFAI PSAP via the Request for Assistance Interface (RFAI) described in ATIS-0500019. Note that calls destined to the RFAI PSAP deliver the typical E9-1-1 TN/ESRK/ESQK and the PSAP queries an ALI system to obtain location information.

In addition, if originating networks want to convert from TDM trunks to IP connectivity, the IPSR accepts native IP 9-1-1 calls from those originating networks. Calls originate with the typical TN/ESRK/ESQK and are routed using this key. The calls are delivered to either the RFAI PSAP or the legacy PSAP. And again, the RFAI PSAP or legacy PSAP must query an ALI system for location information.

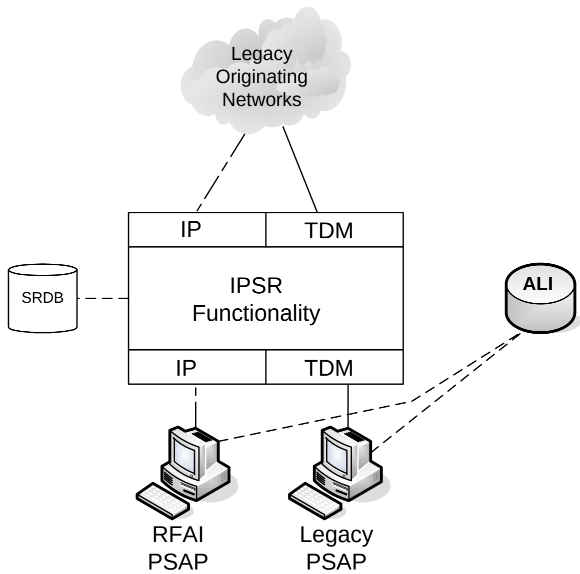

Figure 10-1 IP Selective Router

Figure 10-2 illustrates the call flow to deliver calls to either an RFAI PSAP or a legacy PSAP. Calls originate from the originating network with TN/ESRK/ESQK ①. The IPSR queries the Selective Routing Database and the SRDB returns the ESN associated with an RFAI PSAP ②. The IPSR then delivers the call to the RFAI PSAP across the IP connectivity ③. The RFAI PSAP then queries the ALI for location information ④. Alternatively, the SRDB may return an ESN that is associated with a legacy PSAP and the call is delivered over the TDM trunks to the PSAP (3A). Then the legacy PSAP queries the ALI for location information (4A). A similar flow can be extrapolated for emergency calls from originating networks entering the IPSR via SIP. PSAP Call Control features may be invoked by the PSAP, if supported by the originating and intermediary networks. It is assumed that the IPSR will implement the appropriate TDM-SIP interworking to support PSAP Call Control features end-to-end.

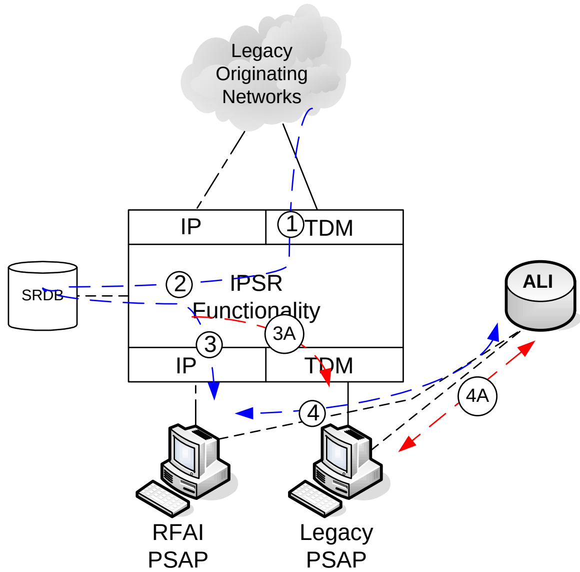

Figure 10-2 IPSR Call Flow

10.3.1 Interactions with NG9-1-1 Systems

Since it is probable that the IPSR and NG9-1-1 systems will operate in parallel for some period of time there is a need for the interaction between the two for call delivery and bridging. Figure 10-3 illustrates a call from a legacy Central Office being routed via the IPSR to a NG9-1-1 PSAP. Figure 10-4 illustrates the call flow where a PSAP hosted by the IPSR needs to bridge a call to a PSAP hosted on an NG9-1-1 systems. Figure 10-5 illustrates the corollary call flow where a call is bridged from a PSAP hosted by the NG9-1-1 systems to a PSAP hosted by the IPSR.

Provisioning in the IPSR causes the call to be routed to the NG9-1-1. The IPSR queries the SRDB and the ESN points to the IP connectivity between the IPSR and the LSRG.

The call flow is shown in Figure 10-3[34]. The legacy wireline subscriber initiates a 9-1-1 call and the End Office (or wireless subscriber from MSC, etc.) routes the call to the IPSR ①. The IPSR looks up the TN (or ESRK or ESQK) in the SRDB to obtain the ESN ②. Since the ESN has been reconfigured, it points to the IP connectivity between the IPSR and LSRG. The IPSR creates a SIP INVITE and routes the call to the LSRG ③. The LSRG acquires location from the ALI ④ and routes the call to the ESRP ⑤. Normal i3 routing occurs where the ESRP queries the ECRF with this location, receives the PSAP routing information ⑥ and delivers the call to the PSAP ⑦.

[34] This figure illustrates the wireline case. Wireless and VoIP call flows can be extrapolated from it.

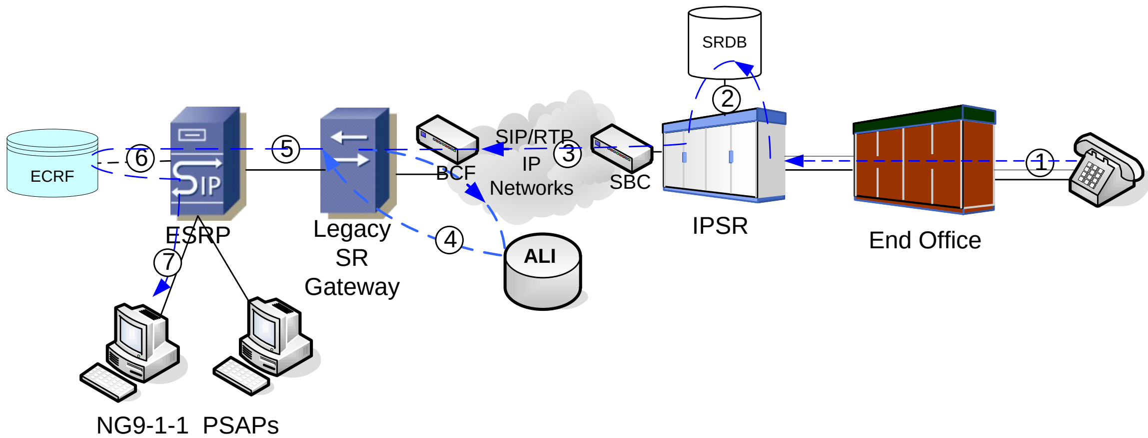

Figure 10-3 Initial Call Routed via IPSR

For bridging calls, Figure 10-4 parallels Figure 8-2 except that the legacy SR is replaced by the IPSR. The IPSR accepts a conference request from the PSAP (either a legacy PSAP or an RFAI PSAP). If the PSAP is a legacy PSAP then the IPSR takes the CAMA signaling and creates an INVITE toward the LSRG. If the PSAP is an RFAI PSAP the IPSR interworks the signaling between the PSAP and the LSRG. The SIP interface between the IPSR and the LSRG needs to be defined to facilitate interworking.

The PSAP Telecommunicator keys in the manual transfer number (or uses one button transfer) and sends a transfer request to the IPSR①. The IPSR Creates an INVITE toward the Legacy SR Gateway via the BCF②. For this method, the Request URI and the To Header would contain a 10 digit number of the NG9-1-1 PSAP (or a number that can be used by the LSRG to route the call to the NG9-1-1 PSAP) and the From Header would contain the ANI (TN, ESRK, or ESQK). Since the IPSR only deals with the E.164 domain, a 10 digit number is needed to identify the destination PSAP. The LSRG will query the ALI for location using the From Header and then the ALI returns location③. The LSRG queries the ALI to obtain the location information to pass to the NG9-1-1 PSAP, but does not use that location information for routing. The ALI database returns the ALI data ④. The ESInet should use destination routing (using the TN in the Route Header), rather than query the ECRF for location based routing, to route the call to the destination PSAP. Therefore, the LSRG determines the routing and forwards the call to the ESRP⑤ and the ESRP delivers the call to the PSAP⑥, including location.

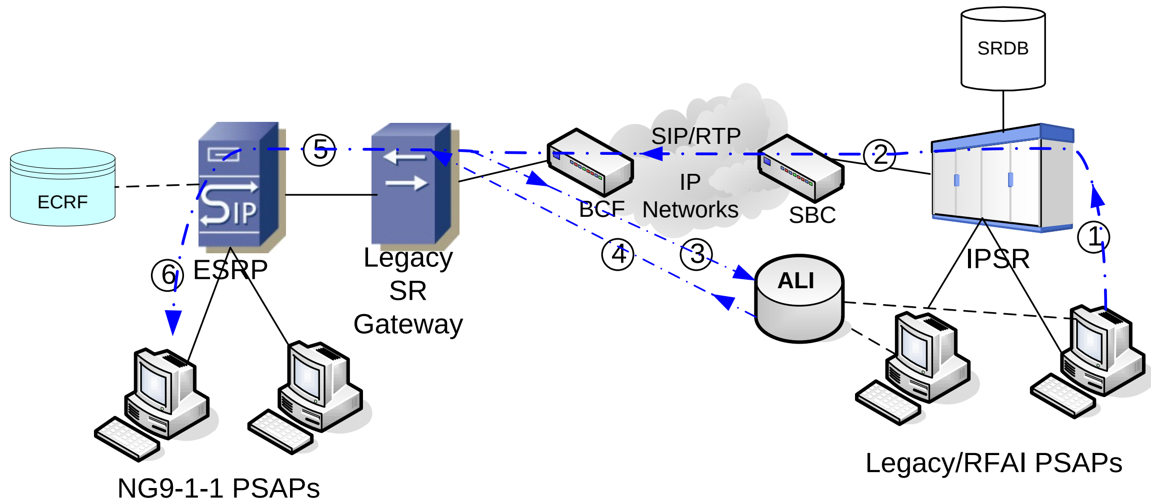

Figure 10-4 Bridging from IPSR to i3 Network

Figure 10-5 parallels Figure 9-3 and illustrates the corollary to the last call flow in that now the NG9-1-1 PSAP bridges a call to a PSAP hosted on the IPSR. This RFAI PSAP uses SIP signaling with the IPSR[35] and normal connections to the ALI. For this call flow the NG9-1-1 PSAP has received the caller's location information and additional data. However, due to the fact that the IPSR does not process location information it cannot be passed in the call set up to the PSAP hosted on the IPSR. The LSGR must cache the location information and allocate a pseudo ANI to be delivered to the PSAP hosted by the IPSR. Then the PSAP queries the Legacy SR Gateway (via the ALI) for location information. That is, the LSRG caches the location information, allocates a pANI and provides that to the PSAP in the call request via the IPSR. This method is similar to the methods used for wireless and VoIP. The PSAP then queries its ALI which steers the request to the LSRG. The location and Callback Number are provided in the response. That call flow is illustrated below.

The LSRG must address the PSAP directly using its 10-digit number as shown in Figure 10-5①. The NG9-1-1 PSAP may obtain this number from the ECRF database or have it pre-programmed. For this method the SIP Request URI, To Header and Route Header would contain a URI containing the 10-digit number defining the PSAP hosted by the IPSR and the From Header would contain the Callback Number. Once the LSRG receives the call request it caches the location information and determines a pANI from a pool associated with the PSAP. The LSRG then forwards the call request via the SBCs/BCFs to the IPSR②. The IPSR formats the appropriate signaling and forwards the call on to the PSAP③. The IPSR must use destination routing to route the call to the PSAP. When the PSAP receives the call it will do an ALI query using the pANI④. The ALI steers the query to the LSRG passing the pANI⑤ and the LSRG returns the Callback Number and the location information ⑥. For an E2 response the ALI combines the information received with a shell record before returning location information and Callback information to the PSAP⑦. For a PAM response, the received information is just formatted by the ALI and returned PSAP.

[35] Note the same flow applies if the PSAP is a legacy PSAP.

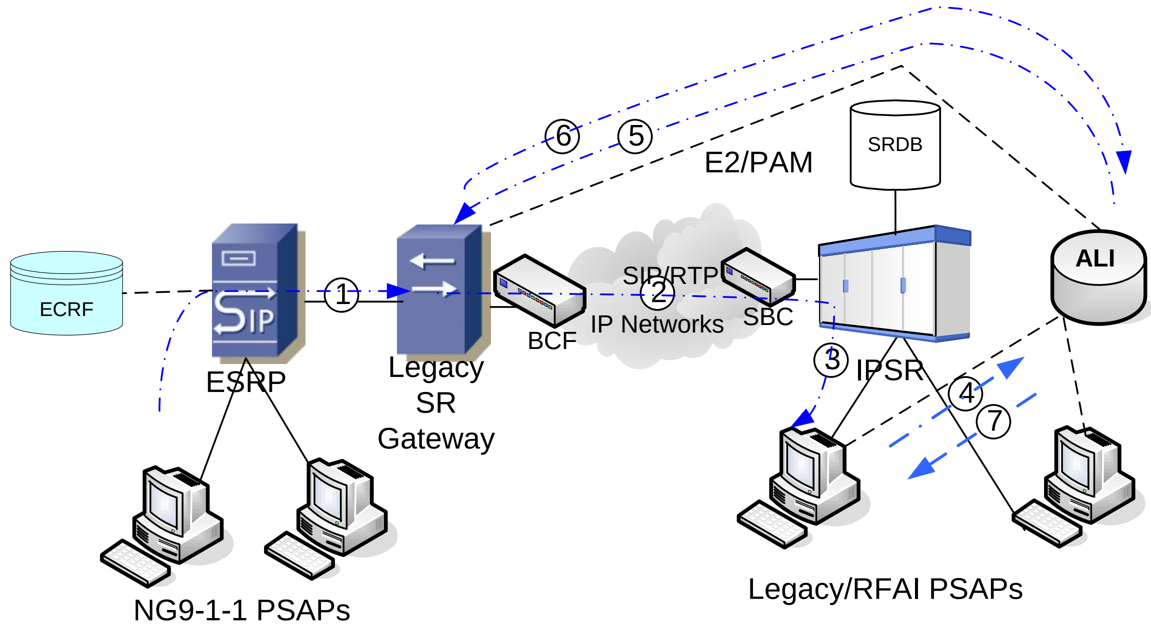

Figure 10-5 Bridging from an i3 Network to the IPSR

As PSAPs and emergency services networks introduce the concepts of i3, the IPSR function will be replaced by the ECRF and ESRP functions. As an implementation option, the IPSR and ESRP functions may be hosted on the same physical or logical host, allowing for the investment in the IPSR to be eventually used as part of the functionality of the ESRP.

11.Database Transition Considerations

11.1 Scope

This section will focus on the transition of data structures and functions currently utilized in 9-1-1 to future structures and functions envisioned for NG9-1-1. The goals of the section are to:

1. Identify data transition steps between E9-1-1 and NG9-1-1, i.e., for transitional NG9-1-1 prior to full i3-based NG9-1-1.
2. Outline what current data moves forward into NG9-1-1 and how;
3. Identify processes that need to be modified or created;
4. Identify any short-comings of current data and/or future data functional elements.

The section will:

1. Exclude any data or processes being worked in their entirety by other NENA Working Groups;
2. Initially develop a framework absent of constraints imposed by a deployment that may involve multiple agencies and/or service providers;
3. Supplement the framework with considerations where multiple agencies and service providers are migrating to NG9-1-1 at different paces.

11.2 Overview

NENA's "Detailed Functional and Interface Specification for the NENA i3 Solution" (08-003) (commonly referred to as the i3 stage 3 specification) describes the functional elements and interactions required for a NG9-1-1 system. Although it describes some functional elements that allow legacy 9-1-1 functionality to co-exist with NG9-1-1 functionality, it does not address what happens to data and data processes as the public safety community is migrating towards a full end state NG9-1-1 environment.

This section will describe recommended changes to data, processes, and stakeholders during what could be a lengthy transition period. Since a 9-1-1 Authority can choose a variety of deployment plans, this section will try to identify the most common and most likely impacts on 9-1-1 data.

A key tenet of NG9-1-1 that applies to any transitional period is articulated in NENA 57-750 "NG9-1-1 System and PSAP Operational Features and Capabilities Requirements," Section 2.10 which states:

> "*In present and future applications of all technologies used for 9-1-1 call and data delivery, it is a requirement to maintain the same level or improve on the reliability and service characteristics inherent in present 9-1-1 system design."*

Functions and data requirements that initially do not meet this standard of comparable functionality and data accuracy need to be identified and addressed before the industry begins a migration towards NG9-1-1.

Throughout this section a "transition period" is referenced. The length of this period is unknown at this time and will vary per deployment.

11.3 Pre-Conditions

This section assumes that a 9-1-1 Authority is likely starting with an environment consisting of traditional components such as an ALI system, Selective Router(s), a DBMS system, tabular MSAG, and a legacy network. It also assumes that the 9-1-1 Authority has developed a set of GIS data to a level that functionally approximates the contents of their MSAG. This data should, at a minimum, include road center lines, emergency service zone and/or responding entity polygons, and PSAP boundary polygons. Each Authority should previously have performed some preliminary reconciliation between their GIS data and their MSAG. The Authority may have also performed further reconciliation work between their GIS and Postal data.

If an Authority that provides GIS data for 9-1-1 use has not performed this reconciliation work it should take up the task at the earliest opportunity as such reconciliation is viewed as a first step in NG9-1-1 data transition. See NENA 71-501[36] for more information on GIS/MSAG synchronization.

[36] https://www.nena.org/?page=synch_gis_msag_ali

11.4 Data Validation in Transition

11.4.1 MSAG's Role

11.4.1.1 MSAG's Current Role

Today's MSAG plays a critical role in validating civic locations for later use during a 9-1-1 call. A 9-1-1 Authority directly (or indirectly through its 911 System Service Provider [SSP]) performs maintenance on the MSAG to reflect changes in street, community, and ESN information. The MSAG is used by the 9-1-1 Authority and the 911 SSP to perform validations in the Agency's or SSP's DBMS on service order content originating from service providers that are attempting to add, delete, or modify data in the ALI database. The MSAG can also be periodically distributed to entities such as CLECs and VSPs in order for them to "pre-validate" locations prior to submission to the DBMS.

11.4.1.2 MSAG's Transitional Role

The end goal is to have location validation performed by a NG9-1-1 Location Validation Function (LVF)[37]. The LVF is a real time functional element that facilitates machine-to-machine validation utilizing an industry standard interface. It is unlikely that a 9-1-1 Authority will (or can) make a flash cut from MSAG based validation to LVF based validation. Thus, the various roles and longevity of MSAG data must be examined. Known needs for MSAG data during transition include:

- **Usage by external third parties**. As mentioned, MSAG data is commonly sent to some carriers to use within their internal provisioning systems to validate subscriber location. Given the general lack of regulation and policy regarding migration to NG9-1-1, it can be assumed that these carriers will enable their provisioning systems with LVF-based validation on a variety of time lines. If migration cannot be mandated, it is in the best interest of both the carriers and the 9-1-1 Authorities to continue to provide MSAG data on a periodic basis.
- **Lack of robust GIS data**. A full implementation of an LVF or Emergency Call Routing Function (ECRF) must be supported by GIS data sanctioned by the 9-1-1 Authority (that also supplies the respective MSAG data). This is important since the LVF will generally be deployed alongside an ECRF that provides information for 9-1-1 call routing. It is desirable to have the LVF and ECRF for a given area utilizing the same data sources. It should be noted that during the transition period, an LVF database can be deployed with only the MSAG data and an ESN to URI mapping in the ECRF, ESRP, or LNG.
- **Inability to modify DBMS to LVF usage**. In the current environment, a service order based record that is intended to add or modify a record in the ALI database is compared to the MSAG street ranges. Ideally, this validation would switch to utilize the LVF. However, there may be unknown constraints in the underlying technology that prevent such a modification to the DBMS software.

With these constraints on eliminating MSAG, a 9-1-1 Authority may desire to reverse engineer a tabular MSAG from the LVF database. To perform this, street segments within the LVF database

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[37] Throughout this section "LVF" will be used to describe the function of location validation and "LVF Database" will be used to describe the underlying data source. The same usage will be applied for "ECRF" and "ECRF Database".

could be reformatted to a tabular MSAG format. This requires that the ESN remain associated with a street even if ESN-based routing is not being performed.

11.4.1.3 MSAG Best Practices for Transition

Given the transitional role of MSAG data and its need for inclusion in LVF and ECRF database(s), some potential best practices may include:

- Include the primary information contained in the current MSAG, the source GIS data, and, secondarily, the Postal data, in the LVF and ECRF database(s). This may be accomplished by reconciling MSAG data into a GIS database, and if available reconciling with Postal. The end goal is that information from MSAG, GIS, and Postal reference data sets become a single data source to be populated in the LVF and ECRF database.
- Maintain the ability to generate and distribute a tabular MSAG until constituents (namely service providers) for a 9-1-1 jurisdiction have fully migrated to NG9-1-1 data processing. This may be accomplished by continuing to maintain a tabular MSAG as a primary source dataset that is in sync with a GIS database. It may also be accomplished by developing a method to "reverse engineer" an MSAG out of an LVF or ECRF database. The latter may include the need for MSAG Conversion Services (described below).
- During transition, 9-1-1 Authorities should strongly advocate a change in location validation processes of outside third parties to become based on the LVF. This advocacy may include changes to local or state regulations, tariffs, and practices.

11.4.2 LVF's Role

11.4.2.1 Change DBMS to utilize LVF.

DBMS systems perform a variety of quality checks on incoming service order data before a record can be modified or added to the ALI. Some of these checks such as Local Number Portability (LNP) verification and database integrity (e.g., is the service order trying to "add" a TN that already exists) will likely continue.

As a 9-1-1 Authority begins to utilize NG9-1-1, an ECRF will be required for call routing over their ESInet. Thus it seems natural for the 9-1-1 Authority to migrate from MSAG validation to LVF validation as NG9-1-1 deployment is underway. This will require that the DBMS systems that support the 9-1-1 jurisdiction utilize the Location to Service Translation (LoST) protocol[38] to perform LVF style validation in lieu of MSAG validation.

Performing LVF validation within a DBMS will require that the DBMS system be able to utilize LVF validation in coordination with MSAG processing. This can be accomplished by using the hierarchical nature of LVF servers as described in IETF's RFC 5222. The process for determining LVF usage will likely be as follows:

- The DBMS system queries a known regional LVF with a recursive validation request.
- If the regional LVF is not able to resolve the validation request, the DBMS system will have to assume that MSAG validation is to be performed. Thus, the existence of MSAG data

[38] Defined in http://datatracker.ietf.org/doc/rfc5222/. Usage for NG9-1-1 is described in NENA 08-003 (http://www.nena.org/?page=i3_Stage3)

within the DBMS does not indicate to perform MSAG-based validation. It is the absence of an LVF source and the existence of MSAG data that would determine MSAG usage.

- Conversely, the DBMS system could look at the MSAG table and if no record is found, assume LVF validation is in order. This assumes that location validation data that has been migrated from MSAG to LVF has been removed from MSAG. Using LVF as the primary is preferred because such usage:
    - Does not require strict removal of reference records from MSAG
    - Supports the notion of increased migration to LVF functionality.

A recommended practice for DBMS-based location validation is to migrate to an LVF-centric method of service order data processing as soon as production worthy LVF data exists. The DBMS system may have to account for multiple LVF instances being used for service order location data validation and/or utilize the recursive or iterative functions of the LoST protocol. See Figure 11-1 below:

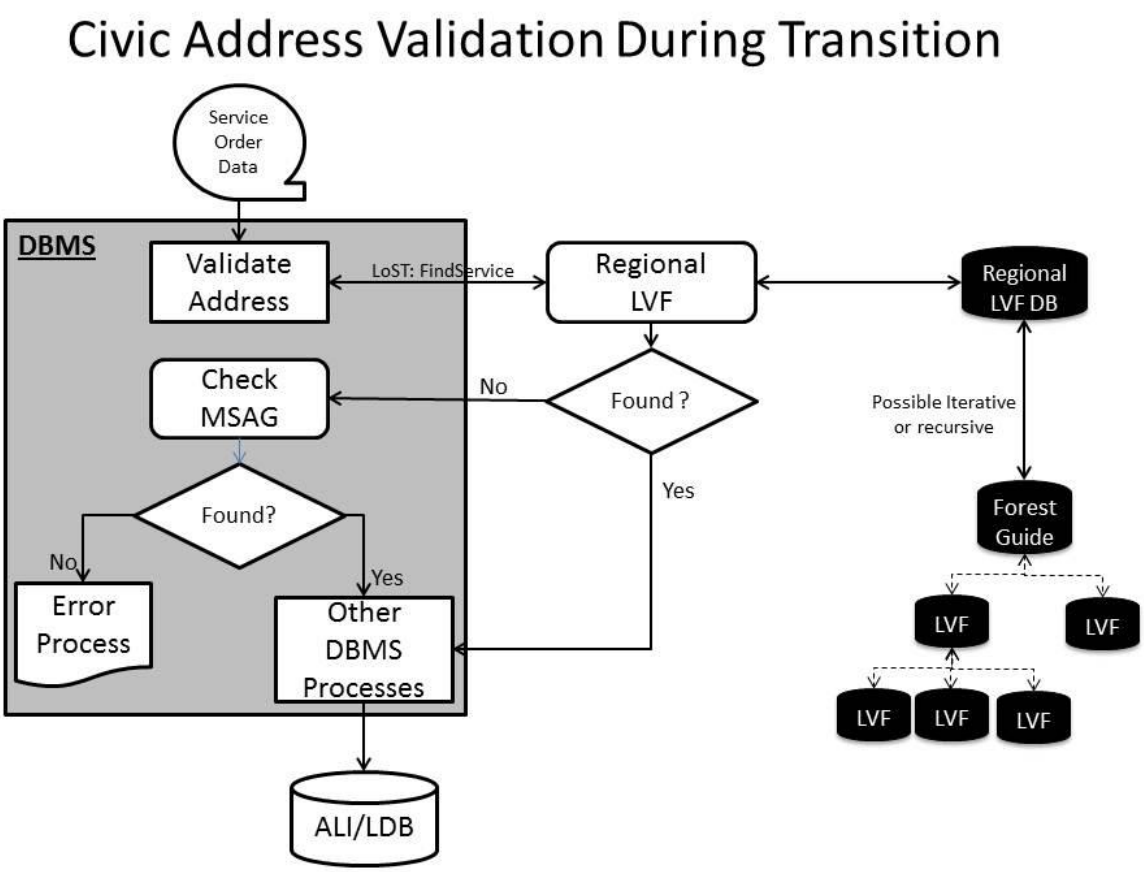

Figure 11-1 Civic Address Validation During Transition

Utilizing a regional LVF (or several regional LVFs) may require an agreement between the DBMS operator and the LVF operator to allow a particular LVF instance to serve as an "entry point" into the LoST hierarchy. Further coordination may be required to determine the use of iterative or recursive LoST queries to subsequent servers in the hierarchy.

11.4.2.1.1 Civic Valid vs. MSAG Valid

The role of MSAG goes away when a 9-1-1 Authority has fully moved to a NG9-1-1 solution. The necessary reference data will predominately be GIS data stored in LVF and ECRF database(s). A recommended approach is to integrate MSAG data into GIS data so that the resulting dataset contains all of the information from the MSAG. However, this integration is not mandatory. A 9-1-1 Authority could "flash cut" from using MSAG to using GIS data that has not been reconciled with MSAG. The result would be that access/service providers would provision locations that are civic valid per the GIS database but possibly not MSAG valid. It is noteworthy that GIS data tends to be more granular than MSAG data. For example, the GIS data may recognize that "150 Main" and "250 Main" are the only valid locations on "Main" but the MSAG may contain a range of "100 – 300 Main" as valid. Performing a flash cut to a new validation process may create issues with access/service providers who are accustomed to the data values and structure of today's MSAG.

A 9-1-1 Authority should also closely examine the impact of changing the data standard on any "downstream" systems such as CAD, etc. If any of those systems are relying on MSAG-valid locations, a flash cut without reconciliation would have adverse effects. Also, changes away from MSAG (without it being integrated into the GIS data) may impact the service order processing from service providers. See examples below:

Example 1:

	Pre –Directional	**Street Name**	**Suffix**
MSAG Values		W MAIN ST	
GIS Values	W	MAIN	ST

Example 2:

	Pre –Directional	**Street Name**	**Suffix**
MSAG Values		SECOND	ST
GIS Values		WILLIE NELSON	BLVD

A preferable approach would be to reconcile the MSAG and GIS data on the creation of the data to support an LVF or ECRF and continue to do periodic reconciliations until MSAG is completely removed from the environment. The deployment of an LVF or ECRF should include a mandate for periodic synchronization of the MSAG and GIS data.

Two examples of common discrepancies are:

- The exclusion of the street suffix. Some system service providers assume a value of "ST" unless the Street Suffix field in the MSAG states differently. Ideally, the MSAG would be correct to include the proper values in the Street Suffix field.

- The concatenation of street pre-directional and/or suffix (see Example 1). Again, the ideal solution would be to correct this issue prior to constructing the data for an LVF or ECRF.

These two examples support the need to perform a complete comparison between the MSAG and GIS data, as well as potentially Postal data. Postal data should be used with caution however. Postal streets often have an address range larger than what truly exists. The benefit of using Postal data is that it bears a closer resemblance to where the end user thinks they reside.

Even though Postal data is intended for a completely different use, it can also be helpful in building alias data between MSAG communities and streets to "real" communities and streets. For example, some MSAGs contain a community for a rural address where the value is something like "ABC COUNTY" or "XYZ – UNINCORP". If a potential caller is subscribing to a new telephony service, they will enter the name of the community from which their mail is delivered (even if it is in a different county). Thus, creating alias between Postal communities/streets to MSAG and/or GIS communities/streets is beneficial.

If a DBMS is to utilize an LVF for validation, then the LVF database must have an ESN for every location. Once the Selective Routers and ALI systems have been replaced, the need for ESN diminishes. Eventually, the routing knowledge represented by an ESN will be contained in the ECRF.

If non-MSAG valid (but Postal valid, i.e., matches a source such as USPS Pub 28) communities and streets are allowed to pass through a DBMS without an error, there is a strong need for MSAG Conversion Service. This service is described in Section 11.4.3.

11.4.2.2 Advocate LVF Usage to Third Parties

As a 9-1-1 Authority begins to develop its LVF, it should notify all third parties of the need to migrate from MSAG-based validation to LVF-based validation. Unless prohibited by regulation, the 9-1-1 Authority should establish a date at which time it will no longer distribute or utilize tabular MSAG for civic address validation.

11.4.2.3 Defining the Minimal Data Content for an LVF

Ideally an LVF database would contain civic location information that is derived from GIS road centerline (RCL) data that has been reconciled to the corresponding MSAG data. For 9-1-1 Authorities without robust/reconciled GIS data, it is possible to create an LVF database using only MSAG data where each street segment in the MSAG mimics a GIS RCL. As previously noted, robust GIS data may be more granular than MSAG data. An LVF database constructed strictly from MSAG data provides no worse validation than exists with an MSAG based validation process in current environments. While not ideal, it will allow for the equivalent of today's MSAG validation process while allowing service providers to migrate to a LoST based validation. It also decouples the data reconciliation process from other activities a 9-1-1 Authority may be performing. Since an LVF database constructed solely from MSAG data does not improve the validation process, it is recommended that this approach only be taken to facilitate a system-wide migration to a full NG9-1-1 solution. Furthermore, implementing such an LVF database should only be done if a parallel project is underway to develop robust GIS data. If the content of an "MSAG only" LVF is also being used for an ECRF, additional logic and data must exist to map an ESN to an appropriate URI for call routing. An MSAG only LVF will not be able to validate a geospatial location.

An "MSAG only" LVF database could be supplemented by reconciling Postal data to each MSAG street segment. While postal data may not be highly accurate, it would provide a means to identify alternative street names and community names (See Section 11.4.2.1.1). Using this approach, service providers would continue to construct service orders with the same MSAG "quirks" that has are used today (e.g., omitting "ST" from the Street Suffix field in some areas). Wireless calls would likely continue to be routed to the proper PSAP using the ESN associated with the pANI in the ALI/LDB (and possibly the LNG).

11.4.3 MSAG Conversion Service (MCS)

NENA 08-003 describes MSAG Conversion services as "a convenient way to provide data to, or get data from, an un-upgraded system that still uses MSAG data". It consists of two functions:

- PIDFLOtoMSAG: which takes a PIDF-LO as described in RFC4119 and returns an MSAG address as an XML object conforming to NENA 02-010 Version 4, XML Format for Data Exchange.
- MSAGtoPIDFLO: which takes an MSAG address as an XML object conforming to NENA 02-010 Version 4, XML Format for Data Exchange and returns a PIDF-LO as described in RFC4119.

MSAG Conversion Service is provisioned using the same mechanism as is used to provision the ECRF and LVF. The layers include all of the layers to create a PIDF, plus any layers needed to construct the MSAG for the local jurisdiction. It is logical that these conversion services will be done utilizing data in the LVF or ECRF database being utilized for validation and routing. A new Web Service could be created with the type of conversion requested and the location data. The LVF and ECRF servers will return the results or an error.

11.4.3.1 Needs Definition

The PIDFLOtoMSAG function will be needed to deliver an MSAG valid location to a legacy PSAP. This will likely occur at the Legacy PSAP Gateway (LPG). The legacy PSAP CPE, as well as other downstream systems such as CAD and records management systems are assumed to be expecting to get only MSAG valid locations. If the environment is one with a LIS or LDB (and no ALI), the LPG will need to build the equivalent of an ALI response in order to deliver data to a legacy PSAP. The minimum fields and the mappings between PIDF-LO and MSAG are detailed in Appendix A of NENA 08-003). One of the implications on transition is that the end state i3 design specifies that the data previously received in a single ALI query is now coming from a variety of sources. These sources include the PIDF-LO generated by the LIS/LNG, a variety of "Additional Data" sources, and the ECRF.

For example, the current proposal[39] is to derive class of service at call time using a combination of:

- The "method" field within the PIDF-LO (current value options are: GPS, A-GPS, Manual, DHCP, Triangulation, Cell, and 802.11)

[39] See Draft Report from NENA's Additional Data Working Group

- The "Service Delivered by Provider" field in the Additional Call Info Database (values include: Wireline, Multi-line telephone system, Fixed Public Pay/Coin telephones, Wireless Telephone Service, and VoIP Telephone Service)
- The "Service Environment" field in the Additional Call Info Database (values include: Residential and Business).

The MSAGtoPIDFLO function will be needed in the situation where location data is being provided by an ALI system but call delivery is handled by an NG9-1-1 system. The PIDF-LO is needed for call routing by the ESRP and ECRF. If the destination PSAP is NG9-1-1 enabled, the PIDF-LO is needed for location data delivery as well. This function may also be used by a service provider prior to LVF validation.

An example may clarify these usages. Assume that there is a legacy PSAP that is connected to an ESInet supporting NG9-1-1 and that key components (e.g., an ECRF) are already deployed. If a 9-1-1 call is delivered using legacy analog signaling, multiple conversions may need to occur. First, the location data would need to be retrieved from the ALI, LDB or LIS using the ANI as the query key. Second, the location data would need to be converted from MSAG to PIDF-LO. Once in PIDF-LO format, the ECRF could be queried for routing. The call would then be directed towards the legacy PSAP. Prior to supplying the location data, one last MCS query is required to convert (possibly by the Legacy PSAP Gateway (LPG)) PIDF-LO back to MSAG location.

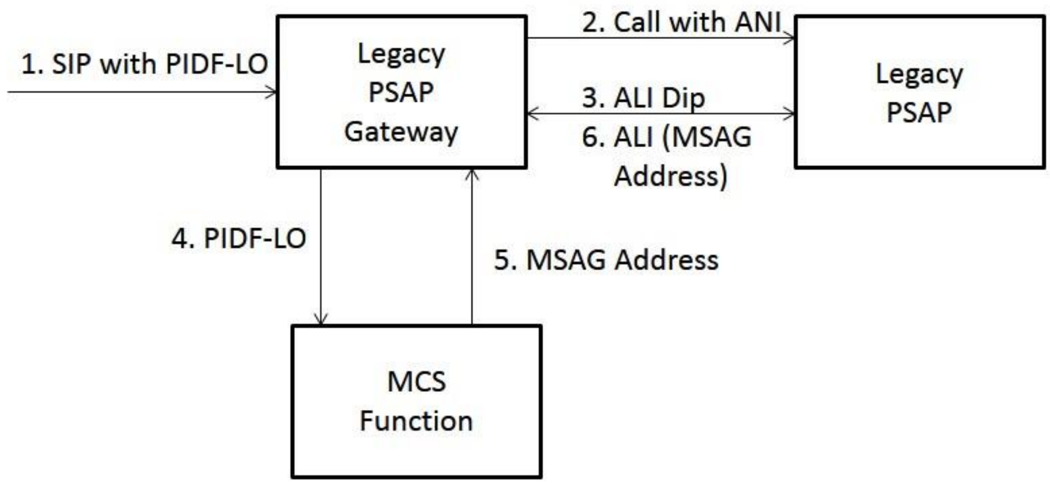

Figure 11-2 MCS Functionality Used by LPG

11.4.3.2 Data Requirements

Per NENA 08-003, MCS is provisioned using the same mechanism as is used to provision the ECRF and LVF: layer replication from the master Spatial Information Function (SIF)[40]. The layers include all of the layers to create a PIDF-LO as described above, plus any layers needed to construct the MSAG for the local jurisdiction. These would typically include an MSAG Community Name, often includes the County ID, and for many 9-1-1 jurisdictions where prefix/suffix and/or directionals are included in the Street Name would include a Street Name layer. Where the content of the MSAG is the same (for all addresses in the 9-1-1 jurisdiction) as the equivalent PIDF-LO field, the layer(s) need not be present.

Other options for building the conversions may also be available. For example a tabular approach could decompose each MSAG street segment into the PIDF-LO components.

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[40] The SIF is a multi-jurisdictional GIS repository.

11.4.3.3 Usage

There are two considerations when traversing between PIDF-LO and MSAG compliant address structures.

The first issue has to do with data element values. This deals with the specific value listed in a street name or community name field. There is a significant issue in today's MSAG where the value listed in the community field bears no resemblance to a Postal or civic community. Often in unincorporated areas, the MSAG community value is set to the county name (or some abbreviation thereof). To properly convert between the two data formats, "alias" values must be kept for street and communities at every data layer (e.g., points, lines, and polygons) to effectively translate the data element values.

Another issue with converting between PIDF-LO compliant and MSAG compliant data structures is that of data concatenation within MSAG street values. In many MSAGs, the practice has been to concatenate pre-directional, street suffix, and post directional values directly into the street name field.

Examples:

	Pre –Directional	**Street Name**	**Suffix**
MSAG Values		W Main ST	
PIDF Equivalent	W	Main	ST

While a majority of this concatenation can be parsed out programmatically at the time of conversion, a recommended practice is to initiate a data cleanup effort to separate out the concatenated MSAG Street Name values into their proper data elements. Such a cleanup should not be looked at lightly. For every MSAG record that is "corrected", potentially many ALI records will need to have a similar correction applied. While the work effort may be significant, the benefit will be that both reference data (MSAG) and source data (ALI) are in PIDF-LO compliant format, thus leaving only the "alias" value issue described above.

11.5 Developing NG9-1-1 Data Functions during Transition.

11.5.1 Location Database (LDB)

The presence of an LDB facilitates the deployment of other critical NG components by a 9-1-1 Authority, such as ECRF-based routing and NG9-1-1-capable CPE. As LIS systems and other additional data sources begin to be deployed, NG9-1-1-capable PSAPs may access these systems for required data. With deployment of these additional sources, the underlying data is now referenced from the new sources instead of the LDB.

Reference [8] defines the location database/server (aka LDB) as a logical element of the LNG. This document extrapolates the concept to the use of a legacy ALI and a database within the LNG.

During transition, the LDB can functionally serve as a Legacy ALI as shown in Figure 11-3. Legacy PSAPs that are not yet served by i3 ESInets and the Location Interwork Function (LIF) of a Legacy

Network Gateway (LNG) will query it using existing protocols (the legacy ALI query or potentially AQS). The legacy ALI will respond with location and additional data provisioned in it. For wireless calls, it will also query the MPC/GMLC to obtain location information.

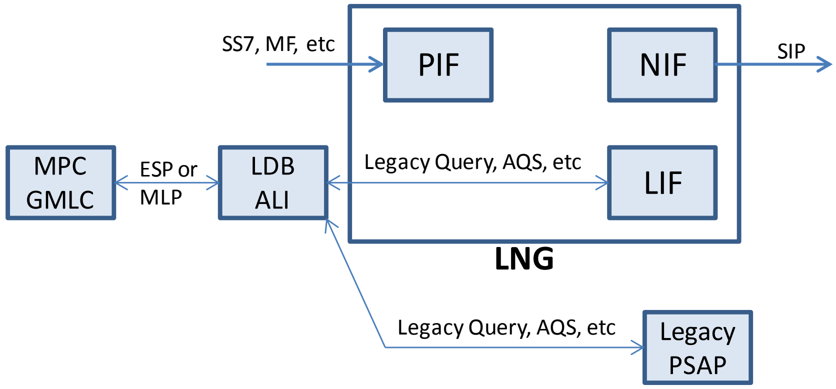

Figure 11-3 LDB as Legacy ALI

Alternatively, The LBD may reside within the LNG as shown in Figure 11-4 and provide the functionality described as the "location database/sever" defined in the i3 specification. The LDB retains all of the current information, functionality, and interfaces of today's ALI and can utilize the new protocols required in an NG9-1-1 deployment. The protocols to the LDB are left undefined but may be legacy ALI query, ALI Query Service (AQS), HTTP Enabled Location Delivery (HELD) or other proprietary protocols.

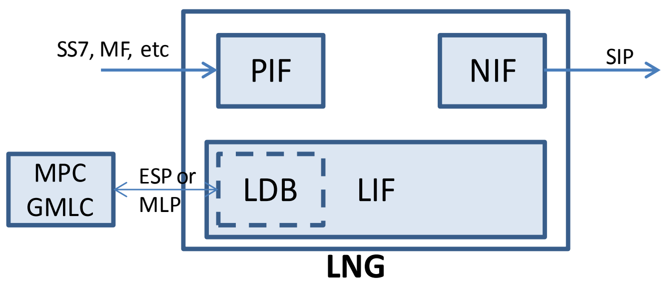

Figure 11-4 LBD integrated into the LNG

Additionally, the LIF associated with the LDB can insert the appropriate URIs that can be used to by PSAPs that are served by i3 ESInets to de-reference location data that originates in/is forwarded by the LDB and is associated with legacy emergency call originations. In doing so, the LDB supports the LNG as the source of resolution for Additional Caller Data that is stored in a Call Information Database (CIDB) that resides at the LNG.

11.5.1.1 Provisioning Data into a LDB

The LDB may continue to be provisioned using existing service order based processes/interfaces. The concept of using the legacy Database Management System (DMS) is illustrated in Figure 11-5. These processes usually involve a service provider submitting records in either NENA 2.x or NENA 4.x format. The database management process that utilizes these records may continue to use MSAG for civic location validation or it may upgrade to using an i3 Location Validation Function (LVF) as that functionality becomes available. The data provisioned into the LDB will be the same as that provisioned into an ALI until such time as that information resides elsewhere. This means that the shell records required to interact with MPCs/GMLCs for wireless calls and VPCs for VoIP calls must exist in the LDB. When a 9-1-1 Agency migrates from an ALI to an LDB, it is likely that all records (including shell records) will be migrated from the ALI to the LDB.

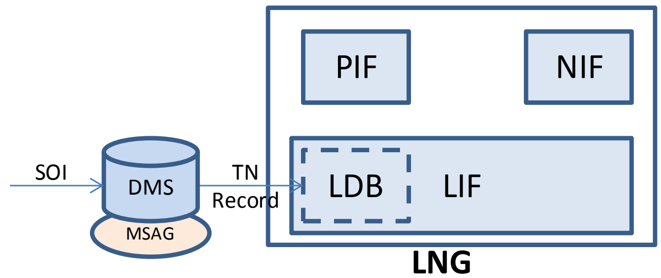

Figure 11-5 LDB Provisioning via the Database Management System

Another potential evolution is shown in Figure 11-6 for the situation where the E9-1-1 SSP does not provide database validation. That validation would be taken over by the NG9-1-1 provider or a third party that provides the data validation service via an LVF. Since the 9-1-1 DMS is not used for validation, the LNG's LDB must incorporate the Service Order Interface (SOI). Service Order 9-1-1 extracts would be sent to the LNG LDB via the SOI. The LNG LDB would then validate the location information with the LVF and return the results. Errors would be processed by the NG9-1-1 provider or the 3rd party and resubmitted to the LNG LDB. It would be prudent for the Service Order inputs to move from a batch process to a near real time process, e.g. 15 minutes.

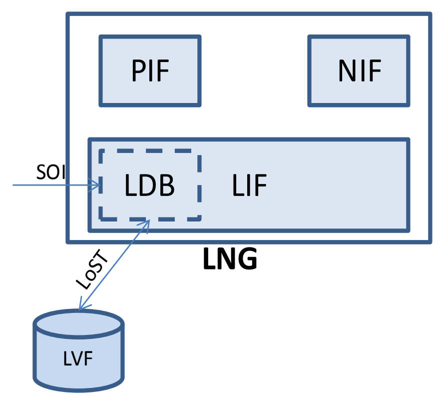

Figure 11-6 LDB Provisioning Directly via SOI

11.5.1.2 Querying an LDB for Data: Legacy PSAP Not Served by an i3 ESInet

As shown in Figure 11-3, the LDB/ALI must be able to respond to a traditional ANI query over either a serial or IP connection from either the LNG or existing Legacy PSAPs. The LDB will return a full ALI response based on the ANI or pANI.

11.5.1.3 Querying an LDB for Data

The LDB will likely be queried multiple times by LNG for every call. Location information may be delivered to an i3 PSAP using Location by Value (LbyV) in which case the PIDF-LO is delivered to the PSAP with the SIP call. Location may also be delivered to an i3 PSAP using Location by Reference (LbyR) in which case the SIP call header contains a URI that is used to retrieve the PIDF-LO from the LNG via the HELD protocol. In the case of legacy wireless (or i2 VoIP) originations, this will require that the LNG query the LDB for updated information, and that the LDB launch a request for updated location to the MPC/GMLC (or VPC).

For legacy PSAPs served by i3 ESInets, the Legacy PSAP Gateway (LPG) will be responsible for associating an ANI/pANI with the emergency call and delivering that ANI/pANI to the legacy PSAP during call setup. Legacy PSAPs served by i3 ESInets will send ALI queries to the LPG using existing ALI interfaces, and the LPG will be responsible for returning a full ALI response based on the pANI. If the location information received by the LPG in SIP signaling is an LbyR, the LPG will use the location reference URI to retrieve the PIDF-Lo from the LNG using the HELD protocol. As above, if the call originated from a legacy wireless or i2 VoIP caller, the LNG will query the LDB for updated location, and the LDB will launch a request for updated location to an MPC/GMLC or VPC.

The SIP signaling delivered to an i3 PSAP or LPG may also contain a header that includes URIs for retrieving additional information. This includes information about the caller (e.g., name) and about the call itself (e.g., class of service). The LNG must be able to generate a proper URI associated with any additional call data that it stores, and respond to these queries for data based on those URIs. The LDB will be responsible for providing additional call data to the LNG so that it can create the data structures and respond to requests from i3 PSAPs and LPGs.

11.5.1.4 Specific Interactions with NG9-1-1 Functional Elements

- Legacy Network Gateway (LNG):
- Legacy emergency call originations that are destined for PSAPs that are served by an ESInet are expected to traverse an LNG. The LNG will query, the LDB for location information. The location information returned by the LDB will ultimately be displayed at the PSAP. In the case of emergency call originations from fixed users, the location information will also be used to perform a LoST query against an ECRF for route determination. In order to use this location, the LNG will first have to invoke the MCS as defined section 11.4.3.
- The LNG may forward the location information retrieved from the LDB to the ESRP (for wireline call originations) in a LO or it will create an LbyR URI.
- Emergency Service Routing Proxy (ESRP): For wireline emergency call originations, the ESRP will use the LO that the LNG obtained from the LDB for call delivery determination via an additional LoST query against an ECRF. The ESRP will use the routing information returned by the ECRF to route the call forward to/toward the PSAP. This will include either the PIDF-LO or an LbyR URI indicating that a location de-reference request should be sent to the LNG.
- Legacy PSAP Gateway (LPG): After the LPG has delivered a call that has been routed via an i3 ESInet to a legacy PSAP, it will receive an ALI request from that PSAP. The LPG will either re-format the location information received “by value” in the SIP message from the ESRP for delivery to the legacy PSAP, or it will de-reference the LbyR using the location reference URI provided to it in SIP signaling from the ESRP. Upon receiving a de-reference

request from the LPG, the LNG will request location data from the LDB using an appropriate interface.

- Legacy Selective Router Gateway (LSRG): After the LSRG has delivered a call that has been routed via an i3 ESInet to a legacy PSAP via the Selective Router, it will receive an ALI request from that PSAP using the methods discussed in section 8.1.2. The LSRG will either re-format the location information received “by value” in the SIP message from the ESRP for delivery to the legacy PSAP, or it will de-reference the LbyR using the location reference URI provided to it in SIP signaling from the ESRP. Upon receiving a de-reference request from the LSRG, the LNG will request location data from the LDB using an appropriate interface.
- MPC / GMLC/ VPC: Although not technically a NG9-1-1 functional element, the LDB will interact with these logical entities (using existing protocols) to obtain location information based on a pANI presented in a location request. This interaction may occur at any point the LDB is queried by the LNG:
- Upon a wireless/VoIP call ingress
- Upon receipt of a de-reference request (either initial request or request for updated location) from an LPG associated with a wireless/VoIP call delivery to a legacy PSAP
- Upon receipt of a de-reference request (either initial request or request for updated location) from a NG9-1-1 capable PSAP associated with wireless/VoIP call delivery.
- NG9-1-1 Capable PSAP (NG PSAP): The LDB may be queried by the LNG as a result of a location de-reference request from an i3 PSAP. The LDB will provide additional call data (only “additional” data that is normally resident in an ALI; e.g., customer name, class of service, etc.) that is forwarded by the LNG to the i3 ESInet and delivered to the NG PSAP “by value” or “by reference”.

11.5.2 LVF/ECRF

11.5.2.1 Impact of Changes of LVF/ECRF Data on LDB Contents

In the current legacy environment, proposed changes to MSAG can be compared to the location records contained in the ALI in order to determine whether the proposed MSAG change will have an adverse impact (e.g., shortening an MSAG street range may “orphan” an ALI record). Within the contemplated NG9-1-1 environment, LIS records are periodically revalidated using the LVF to catch any such adverse impact. The likelihood and frequency of such revalidation and the impact of incorrect data between evaluations are beyond the scope of this section.

During transition, one recommended approach is that the LVF and ECRF is operated by (or in cooperation with) the LDB operator. This would allow adverse impacts of reference data on location records to be identified before they are committed to the LVF and ECRF database(s).

11.6 Changes to Data Processes as Other Functional Elements Become Deployed

The role and scope of the LDB will change when/if access providers and/or service providers begin to deploy other functional elements in the i3 design. This will have an impact on data processes (such as SOI) and data retrieval at call time. Additionally, the normalization of this data may require new quality assurance processes to ensure the integrity of critical 9-1-1 data. This section will examine the transitional impact of several key functional elements.

The scope of this section is limited to defining data and data processes that are required to transition data that is available in the current 9-1-1 environment. As such, some of the data defined in NENA 08-003 and 71-001 are not within the scope of data transition. Examples include information about a caller or location that is currently not stored in ALI (see work in process by the Additional Data Working Group).

11.6.1 Call Information Database (CIDB)

A call entering a NG9-1-1 system that passes through an origination network or service provider system of any kind may have a Call info header with a URI that resolves to an Additional Call Data structure. This URI may reference a provider's CIDB or may point to a CIDB resident in an LNG that may have acquired call data from the LDB.

The database that dereferences this URI is a Call Information Database (CIDB). There is a minimum amount of information listed as Mandatory in NENA 71-001 that mirrors the non-location related information currently provided by the ALI. These mandatory fields are:

- Data Provided by
- Provided by Company ID (This data is required unless the additional data structure is provided by the device)
- Provided by Contact URI
- Service Environment (either "Business" or "Residential")
- Service Delivered by Provider to End User ("Wireline", "VoIP", etc.)
- Telephone Number Privacy Indicator
- vCard for Subscriber's Data.

Two of these elements are beyond the scope of data available in today's environment. "Provided by Contact URI" is not required during transition but will be accepted by a NG9-1-1 capable functional element if present. The "vCard for Subscriber's Data" is also not required but will be accepted. If present, the minimum fields required are "surname" and "given name" for an individual or "org" for a business as defined in IETF RFC 6350.

Elements from the CIDB are used to derive Class of Service in a full NG9-1-1 environment. Absent a CIDB, COS and most of the elements listed above could be retrieved from an ALI query or an AQS query.

11.6.1.1 Ownership

If a service or access provider is supplying the URL with the call, it is assumed that the provider either owns the CIDB or has become aware of it from a party in the call delivery path. When a call is delivered to the LNG, it is assumed that the CIDB resides in the LNG. Provisioning

If the CIDB is provided by a service provider, they will assume all responsibility for provisioning the mandatory elements.

If the CIDB is not provided by a service provider, the required information, obtained from the LDB, will be stored in the LNG. Thus the data in the CIDB is a logical subset of the data in the LDB when not a provider specific data source.

If there is not a service provider CIDB and the CIDB resides in the LNG, the additional data provided by the LDB, will be provisioned in the LDB using the SOI process similar to what is currently utilized. The SOI process will need to be extended to include elements that are not part of the current process. A change to the SOI process will also necessitate a change to current NENA data formats to incorporate these additional data elements. These elements include:

- Service Environment (either "Business" or "Residential")
- Service Delivered by Provider to End User ("Wireline", "VoIP", etc.)
- Telephone Number Privacy Indicator.

It is assumed that the LNG will be able to take subscriber information from the LDB and generate a simple subscriber vCard.

11.6.2 Additional Location Data

NENA 71-001 lists the types of information that may be available about a location. This does not apply for Transition.

11.6.3 Additional Caller Data

There is a minimum amount of information listed in NENA 71-001. This does not apply for Transition.

11.7 Data Quality and Availability Expectations for Third Party Data Providers

To the extent that data that currently resides in ALI begins to fragment into additional data structures such as a CIDB and LIS, there is an expectation by the public safety community that the data maintains at least the same or higher quality as it maintains today and that the availability is on par or better than what is expected of an ALI. Some of the high level characteristics include:

- Periodic quality checks of all records against reference sources such as an LVF
- Redundant servers that are geographically diverse
- 99.99% availability of at least one server for any NG9-1-1 functional element that may be utilizing the data.

12. Recommended Reading and References

[1] NG9-1-1 Preliminary Transition Plan, US Department of Transportation, April 2008, http://www.its.dot.gov/ng911/

[2] NENA Functional and Interface Standards for NG9-1-1 Version 1.0, December 2007, http://www.nena.org/?page=i3_Stage3

[3] Focus Group 1B. "Long Term Issues for Emergency/E9-1-1 Services: Report 4." FCC NRIC VII. Sept. 2004. 26-27. https://transition.fcc.gov/nric/nric-7/fg1b-report-march-2005.pdf.

[4] NG9-1-1 System Preliminary Concept of Operations, DoT, http://www.its.dot.gov/ng911/

[5] NENA i3 Technical Requirements Document, NENA 08-751, Issue 1, September 28, 2006, http://www.nena.org/?page=i3_Requirements_LTD

[6] NENA Technical Requirements Document for Location Information to Support IP-Based Emergency Services, NENA 08-752, December 21, 2006, http://www.nena.org/?page=LocnInfoIP_EmergSvc

[7] Interim VoIP Architecture for Enhanced E9-1-1 Services (i2), NENA 08-001, Version 2, November 5, 2005, http://www.nena.org/?page=Interim_VoIP_i2

[8] Detailed Functional and Interface Standards for Next Generation 9-1-1 Version 1.0 (i3), NENA 08-003, Version 1.0, June 17 2011, http://www.nena.org/?page=i3_Stage3

[9] NENA Standard – Generic Requirements for an Enhanced 9-1-1 Selective Routing Switch, NENA 03-005 issue 1, January 2004, http://www.nena.org/?page=E911_SR

[10] NENA Standard – Legacy Selective Router Gateway Technical Standard, NENA 08-xxx, To be Published

[11] Request for Assistance Interface Specification – American National Standard, ATIS 05000019.2010, 2010

[12] NENA Security for Next-Generation 9-1-1 Standard (NG-SEC), NENA 75-001, Version 1, February 6, 2010, http://www.nena.org/general/custom.asp?page=NG911_Security

[13] NG9-1-1 Security (NG SEC) Audit Checklist, NENA 75-502, Version 1, December 14, 2011, http://www.nena.org/?page=NGSecurityChecklist

[14] NENA Recommended Method(s) for Location Determination to Support IP-Based Emergency Services - TID, NENA 08-505, Issue 1, December 21, 2006, http://www.nena.org/?page=LocnDetrmIP_EmergSvc

[15] NRIC Focus Group 1D. "Focus Group 1D Final Report–Communication Issues for Emergency Communications Beyond 9-1-1." FCC NRIC VII. Dec. 2005 http://www.nric.org/meetings/docs/meeting_20051216/FG1D_Dec%2005_Final%20Report.pdf

[16] NENA Recommendation for the implementation of Inter-Networking, E9-1-1 Tandem to Tandem, NENA 03-003 Issue 1, February 2000 http://www.nena.org/?page=InterNetworking

[17] NENA Emergency Services IP Network Design for NG9-1-1 (NID), NENA 08-506, Version 1, December 14, 2011, http://www.nena.org/?IP_Network_NG911

[18] Overview of NG9-1-1 Policy Rules for Call Routing and Handling, NENA 71-502, Version 1, August 24, 2010, http://www.nena.org/general/custom.asp?page=NG911_Policy_Rules

[19] NENA Information Document for Synchronizing Geographic Information Systems Databases with MSAG and ALI, 71-505, Version 1,1 September 8, 2009, http://www.nena.org/general/custom.asp?page=synch_gis_msag_ali

[20] NENA GIS Data Collection and Maintenance Standards, Issue 1, 02-014, July 17, 2007, http://www.nena.org/general/custom.asp?page=gisdatacollection

Appendix A – Legacy Baselines

A.1 Legacy Baseline – Wireless / Legacy / No 9-1-1

Doc. No. 1
19 June 2007
(ver. 1.0)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Beginning Point Description

Legacy Baseline Work Group Starting Point

Starting Point Name: Wireless / Legacy / No 9-1-1

Applicability to: Wireless calls made to 9-1-1 over the Legacy network in areas where the PSAP has no 9-1-1 equipment.

A.1.1 Introduction

This document discusses the characteristics of a configuration for a wireless call in a legacy environment where the PSAP has no 9-1-1 equipment. The call is converted to a seven or ten digit number and is routed to a default emergency center or PSAP admin number with voice only. This call does not come over a dedicated 9-1-1 trunk.

A.1.2 Functional Elements

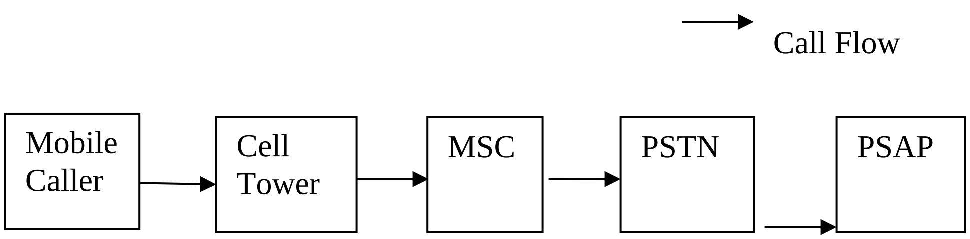

Figure 12-1 Legacy Baseline – Wireless / Legacy / No 9-1-1

A.1.3 Emergency Services Flows

A.1.3.1 Call Flow

Calls originate from mobile callers go through a cell tower to an MSC. Calls are routed by 10-digit or 7-digit phone numbers to the designated PSAP.

A.1.3.2 Data Flow

No data is provided to the PSAP

A.1.4 Operational Considerations

Operational considerations for moving from no 9-1-1 service Next Generation 9-1-1 span the political, economic and technology spectrums. PSAPs will need to upgrade their call taking platform, ALI and GIS equipment. The PSAP will also need to request Phase 1 / Phase II service from each carrier providing communication services in their area.

A.1.5 References

There are many publications and NENA courses available to those who would transition from No 9-1-1 service to the Next Generation. A few of the NENA courses relevant to this starting point are:

[21] Intro to Converging 9-1-1 Technologies (http://www.nena.org/?page=IntroConverg911Tech)

[22] The 9-1-1 Puzzle: Putting All the Pieces Together (http://www.nena.org/general/custom.asp?page=Course_911Puzzle)

[23] Introduction to Wireless for PSAPs (http://en.wikipedia.org/wiki/Enhanced_911)

A.2 Legacy Baseline – Wireline / Legacy / No 9-1-1

Doc. No. 2
July 5, 2007
(ver 1.0)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Beginning Point Description

Legacy Baseline Work Group Starting Point

Starting Point Name: <u>Wireline / Legacy / No 9-1-1</u>

Applicability to: Wireline calls made to 9-1-1 over the Legacy network in areas where the PSAP has no 9-1-1 equipment.

A.2.1 Introduction

This document discusses the characteristics of a configuration for a wireline call in a legacy environment where the PSAP has no 9-1-1 equipment. The call is converted to a seven or ten digit number and is routed to a default emergency center or PSAP admin number with voice only. This call does not come over a dedicated 9-1-1 trunk.

A.2.2 Functional Elements

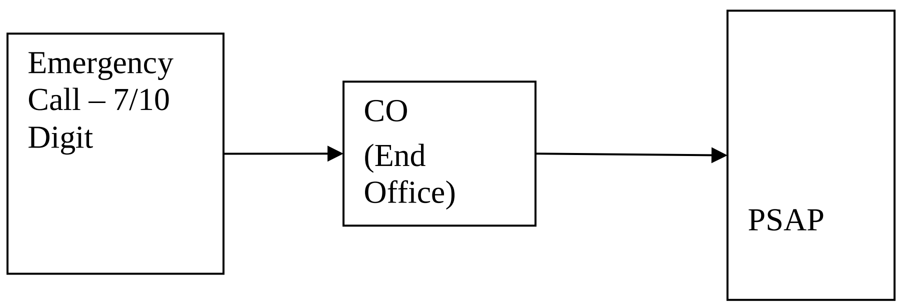

Figure 12-2 Legacy Baseline – Wireline / Legacy / No 9-1-1

- CO – Central Office
- PSAP – Public Safety Answer Point

A.2.3 Emergency Services Flows

A.2.3.1 Call Flow

An emergency services call is placed from a wireline telephone by dialing a dedicated 7 or 10 digit emergency number. The call is routed to the central office (CO) and sent to the PSAP for that wireline station.

A.2.3.2 Data Flow

No Data is delivered to the PSAP.

A.2.4 Operational Considerations

Caller must be able to identify their location.

There is no transfer capability at the PSAP or ALI retrieval.

B.1.1 References

[24] 03-007 NENA Standard for Emergency Service Central Office (ESCO) Code Selection, Assignment and Display Management, Issue 1, June 7, 2005

[25] 03-002 NENA Standard for the Implementation of Enhanced MF Signaling, E9-1-1 Tandem to PSAP, Issue 3, January 17, 2007

A.3 Legacy Baseline – Wireline / IP / No 9-1-1

Doc. No. 3
November 15, 2010
(ver. 1.1)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Beginning Point Description

Legacy Baseline Work Group Starting Point

Starting Point Name: Wireline / IP / No 9-1-1

Applicability to: Wireline Calls made to 9-1-1 using an IP network in areas where the PSAP has no 9-1-1 equipment.

A.3.1 Introduction

This document discusses the characteristics for a configuration for a wireline call from an Internet Protocol (IP) device in the legacy environment. In this configuration, the PSAP has no 9-1-1 equipment and the call is routed to the PSAP via ten-digit phone number over the Public Switched Telephone Network (PSTN).

A.3.2 Functional Elements

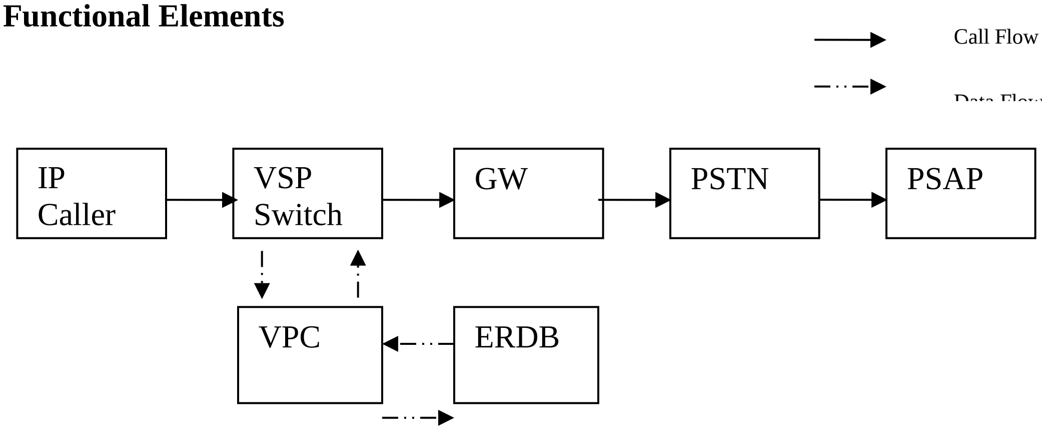

Figure 12-3 Legacy Baseline – Wireline / IP / No 9-1-1

- VSP - VoIP Service Provider
- VPC – VoIP Positioning Center
- ERDB – Emergency Routing Database
- GW – Gateway for Media & Signaling

A.3.3 Emergency Services Flows

A.3.3.1 Call Flow

A 9-1-1 call from an IP device goes to the IP provider's switch (VSP). The VSP recognizes the IP address of the call and dips VPC, which in turn dips the Emergency Routing Database for the correct routing keys, in this case a CRN (Contingency Routing Number). The ten-digit CRN is used by the Gateway to access the public switched telephone network which delivers the call to the PSAP.

A.3.3.2 Data Flow

The ERDB contains the routing information associated with the CRN. It supports the boundary definitions for Emergency Service Zones (ESZs) and the mapping of civic address or geo-spatial coordination location information to a particular ESZ.

For each ESZ, the ERDB contains an Emergency Services Zone Routing Database Route Tuple (ERT) consisting of a Selective Routing Identifier, a routing Emergency Services Number (ESN) that uniquely identifies the ESZ in the context of that SR, and an NPA that is associated with the outgoing route to the SR. The ERDB will need to contain a CRN (a 10-digit 24X7 PSAP number) associated with the ESZ for all areas where the PSAPs have no 9-1-1.

When an emergency call is originated and location information is received, the ERDB will identify the ESN and routing information associated with the location information. It will return the CRN to the VPC which hands the 10-digit 24x7 number off to the VSP switch which in turn sends it via the gateway to the PSTN and on to the PSAP.

A.3.4 Operational Considerations

To keep pace with rapidly advancing technology and the reality of E9-1-1 Next Generation, PSAPs will need to implement or upgrade their existing platforms, ALI and GIS equipment to Phase 1 / Phase II recommended standards. These services can be obtained by contacting carriers providing communication services.

The ERDB data must be loaded and managed. Coordination with the governing bodies will be ongoing to define PSAP boundaries and geo-code civic addresses for assignments of ERTs.

A.3.5 References

[26] Interim VoIP Architecture for Enhanced 9-1-1 Services NENA 08-001, Issue 1 December 6, 2005

A.4 Legacy Baseline – Wireline Basic 9-1-1

Doc. No. 4
August 7, 2007
(1.0)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Beginning Point Description

Legacy Baseline Work Group Starting Point

Starting Point Name: **Wireline / Legacy / Basic 9-1-1**

Applicability to: Wireline Calls made to 9-1-1 over the Legacy network where the PSAP has Basic 9-1-1 equipment with dedicated trunks.

A.4.1 Introduction

This document discusses the characteristics for a configuration for a call in a legacy environment with Basic 9-1-1 equipment. The call is routed over dedicated 9-1-1 trunks which may or may not have ANI.

A.4.2 Functional Elements

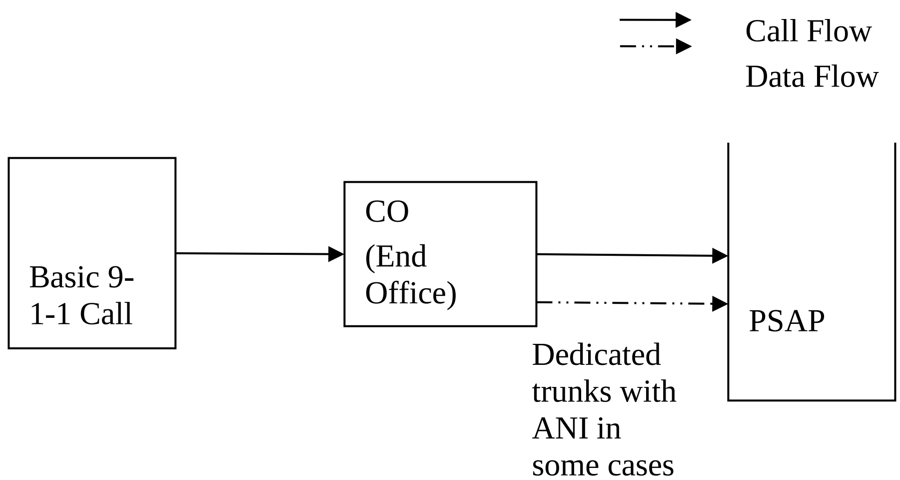

Figure 12-4 Legacy Baseline – Wireline Basic 9-1-1

- CO – Central Office
- PSAP – Public Safety Answer Point

A.4.3 Emergency Services Flows

A.4.3.1 Call Flow

An emergency services call is placed from a wireline telephone by dialing 9-1-1. The call is routed to the PSAP over dedicated 9-1-1 trunks with ANI.

A.4.3.2 Data Flow

In some Basic 9-1-1 systems, ANI is passed; in others it is not. ALI is not available, however, to PSAPs who have only Basic CPE.

A.4.4 Operational Considerations

The caller can be called back if ANI has been passed or they are able to provide their telephone number. No location information is automatically available.

A.4.5 References

[27] 03-506 NENA E9-1-1 Voice Circuit Requirements, Providing a P.01 Grade of Service TID, Issue 1, April 13, 2007

[28] 03-501 NENA Network Quality Assurance, Issue 2, October 3, 2005

A.5 Legacy Baseline – Wireline/IP/Basic 9-1-1

Doc. No. 5
November 15, 2010
(ver. 1.1)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Beginning Point Description

Legacy Baseline Work Group Starting Point

Starting Point Name: <u>Wireline / IP / Basic 9-1-1</u>

Applicability to: Wireline Calls made to 9-1-1 using an IP network in areas where the PSAP has Basic 9-1-1 equipment. The call is routed over dedicated 9-1-1 trunks.

A.5.1 Introduction

This document discusses the characteristics for a configuration for a wireline call from an Internet Protocol (IP) device in the legacy environment. In this configuration, the PSAP has Basic 9-1-1 capability and the call is routed to dedicated 9-1-1 trunks over the Public Switched Telephone Network (PSTN).

A.5.2 Functional Elements

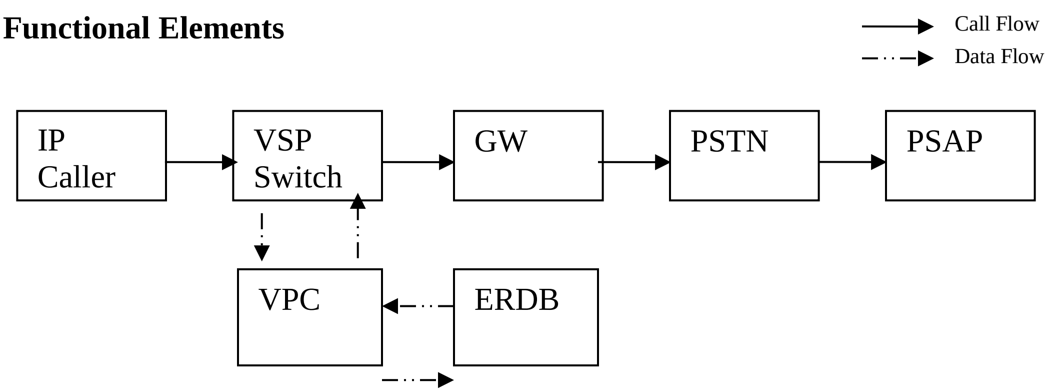

Figure 12-5 Legacy Baseline – Wireline/IP/Basic 9-1-1

- VSP - VoIP Service Provider
- VPC – VoIP Positioning Center
- ERDB – Emergency Routing Database
- GW – Gateway for Media and Signaling

A.5.3 Emergency Services Flows

A.5.3.1 Call Flow

A 9-1-1 call from an IP device goes to the IP provider's switch (VSP). The VSP recognizes the IP address of the call and dips VPC, which in turn dips the Emergency Routing Database for the correct routing keys, in this case a CRN (Contingency Routing Number) because the PSAP has Basic 9-1-1, and passes this information back to the VSP. The ten-digit CRN is used by the Gateway to access the public switched telephone network which delivers the call to the PSAP.

A.5.3.2 Data Flow

In Basic systems, ANI or ESQK (Emergency Services Query Key) is only available at the PSAP if the PSAP has equipment to receive and display it.

A.5.4 Operational Considerations

To keep pace with rapidly advancing technology and the reality of E9-1-1 Next Generation, PSAP will need to implement or upgrade their existing platforms, ALI and GIS equipment to Phase 1 / Phase II recommended standards. These services can be obtained by contacting carriers providing communication services.

The ERDB data must be loaded and managed. Coordination with the governing bodies will be ongoing to define PSAP boundaries and geo-code civic addresses for assignments of ERTs.

A.5.5 References

[29] Interim VoIP Architecture for Enhanced 9-1-1 Services NENA 08-001, Issue 1 December 6, 2005

A.6 Legacy Baseline – Wireline/Legacy/Enhanced 9-1-1

Doc. No. 6
August 14, 2007
(1.0)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Beginning Point Description

Legacy Baseline Work Group Starting Point

Starting Point Name: <u>Wireline / Legacy / Enhanced 9-1-1</u>

Applicability to: Wireline calls made in areas where the PSAP has Enhanced 9-1-1 Capability

A.6.1 Introduction

This document discusses the characteristics for a configuration for a wireline call in the legacy emergency services network. In this configuration customer location information is provisioned from a service order through a Database Management System (DBMS) to an Automatic Location Identification (ALI) system. Calls originate through end offices or private switched networks with the delivery of voice and ANI to the PSAP. They are routed based upon TN/ESN association via a Selective Router to the appropriate PSAP. When the call is delivered, the PSAP CPE au queries for location information from the ALI database.

A.6.2 Functional Elements

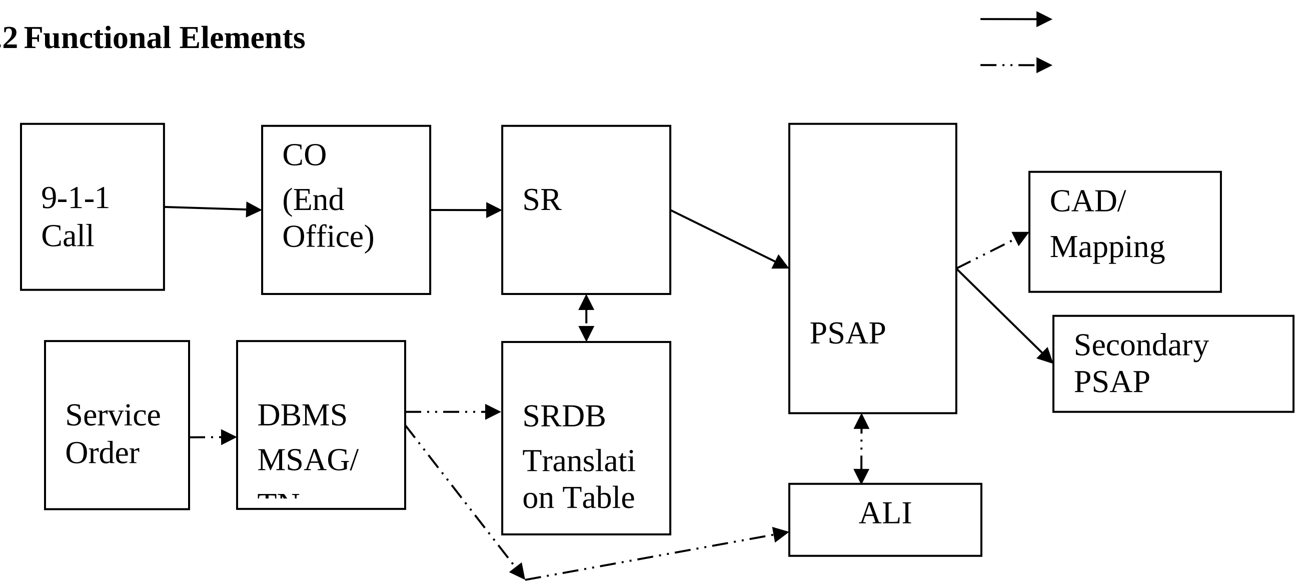

Figure 12-6 Legacy Baseline – Wireline/Legacy/Enhanced 9-1-1

- ANI-Automatic Number Identification
- ALI – Automatic Location Identification
- DBMS – Database Management System
- MSAG – Master Street Address Guide
- PSAP – Public Safety Answer Point

- SR – Selective Router
- SRDB – Selective Router Database
- CAD/Mapping – Computer Aided Dispatch with optional Mapping Feature
- CPE-Customer Premise Equipment

A.6.3 Emergency Services Flows

A.6.3.1 Call Flow

A 9-1-1 call is placed from a wireline telephone and sent to the local central office (CO) for that wireline station. The central office recognizes the call as 9-1-1 and forwards the call to the Selective Router (SR) with Automatic Number Identification (ANI) The SR queries the Selective Router Database (SRDB) for routing instructions. The SRDB returns the Emergency Service Number (ESN). The SR uses the ESN to choose a trunk group to the appropriate Public Safety Answering Point (PSAP) and delivers the call. Equipment located at the PSAP receives the call with ANI and sends a query to a database to retrieve Automatic Location Information (ALI). If CAD/Mapping is present, the PSAP may add additional support based on stored information about the caller's location. PSAP may selectively transfer caller to a Secondary PSAP.

A.6.3.2 Data Flow

In order to populate appropriate data elements the Database Management System (DBMS) receives a 9-1-1 extract from the data provider's Service Order system. The DBMS validates the address against a Master Street Address Guide (MSAG) for consistency of format. The DBMS then creates two files: one for routing and one for location. The first file for routing correlates the user's ANI with an ESN and is sent to the Selective Router Database (SRDB). The second file which is used for location is sent to the ALI.

A.6.4 Operational Considerations

For records that do not pass MSAG validation, Data Integrity Unit (DIU) clerks are assigned to research the error. The error may require the DIU clerk to correct the customer's address that was submitted in the service order. Or, the error may be such that the MSAG is in error. The DIU clerk may have to work with the appropriate jurisdictional authority to correct the MSAG.

The MSAG is maintained by the jurisdiction and submitted to the DBMSP for storage and processing in the DBMS.

If calls are misrouted to a PSAP, the PSAP reports the error to the DBMSP or the SP. This party researches the error to determine the source of the error and corrects the problem.

If calls are received at the PSAP with an error in the ALI, the error is reported to the DBMSP. If the error is associated with the DBMSP's customer record they must correct the information in the appropriate databases. If the error can be tracked to another SP, the DBMSP passes the error to that party for correction.

Computer Aided Dispatch (CAD) equipment is an enhancement to the Call-takers and Administrators at the PSAP. It allows additional information to be stored and has become an integral part of the PSAP Operations since it was introduced in the 1990's. While it facilitates identification of needed resources and aides in the Telecommunicator's decision-making process, CAD is not a requirement for answering a 9-1-1 call.

A.6.5 References

[30] 03-506 NENA E9-1-1 Voice Circuit Requirements, Providing a P.01 Grade of Service TID, Issue 1, April 13, 2007

[31] 03-002 NENA Standard for the Implementation of Enhanced MF Signaling, E9-1-1 Tandem to PSAP, Issue 3, January 17, 2007

[32] 03-004 NENA Recommendation for an E9-1-1 Functional Entity Model, Issue 1, June 1, 2000

[33] 02-011 NENA Data Standards for Local Exchange Carriers, ALI Service Providers & 9-1-1 Jurisdictions, Issue 6, November 21, 2006

[34] 03-506 NENA E9-1-1 Voice Circuit Requirements, Providing a P.01 Grade of Service TID, Issue 1, April 13, 2007

[35] 03-002 NENA Standard for the Implementation of Enhanced MF Signaling, E9-1-1 Tandem to PSAP, Issue 3, January 17, 2007

[36] 03-004 NENA Recommendation for an E9-1-1 Functional Entity Model, Issue 1, June 1, 2000

[37] 02-011 NENA Data Standards for Local Exchange Carriers, ALI Service Providers & 9-1-1 Jurisdictions, Issue 6, November 21, 2006

A.7 Legacy Baseline – Wireline/IP/Enhanced 9-1-1

Doc. No. 7
November 15,2010
(ver. 1.1)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Beginning Point Description

Legacy Baseline Work Group Starting Point

Starting Point Name: Wireline/ IP / Enhanced 9-1-1

Applicability to: Wireline Calls made to 9-1-1 using an IP network in areas where the PSAP has Enhanced 9-1-1 equipment.

A.7.1 Introduction

This document discusses the characteristics for a configuration for a wireline call from an Internet Protocol (IP) device to the legacy emergency services network. In this configuration, the answering point has Enhanced 9-1-1 capability and the call selectively routed to the dedicated 9-1-1 trunks over the legacy emergency services network. The PSAP receives ANI and ALI.

A.7.2 Functional Elements

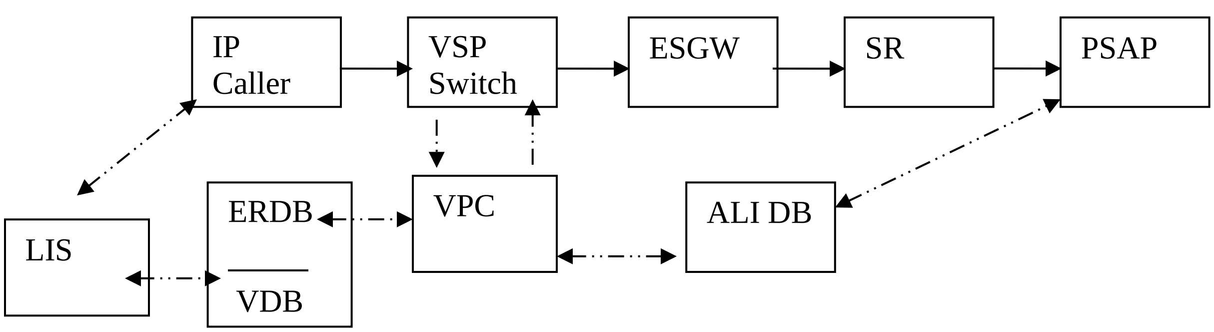

Figure 12-7 Legacy Baseline – Wireline/IP/Enhanced 9-1-1

- VSP --- VoIP Service Provider
- VPC ---VoIP Positioning Center
- ERDB --- Emergency Routing Database
- ESGW --- Emergency Services Gateway
- SR --- Selective Router
- ALI DB --- Automatic Location Identification Database
- LIS --- Location Information Server
- VDB --- Validation Data Base

A.7.3 Emergency Services Flows

A.7.3.1 Call Flow

A 9-1-1 call from an IP device goes to the IP provider's switch (VSP). The VSP recognizes the IP address of the call as the location key, and dips the VPC to obtain routing information for the call. Optionally, the VPC uses the location key to obtain a location from the LIS that has previously been validated by the VDB. The VPC then dips the ERDB for the correct routing and passes this information back to the VPC. The VPC sends the ESQK and routing information to the VSP. The VSP forwards the call to the ESGW and on to the Selective Router and the SR sends the call to the PSAP. As the ANI is received at the PSAP a dip is done in the ALI DB which determines this is an ESQK and goes back to the VPC for the valid location and provider information. Both ANI and ALI are received by the PSAP.

A.7.3.2 Data Flow

The ERDB supports the boundary definitions for Emergency Service Zones (ESZs) and the mapping of civic address or geo-spatial coordination location information to a particular ESZ.
.

For each ESZ, the ERDB contains an Emergency Services Zone Routing Database Route Tuple (ERT) consisting of a Selective Routing Identifier, a routing Emergency Services Number (ESN) that uniquely identifies the ESZ in the context of that SR, and an NPA that is associated with the outgoing route to the SR. The ERDB will need to contain a CRN (Contingency Routing Number which is a 10-digit 24X7 PSAP number for failure situations), a call back number, location and provider information for all areas where the PSAPs have Enhanced 9-1-1.

A.7.4 Operational Considerations

To keep pace with rapidly advancing technology and the reality of NG9-1-1, the PSAP will need to ensure their tabular MSAG and GIS databases are in synch. All telephone number records must pass the edits of both databases since an IP device will either pass a civic or geodetic location.

The ERDB data must be loaded and managed. Coordination with the governing bodies will be ongoing to define PSAP boundaries and geo-code civic addresses for assignments of ERTs.

A.7.5 References

[38] Interim VoIP Architecture for Enhanced 9-1-1 Services NENA 08-001, Issue 1 December 6, 2005

A.8 Legacy Baseline – Wireless/Legacy/Phase 1

Doc. No. 8
November 15, 2010
(ver. 1.1)

NENA Next Generation 9-1-1 Transition Planning Committee
Transition Beginning Point Description
Legacy Baseline Work Group Starting Point

Starting Point Name: Wireless / Legacy / Phase 1
Applicability to: Wireless calls made to 9-1-1 over the Legacy network in areas where the PSAP has Phase 1 – capable 9-1-1 equipment.

A.8.1 Introduction

This document discusses the characteristics for a configuration for an NCAS (Non Call-Associated Signaling) wireless 9-1-1 call in the legacy telecommunications network. In this configuration, customer location information is determined based on the address of the cell site and sector which originates the call. Cell site addresses are provisioned in the coordinate Routing Database (RDB) and in an Automatic Location Identification (ALI) system. Calls are routed based upon cell site and sector to the appropriate PSAP and when the call is delivered, the PSAP receives the caller's Callback Number (CBN) and the originating cell site address location. NOTE: A number of PSAPs are deployed Phase 1 with a Call -Associated Signaling (CAS) solution.

A.8.2 Functional Elements

Figure 12-8 illustrates the reference model for this legacy configuration. The 9-1-1 call from the cellular handset originates from a cell site sector to the Mobile Switching Center (MSC) which communicates with the Mobile Positioning Center (MPC), for CDMA, or Gateway Mobile Location Center (GMLC), for GSM, to obtain the routing instructions for the call. After the routing instructions are received by the MSC, the voice routing instructions (trunk group number / Emergency Service Routing Key (ESRK)) are sent to the Selective Router (SR) to be delivered to the PSAP. Routing instructions for Integrated Digital Enhanced Network (iDEN) are resident in reference tables in the MSC. After the PSAP has received the voice portion of the call, the PSAP Customer Premise Equipment (CPE) queries through an ALI server to the MPC or GMLC for the location information. The MPC or GMLC sends the data instructions (Call back number (CBN) and cell location address information) to the Automatic Location Information (ALI) database which forwards the location information to the PSAP CPE.

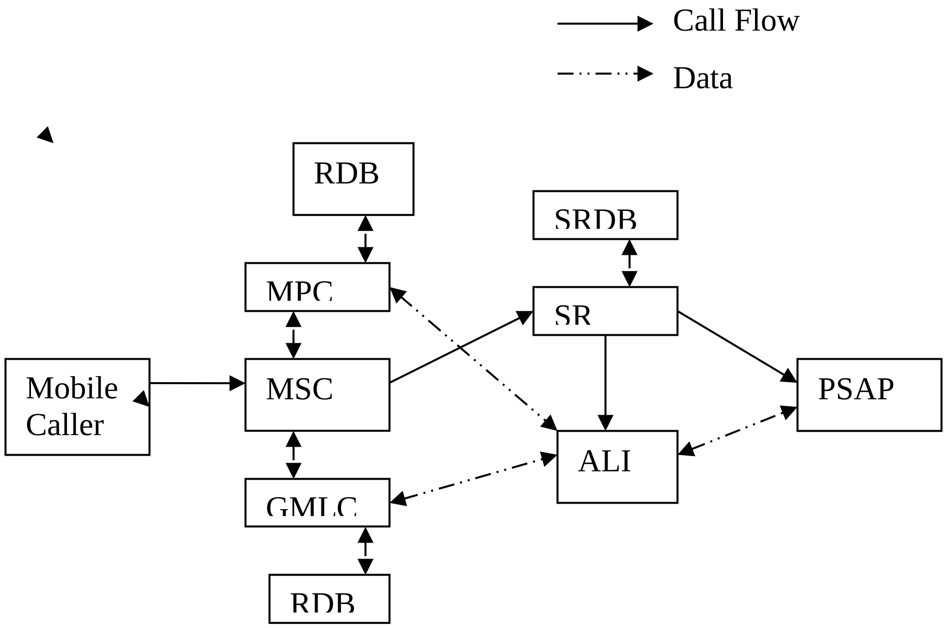

Figure 12-8 Legacy Baseline – Wireless/Legacy/Phase 1

- ALI – Automatic Location Identification
- CAS – Call Path Associated Signaling
- CBN – Call Back Number
- ESN – Emergency Services Number
- ESRK – Emergency Services Routing Key
- GMLC – Gateway Mobile Location Center
- ISDN – Integrated Services Digital Network
- ISUP - Integrated Services Digital Network User Part
- MF trunks – Multi - Frequency
- MPC – Mobile Positioning Center
- MSAG - Master Street Address Guide
- ORREQ – Origination Request
- PSAP – Public Safety Answer Point
- RDB – Routing Database
- Coordinate
- Cell Address
- SR – Selective Router
- SRDB – Selective Router Database
- SS7 – Signaling System #7

A.8.3 Emergency Services Flows

A.8.3.1 Call Flow

In order to ensure the call routing for a 9-1-1 call, multiple databases have to be populated and checked prior to implementation. Emergency Services Routing Keys (ESRKs) are pools of 10 digit numbers assigned to individual PSAPs for call routing identification. The ESRKs are loaded into the MPC / GMLC, the MSC, and the Selective Router to ensure the voice portion of the 9-1-1 call routes to the correct PSAP.

When a 9-1-1 call is initiated from a wireless handset, it originates on a cell site sector and the emergency call request is sent to the MSC. In CDMA networks, the MSC sends an Origination Request to the MPC with CBN and cell site information which will be used to identify the PSAP to receive the call. The MPC will query the RDB to identify the PSAP to determine the Emergency Services Routing Key (ESRK) routing instructions. In GSM networks, the MSC sends a Subscriber Location Report (SLR) to the GMLC, containing the CBN and Cell Global Identity (CGI). The GMLC queries its RDB to identify the PSAP to determine the ESRK routing instructions. In both CDMA and GSM networks, the ESRK routing instructions are sent to the MSC which are used to identify the trunk group to send the call to the Selective Router (SR). For iDEN the routing instructions are resident in reference tables in the MSC. Using the routing instructions from the MSC (ESRK and Trunk group) the SR will query the SRDB to identify, select, and deliver the call to the appropriate Public Safety Answering Point (PSAP). Customer Premise Equipment (CPE) located at the PSAP will be capable of receiving the call from the Selective Router.

A.8.3.2 Data Flow

In order to ensure the flow of data for a 9-1-1 call, multiple databases containing address information have to be populated and checked prior to implementation. The Service Provider's cell site and sector address (CDMA) or Cell address (GSM) information is populated into the MPC / GMLC RDB and the Automatic Location Information (ALI). For iDEN the Service Providers cell site and sector address is populated into the MPC.

The address information must be in a Master Street Address Guide (MSAG) format and accepted by the PSAP prior to deployment or implementation.

When a 9-1-1 call is initiated from a wireless handset, it originates on a cell site sector and the emergency call request is sent to the MSC. For CDMA and GSM, after the MPC returns the orreq response, or the GMLC returns the SLR acknowledgement to the MSC with the routing instructions, they stage the CBN received from the MSC and perform a look-up of the cell site sector MSAG address populated in the RDB. For iDEN, CDMA and GSM, after the PSAP has received the voice portion of the call, the PSAP Customer Premise Equipment (CPE) queries the MPC or GMLC for the location information through the ALI database. The MPC or GMLC sends the data instructions (Call back number (CBN) and cell location address information) to the Automatic Location Information (ALI) database which forwards the routing information to the PSAP CPE

Customer Premise Equipment (CPE), located at the PSAP, is implemented and formatted to receive emergency calls and display required caller data.

A.8.4 Operational Considerations

PSAP call routing is a key function in the 9-1-1 process. The Wireless Carrier or its Service Provider identifies the Radio Frequency (RF) cell site location and coverage areas then maps them to the PSAP boundary. From this overlay identification process, the information and maps are presented to the PSAP for their agreement and approval. The PSAP 9-1-1 call routing plan is then based on the PSAP agreement and acceptance to receive call traffic from cell site sectors that are located in, or provide border support to, areas within their boundaries. Also, a review of cell site sector MSAG addresses should be conducted between the PSAP and the Wireless Carrier or its Service Provider and any issues corrected prior to the deployment of Phase 1 service.

Customer Premise Equipment, located at the PSAP will be implemented and formatted to receive emergency calls and display required caller data. Resources at the PSAP will be familiar with the equipment and have sufficient training to understand the overall operation and output results.

Along with the Wireless Carrier or its Service Provider and the LEC, the PSAPs will identify and determine how they want to handle overflow, alternate and default call routing. Once the alternate and default routing instructions and processes have been developed, they will be shared with the Service Providers and implemented at the Selective Router and the MSC.

NOTE: A limited number of PSAPs are deployed Phase 1 with a Call Path Associated Signaling (CAS) solution. In this solution, 20 digits are passed from the MSC to the SR; and up to 20 digits can be passed to the PSAP. The current trunk signaling methods used include: Feature Group D or SS7/ISUP to the SR and Enhanced MF or ISDN to the PSAP and generally requires upgrades to PSAP equipment and E9-1-1 Selective Routers. These systems will require equipment updates to become Phase II capable.

A.8.5 References

[39] ANS/J-STD-036-C Enhanced Wireless 9-1-1 Phase II

[40] 3GPP TS 23.271 Functional stage 2 description of Location Services (LCS)

A.9 Legacy Baseline – Wireless/Legacy/Phase II

Doc. No. 9
August 27, 2007
(1.0)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Beginning Point Description

Legacy Baseline Work Group Starting Point

Starting Point Name: Wireless / Legacy / Phase II

Applicability to: Wireless calls made to 9-1-1 over the Legacy network in areas where the PSAP has Phase II – capable 9-1-1 equipment.

A.9.1 Introduction

This document discusses the characteristics for a configuration for an NCAS Phase II wireless 9-1-1 call in the legacy telecommunications network. In Phase II, additional equipment will be deployed in the legacy communications network that will be used to identify and calculate data to determine the caller location information, Latitude / Longitude. The call will be routed based on the cell site and sector which originates the call and will deliver the Call back number and cell site address the same as a Phase 1 call. For delivery of the Phase II caller location data, the PSAP will need to request the location data from MPC/GMLC.

A.9.2 Functional Elements

Processing

Call Flow

Data

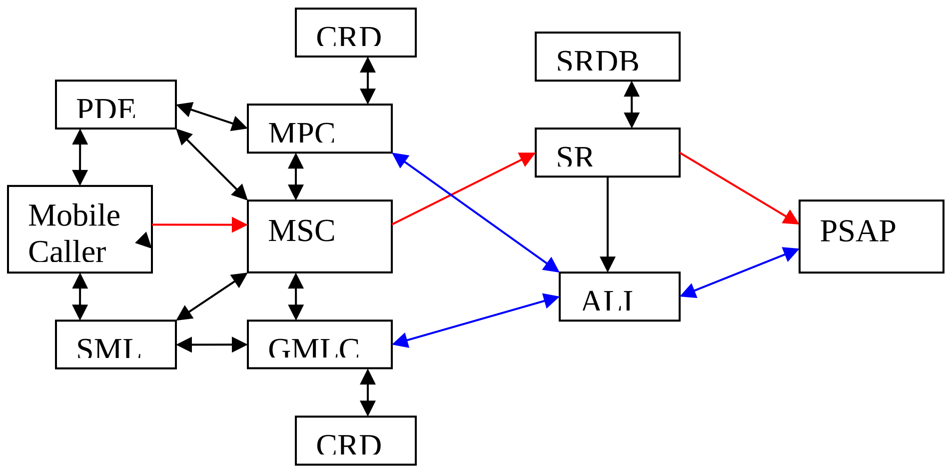

Figure 12-9 Legacy Baseline – Wireless/Legacy/Phase II

Figure 12-9 illustrates the reference model for the Phase II legacy configuration. The 9-1-1 Phase II call from the cellular handset originates from a cell site sector to the Mobile Switching Center (MSC) which communicates with the Mobile Positioning Center (MPC), for CDMA, or Gateway Mobile Location Center (GMLC), for GSM, to obtain the routing instructions for the call and to trigger a request to calculate position of the caller, latitude/longitude, location. After the routing instructions are received by the MSC, the voice routing instructions (trunk group number / Emergency Service Routing Key (ESRK)) are sent to the Selective Router (SR) to be delivered to the PSAP. Routing instructions for iDEN are resident in reference tables in the MSC. After the PSAP has received the voice portion of the call, the PSAP Customer Premise Equipment (CPE) queries, through the ALI database, the MPC or GMLC for the location information. The MPC or GMLC sends the data instructions (Call back number [CBN] and cell location address information) to the Automatic Location Information (ALI) database which forwards the location information to the PSAP CPE. If the calculated caller location data is not available upon initial bid by the PSAP, it is staged at the MPC/GMLC waiting to be delivered upon the PSAP's subsequent request.

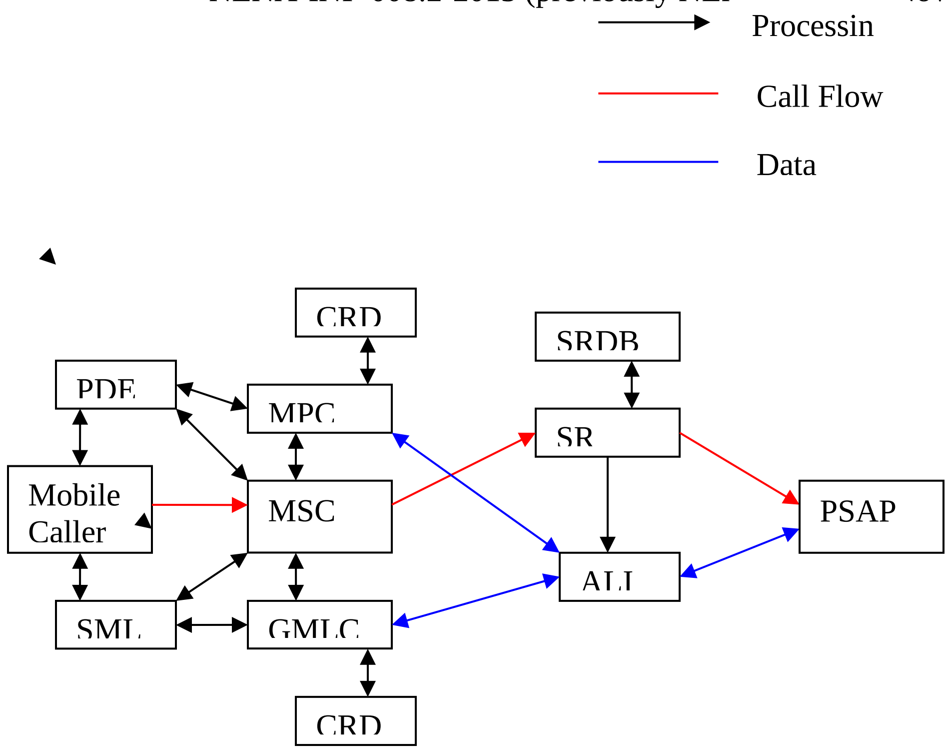

Figure 12-10 Legacy Baseline – Wireless/Legacy/Phase II - 2

- ALI – Automatic Location Identification
- CAS – Callpath Associated Signaling
- CBN – Call Back Number
- ESN – Emergency Services Number
- Esn – Electronic Serial Number
- ESRK – Emergency Services Routing Key
- GMLC – Gateway Mobile Location Center
- ISDN – Integrated Services Digital Network
- ISUP - Integrated Services Digital Network User Part
- MF trunks – Multi - Frequency
- MPC – Mobile Positioning Center
- MPCAP – Mobile Position Capability
- MSAG - Master Street Address Guide
- NCAS – Non-Callpath Associated Signaling
- ORREQ – Origination Request
- PDE – Position Determining Entity
- PSAP – Public Safety Answer Point
- RDB – Routing Database
- Cell Address
- SR – Selective Router

- SRDB – Selective Router Database
- SS7 – Signaling System #7
- SMLC – Serving Mobile Location Center

A.9.3 Emergency Services Flows

A.9.3.1 Call Flow

The call flow and routing for a 9-1-1 Phase II call are the same as the Phase I process. (See A.8)

A.9.3.2 Data Flow

During a 9-1-1 Phase II call, the Phase I data, customer call back number and address of the cell tower where the call originated, will be sent to the PSAP as outlined in the Legacy 9-1-1 Phase I document (See A.8)

In order to calculate and deliver caller location data, additional functions take place to obtain caller location data, latitude/longitude. For handset based solutions, when the MPC receives the handset Electronic Serial Number (Esn) populated in the initial ORREQ from the MSC, the MPC performs a look-up in the Mobile Position Capability (MPCAP) table. When the MPC matches a handset Esn in the MPCAP table, a request message is sent to the Position Determining Entity to trigger a GPS search for the caller location. When the PDE has calculated the location fix, the data is staged at the MPC waiting for a request from the PSAP to deliver the data.

In the iDEN and GSM/network based solutions, at the time of 9-1-1 call origination, components of the SMLC which monitor call signaling are notified of a 9-1-1 call, and begin locating the handset. At the point that the PSAP requests the Phase II location from the GMLC, the GMLC issues a Provide Subscriber Location (PSL) message through the MSC to the SMLC. The SMLC then provides the calculated location estimate (or in the case that the location estimate calculations are not yet complete, the Phase I location) as a lat/long with an uncertainty calculation in a PSL acknowledgement message to the GMLC which sends it through the ALI to the PSAP.

Customer Premise Equipment (CPE), located at the PSAP, is implemented and formatted to receive emergency calls and display required caller data.

A.9.4 Operational Considerations

For 9-1-1 Phase II service, Customer Premise Equipment, located at the PSAP will be implemented and formatted to receive emergency calls and display required caller data. Resources at the PSAP will be familiar with the equipment and have sufficient training to understand the overall operation and output results. In order to obtain 9-1-1 Phase II call latitude/longitude data, the PSAP will be required to know, understand and be able to perform a request for data (re-bid, re-transmit ALI, etc.) on their CPE equipment. The request should be made 15-30 seconds after the call was answered. Some PSAP CPE equipment can be configured to automate the request process.

Along with the Wireless Carrier or its Service Provider and the LEC, the PSAPs will determine how they want to handle overflow, alternate and default call routing. Once the alternate and default routing instructions and processes have been developed, they will be shared with the LEC and Service Providers to be implemented at the Selective Router and the MSC.

For Wireless Phase II Service, the Phase I call routing and data delivery will remain the same. In order to receive Phase II data, the caller's Latitude /Longitude, the PSAP will need to ensure their CPE equipment is capable of displaying the new updated information and is capable of initiating a request to have the data delivered. It is recommended that a CAD or mapping system be deployed to utilize and display the caller location data.

A.9.5 References

[41] ANS/J-STD-036-C Enhanced Wireless 9-1-1 Phase II

[42] 3GPP TS 23.271 Functional stage 2 description of Location Services (LCS)

[43] http://www.nena.org/operations/standards/wireless-911-planning-implementation

[44] FCC's Richardson Order, issued 2001

A.10 Legacy Baseline – 3 Party Relay Calls

Doc. No. 10
September 11, 2007
(ver. 0.1.)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Beginning Point Description

Legacy Baseline Work Group Starting Point

Starting Point Name: 3 Party Relay Calls

Applicability to): Calls For Service initiated by contacting a third party who must relay the request to a PSAP.

A.10.1 Introduction

There are times when a person needs emergency assistance but calls an agency or is routed to an agency other then 9-1-1. For example, a call might be placed to the telephone operator (i.e., dialing “0”), or it might be placed to an alarm monitoring company, or a notification might be sent to a telematics provider via an automatic crash notification system. Voice calls might be placed via a wired or wireless device; automatic crash notifications are conveyed universally via wireless devices. In all cases, a third party (operator, alarm monitor, telematics provider, etc.) must initially determine if a public safety agency is needed, where it is needed, and ultimately the PSAP responsible for fulfilling the need. The caller might be transferred to the PSAP, but in most instances, a three-way conference call is established until the third party is confident that the caller has been connected to the correct PSAP.

With the exception of telematics calls, there is no location data transmitted from the caller to the relay service or from the relay service to the PSAP.

This document describes the three methods of third party relays of Calls For Service. In a wireless environment emergency access to “0” (Operator) may or may not be available dependent upon the wireless service provider.

A.10.2 Functional Elements

A.10.2.1 2.a. of Wireline Call to 3rd Party

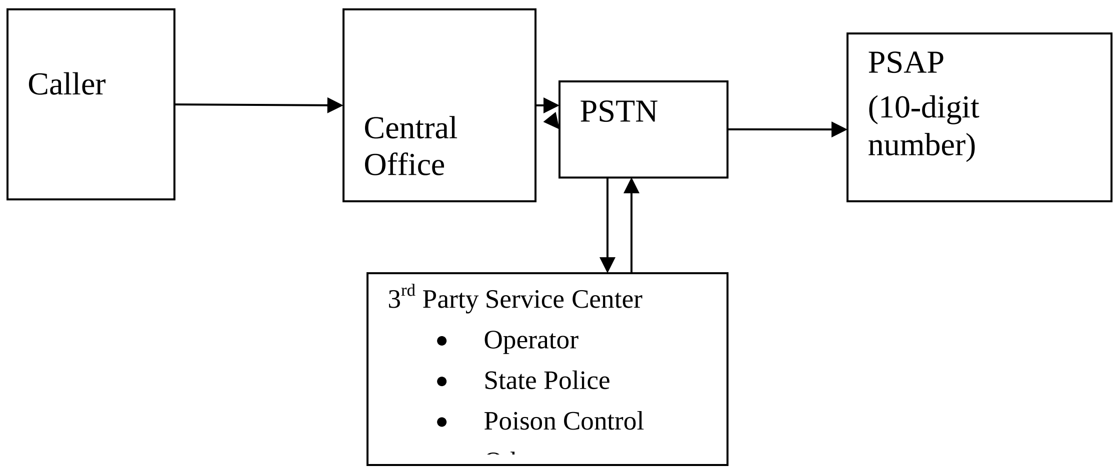

Figure 12-11 Legacy Baseline – 3 Party Relay Calls 2a

Caller places call to communication service provider (e.g., “0”, “6-1-1”) - some operators provide a relay service if the caller communicates that the call is an emergency. Call routing and handling is the same as the 10-digit relay service.

A.10.2.2 2.b. of Wireless Call to 3rd Party

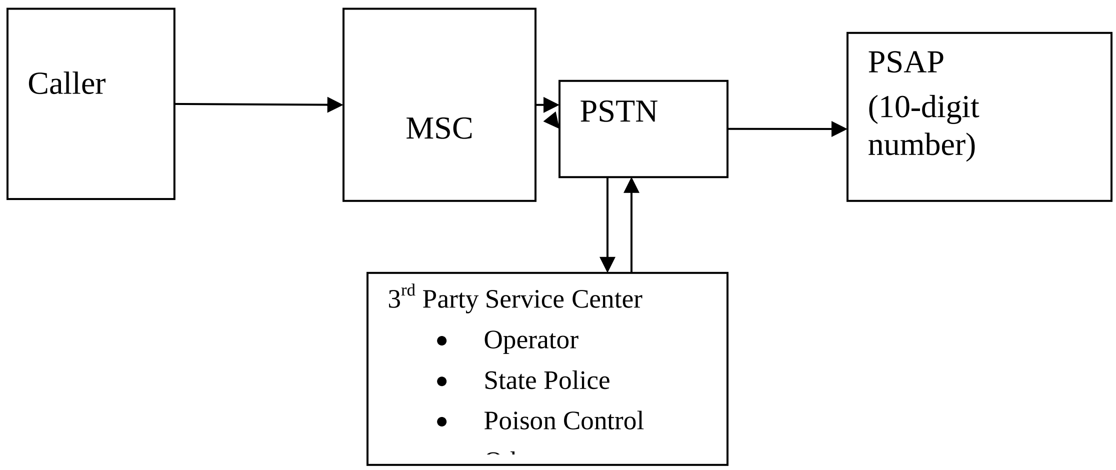

Figure 12-12 Legacy Baseline – 3 Party Relay Calls 2b

An emergency services call is placed from a wireless handset. The call is routed to the mobile switching center (MSC) associated with the originating site, where a digit translation for the site / sector is translated to a 10 digit number. The voice and Caller ID are routed to a "third party" service center. The service center will reference PSAP routing information, based on information collected from the caller and bridges the call to the applicable 10 digit emergency number.

A.10.2.3 Data Flow

In these data flows there will be a 3 party voice connection (calling party, service center and PSAP) and no data transfers (with exception of Caller ID where equipped). All related details to the emergency call will be relayed by voice and (where equipped) may be entered into supporting data systems (CAD, etc.).

A.10.2.4 2.c. of Telematics Call to 3rd Party

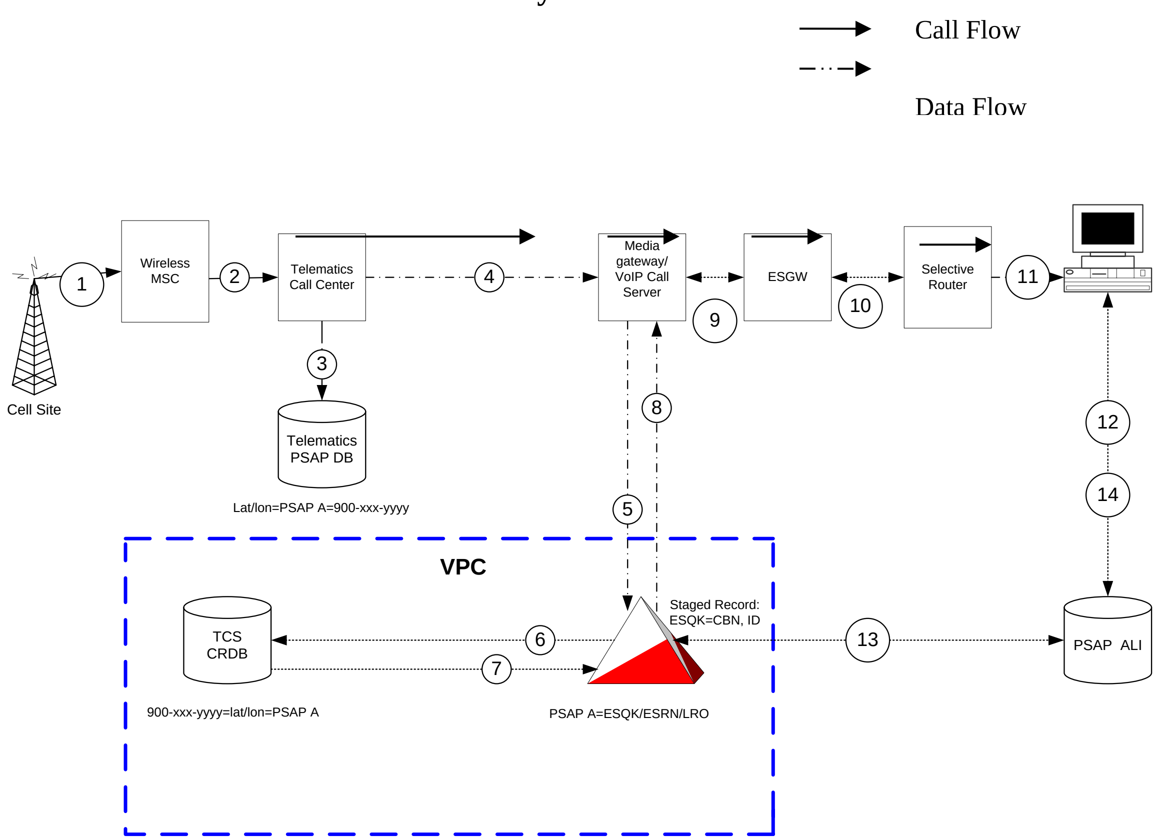

Figure 12-13 Legacy Baseline – 3 Party Relay Calls 2c

A call to a telematics center is automatically initiated by an event detected in a vehicle and additional data can be sent to the telematics center simultaneously (e.g., caller's location). The telematics attendant can provide the relay service to the PSAP using the location received from the received data instead of via communication with the caller. Call routing and handling is similar to the 10-digit relay service with the exception of some call information may be received from the data session instead of from communication with the caller.

IP Telematics – this emerging solution integrates a telematics center with a VPC for emergency call routing to a PSAP. The telematics center provides a relay service for the caller to the PSAP. The VSP network is between the telematics center and PSAP. The location received in the telematics data is forwarded to the VSP in IP signaling (with the telematics provider's toll free call back number). The VSP is unaware the telematics center is acting on behalf of the caller and handles the call as a 2-party IP emergency call (see section A.5).

A.10.3 Operational Considerations

The emergency call is first routed to the 10-digit third-party call center or answering point based on MSC translations associated with the tower site processing the call. Upon receipt at the third party answering point the caller will be queried for the location and nature of the emergency call. Utilizing look-up / data files the third party will bridge the call to the appropriate PSAP, staying on the line to confirm the transfer. The third party, where equipped, may transfer the call either using one-button transfer or dialing the associated 10-digit number. The call is routed to the PSAP utilizing the public switched telephone network.

Telematics technology enables the call center to interface with the telematics equipment installed in customer vehicles. Most of these emergency calls do not travel to the PSAP through existing 9-1-1 networks.

Emergency calls received on 10-digit administrative lines may not receive the same priority as 9-1-1 calls, and could result in delays for telematics emergency calls.

A.10.4 References

[45] NENA Technical Information Document on Automatic Collision Notification and Vehicle Telematics NENA 07-504, June 1, 2007; http://www.nena.org/?page=Telematics

Appendix B – NG9-1-1 Baselines

NG9-1-1 Baseline – 3 Party Wireline/Wireless IP Origination

August 30, 2007
(0.1)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Ending Point Description

Ending Point Name: 3 Party Wireline/Wireless IP Origination
Applicability to 3rd Party initiated, IP origination device using SIP

B.1.2 Introduction

This document discusses the characteristics for a configuration where the end device (e.g., the SIP handset) is able to obtain its location information and initial emergency routing address but needs the assistance of a third party to place the call. Examples of third parties are telematics providers, Text/Video/IP Relay and some forms of Central Alarm Monitoring. The caller places a call to the third party, which then establishes a three way emergency call with the PSAP. The call is routed through the network(s) using the location provided from the end device in the call set up. This call origination may be any media type (e.g. voice, text, video, etc.).

B.1.3 Functional Elements

Figure 12-14 illustrates the reference model for this configuration. The Location Information Server (LIS) contains the location of the end device (User Agent [UA]). How it obtains the location is beyond the scope of this document. The 3rd Party receives a 2 way call from the UA and initiates a 3 way call with the PSAP. The Emergency Call Routing Function (ECRF) contains the mapping from location to an entity within the Emergency Services IP network. The SIP Proxy is the proxy within the calling network that forwards the call request to the Emergency Services IP network (ESInet). The Emergency Services Routing Proxy (ESRP) is the proxy that understands how to route calls within the ESInet. Based upon the network configuration, there may be multiple ESRPs in the call path. For example, the ECRF may have routing instructions that point to the first ESRP. Once the call arrives at the first ESRP, it interrogates the ECRF to determine the next step. The next step may be the target PSAP, or as shown in the figure an intermediate ESRP. This ESRP again interrogates the ECRF to determine the target PSAP and delivers the call request, including the location information.

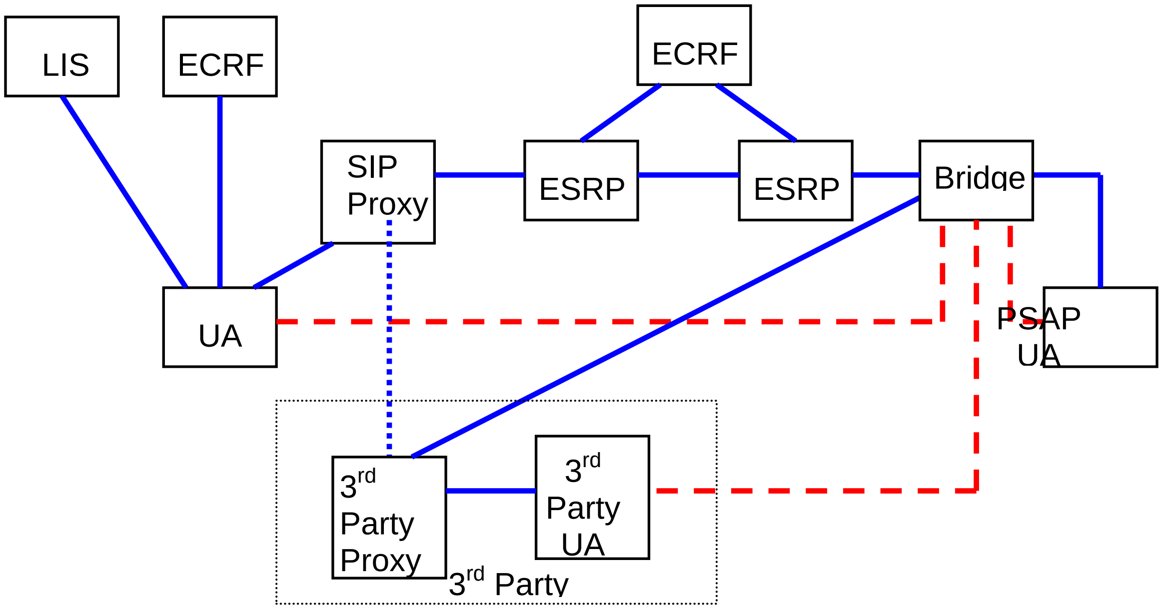

Figure 12-14 Next Generation 9-1-1 Baseline – Wireline IP Origination

- UA – User Agent, the end device initiating a call to 9-1-1
- SIP Proxy – A Proxy Server, usually operated by a carrier processing a 9-1-1 call
- 3rd Party – A call center who wishes to be on the 3 way call established with the PSAP
- 3rd Party Proxy – A Proxy Server operated by the 3rd party call center
- 3rd Party UA – The User Agent for the 3rd party call center
- ESRP – Emergency Services Routing Proxy, a Proxy server operated by a state, regional or 9-1-1 Authority processing 9-1-1 calls
- ECRF – Emergency Call Routing Function, Emergency Call location-based routing function operated by the state, regional or 9-1-1 Authority
- PSAP UA – The User Agent for the PSAP telecommunicator
- LVF – Location Validation Function, which verifies that a location is recognized in the 9-1-1 system prior to use in an emergency call
- LIS – Location Information Server, database of location for endpoints, typically operated by the access network
- Bridge – a multimedia conference server and mixer operated by or on behalf of the PSAP

B.1.4 Emergency Services Flows

B.1.1.1 Call Flow

User Agents (end devices) behave as normal IP endpoints similar to 2 Party IP origination processes with respect to location, LIS interactions and ECRF interactions.

The UA places a call (which may be automated) to its 3rd party call center through the user's SIP Proxy and the call center's SIP proxy. This is a normal 2-party call. The call center determines that the call is an emergency call. The call center sends a REFER/Replaces transaction to the UA asking it to replace the UA-to-3rd party call with an emergency call. The

UA initiates a 9-1-1 call towards the PSAP, with the Replaces header marking it as a 3rd party initiated call. The call is answered at the PSAP Bridge. The Replaces header indicates the identity of the 3rd party call center and agent. The bridge initiates a leg to a Telecommunicator. The bridge then initiates a call to the 3rd party and bridges that leg with the leg to the caller. A three way call with the caller, call center agent and PSAP Telecommunicator is thus established with PSAP bridge.

If a Telecommunicator needs to transfer a call to another PSAP, it will ask the bridge to INVITE the other PSAP to the conference, and when the Telecommunicator at the other PSAP is on the line and apprised of the situation, the Telecommunicator at the original PSAP will drop off. The bridge can be configured such that it recognizes that none of its UAs are on the call and request the other PSAP to assume bridge duties. The 3rd party should not use its own bridge.

In some specialized devices, the device does not use SIP, and its protocol may not be interworkable to SIP. It is possible for the 3rd party to initiate a 2-way 9-1-1 call to the PSAP, and supply a location of its subscriber. This may be the case, for example, for a central alarm monitoring system with no voice channel. This would be a “real” 9-1-1 call, traversing all of the elements of the NG9-1-1 system. It would be routed to the PSAP serving the subscriber, because the location of the subscriber would be placed in the location information with the call. The result is a 2- party call, initiated by the 3rd party agent. This mechanism should not be used if a media channel can be established with the end device. If it can, a 3 way call should be established as outlined above.

The current i3 specification describes the possibility of using a bridge in the 3rd party with a two way IP call originated by the 3rd party using the location of its subscriber when the subscriber does not have public access to place a 9-1-1 call. Cascading of bridges (which would be required when the PSAP transfers or bridges the call to secondary PSAPs or responders) is not recommended. Also, cascaded bridges mask the identity of the participants.

B.1.1.2 Data Flow

Normal data flow as described in 2-party IP origination is maintained for this flow. The bridge supports the conference event package, which allows any party to get a roster of participants. Thus every party can determine the identities of all other parties.

Along with the call request, there may be specific pointer information (e.g. URIs) that allows access to supplemental call related information. The URI may point to a service interface to get access to the data. The supplemental data can include ACN or other specialized information about the call. This data can be sent direct from the caller’s UA or from the 3rd party call center. The 3rd party or the originating UA can include an additional data URI. The carrier will also supply an additional data URI but may not have access to ACN or other 3rd party data. The bridge will copy the URI to other parties in the call.

B.1.5 Operational Considerations

All operational considerations for 2- party IP origination apply to 3-party IP origination.

The 3rd party may be required to have a pre-established relationship with the PSAP before the PSAP will permit it to create 3-party calls. Note that an unauthorized 3rd party who refers a caller to the PSAP following these flows will not be invited to the call. In this case, the caller will experience a normal 2- party IP originated 9-1-1 call. To identify authorized 3rd party originators, the PSAP or 9-1-1 Authority may choose to issue credentials to the 3rd party which it will include when the bridge attempts to create the 3rd leg. A national credentialing service may provide credentials acceptable to the PSAP/9-1-1 Authority for 3rd parties serving a large area.

The PSAP must have access to a multimedia bridge which can provide this service. The bridge can be provided in the PSAP or in the ESInet as a service to the PSAP.

B.1.6 References

[46] Functional and Interface Standards for Next Generation 9-1-1 Version 1.0 (i3), National Emergency Number Association, [8]

[47] Ending Point: 2 Party Wireline IP Origination, NENA NGTPC NG9-1-1 Baseline WG[0]

NG9-1-1 Baseline – Data Only Call

November 15, 2010
(0.2)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Ending Point Description

Ending Point Name: Data Only Call

Applicability to Authorized Agency/Enterprise Asynchronous Event using SIP

B.1.7 Introduction

This document discusses the characteristics for a configuration where there is no "call" in the conventional sense; meaning there is no two way media channel established between the PSAP and the caller, but rather an asynchronous event notification is received by the PSAP which triggers processing much like if a conventional call was received. The event contains data which is used by the PSAP to decide its course of action. Events are discussed in the i3 Functional and Interface Standards for Next Generation 9-1-1 Version 1,0 (i3) document[1]. (The i3 document refers to events of this type as "emergency events" and distinguishes such events from other uses of a generalized event mechanism that the standard defines). A typical example of an emergency event might be a roll-over detection in a truck containing hazardous materials.

NOTE: The i3 document does not recommend a specific for event notification and indeed gives several examples only one of which is a SIP-based event notification mechanism. SIP is used as an example only in this document. The principles apply to all event notification protocols contemplated by the i3 specification.

B.1.8 Functional Elements

Figure 12-15 illustrates the reference model for this configuration. The Location Information Server (LIS) contains the location of the end device (User Agent [UA]). How it obtains the location is beyond the scope of this document. The UA is the element that raises the event. The Emergency Call Routing Function (ECRF) contains the mapping from location to an entity within the Emergency Services IP network. The SIP Proxy is the proxy within the calling network that forwards the event NOTIFY to the Emergency Services IP network (ESInet). The Emergency Services Routing Proxy (ESRP) is the proxy that understands how to route events within the ESInet. Based upon the network configuration, there may be multiple ESRPs in the event notification path. For example, the ECRF may have routing instructions that point to the first ESRP. Once the event arrives at the first ESRP, it interrogates the ECRF to determine the next step. The next step may be the target PSAP, or as shown in the figure an intermediate ESRP. This ESRP again interrogates the ECRF to determine the target PSAP and delivers the event, including the location information.

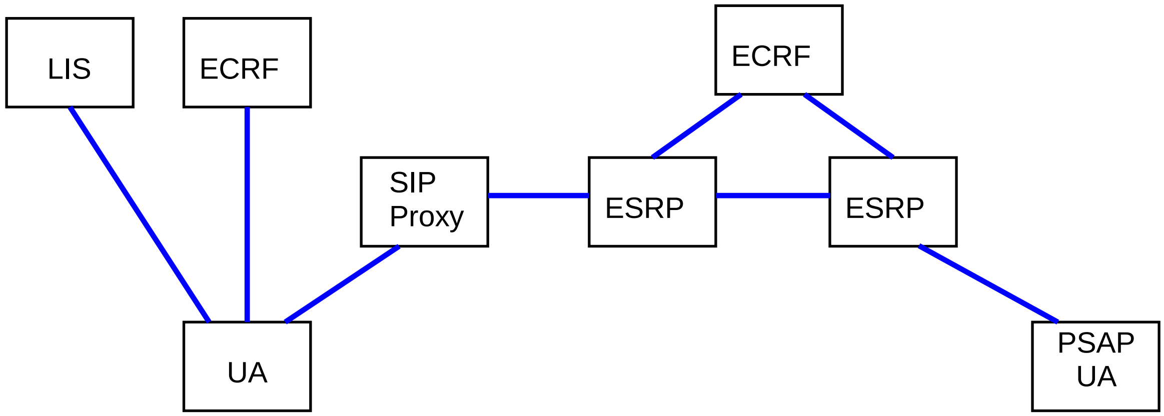

Figure 12-15 Next Generation 9-1-1 Baseline – Event Notification

- UA – User Agent, the end device initiating the event
- SIP Proxy – A Proxy Server, usually operated by a carrier processing an event
- ESRP – Emergency Services Routing Proxy, a Proxy server operated by a state, regional or 9-1-1 Authority processing events. The ESRP is the same ESRP used for all 9-1-1 calls in the ESInet
- ECRF – Emergency Call Routing Function, Emergency Call location based routing function operated by the state, regional or 9-1-1 Authority. The ECRF routes events as well as calls.
- PSAP UA – The User Agent for the PSAP telecommunicator
- LVF – Location Validation Function, which verifies that a location is recognized in the 9-1-1 system prior to use in an emergency event
- LIS – Location Information Server, database of location for endpoints, typically operated by the access network

B.1.9 Emergency Services Flows

B.1.1.3 Event Flow

User Agents (end devices) behave as normal IP endpoints similar to 2-Party IP origination processes [4] with respect to location, LIS interactions and ECRF interactions. An essential aspect of handling emergency events is that they use the same location and routing elements. The function of a LIS in an event can be substantially different for events that are not point or small area locations. A severe weather event covering a large area uses a different kind of a LIS than the hazmat event used as the example earlier. However, the fundamental aspect that the LIS returns to the UA the location of the event is preserved and used the same way as a LIS providing the location of a normal 9-1-1 caller.

Events have a type or "topic". The rollover of a hazmat truck is one topic, while an impending tornado event is another. PSAPs decide which topics they wish to receive events for. As noted in the i3 specification, the PSAP must SUBSCRIBE (the SIP event subscription transaction) to a specific event topic from a specific event publisher. The ECRF can be used as an event registry to determine which agencies or entities publish events that the PSAP may be interested in. The PSAP instantiates the subscription before the event occurs.

When the event occurs the UA sends a SIP NOTIFY message to all agencies subscribed to it for that event topic. The NOTIFY includes information specific to the event, as well as the location (just like a call). The signaling path for an event is the same as that for a call; from the originating UA to its SIP Proxy server, from the proxy to an ESRP, possibly through several intermediate ESRPs to a PSAP ESRP and from the PSAP ESRP to a UA. This UA may be a management workstation or a regular Telecommunicator workstation.

Unlike calls, events do not establish sessions, cannot be transferred, and have no concept of termination. A PSAP may raise an event of its own, NOTIFYing a secondary PSAP of the event, or the secondary PSAP may subscribe to the original event.

B.1.1.4 Data Flow

When an event notification is sent, the body of the NOTIFY contains a topic-specific message. For emergency events, the message will be a Common Alerting Protocol (CAP)[2] message wrapped in Emergency Data eXchange Language (EDXL)[3]. The contents of the CAP message will be defined for each topic. The message flows with the event from the publisher to the subscriber. Also included in the NOTIFY is the location for the event, sent in the SIP Geolocation header in the form of a PIDF as with a call.

B.1.10 Operational Considerations

All operational considerations for 2-party IP origination apply to event notification.

The ECRF must be provisioned with:

- Topics PSAPs or other agencies within the ESInet may be interested in. Each topic will have a service URN associated with it
- Agencies which can generate events, listed with the topic and the area of coverage. This will be queried by PSAPs and other event subscribers.

PSAPs must have mechanisms to query the ECRF for the topic they are interested in. Policy within the PSAP should be used to control which topics are subscribed to and which agencies that publish such topics. Policy must also control which UAs receive events for each topic.

B.1.11 References

[48] Functional and Interface Standards for Next Generation 9-1-1 Version 1.0 (i3), National Emergency Number Association, [8]

[49] Common Alerting Protocol V1.0, A. Botterell, Organization for the Advancement of Structured Information Standards (OASIS), oasis-200402-cap-core-1.0

[50] Emergency Data Exchange Language (EDXL) Distribution Element, v. 1.0, Organization for the Advancement of Structured Information Standards (OASIS), EDXL-DE-V1.0

[51] Ending Point: 2 Party Wireline IP Origination, NENA NGTPC NG9-1-1 Baseline WG [0]

NG9-1-1 Baseline – 2 Party Wireless Legacy Origination

November 15, 2010
(0.2)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Ending Point Description

Ending Point Name: 2 Party Wireless Legacy Origination

B.1.12 Introduction

This document discusses the configuration for a Wireless Legacy Origination 9-1-1 call that needs to be processed through the new next generation Emergency Services IP Network to a PSAP. This particular transition is for those wireless phones utilizing legacy NCAS call routing, where the Wireless Service Provider (WSP) has yet to convert their final demark point to an IP switch. This description represents the migration point where an Emergency Services IP Network has been established and a WSP still utilizes legacy wireless call set up with a mobile switching center (MSC) and must enter through a gateway instead of a Selective Router. Also the wireless caller information (callback number and location) will be passed through a location database/server associated with the gateway instead of the ALI Database. Wireless phones connecting through hotspots (WiFi) are not part of this document.

B.1.13 Functional Elements

Figure 12-16 illustrates the reference model for this configuration. The legacy WSP functional elements exist on the front end. The Mobile Switching Centers (MSCs) communicate with the Mobile Positioning Center (MPC), for CDMA, or Gateway Mobile Location Center (GMLC), for GSM, to obtain the routing instructions for the call. The Routing Database (RDB) is another functional element that receives a query to identify the PSAP to determine the Emergency Services Routing Key (ESRK) for routing instructions. The Gateway replaces the Selective Router and shall accommodate any WSP interface at the MSC demark, such as SS7, and MF. The location database/server associated with the LNG replaces the ALI Database. The Emergency Call Routing Function (ECRF) contains the mapping from location to an entity within the Emergency Services IP network (ESINet). The ESRP is the proxy that understands how to route calls within the ESINet to the appropriate PSAP.

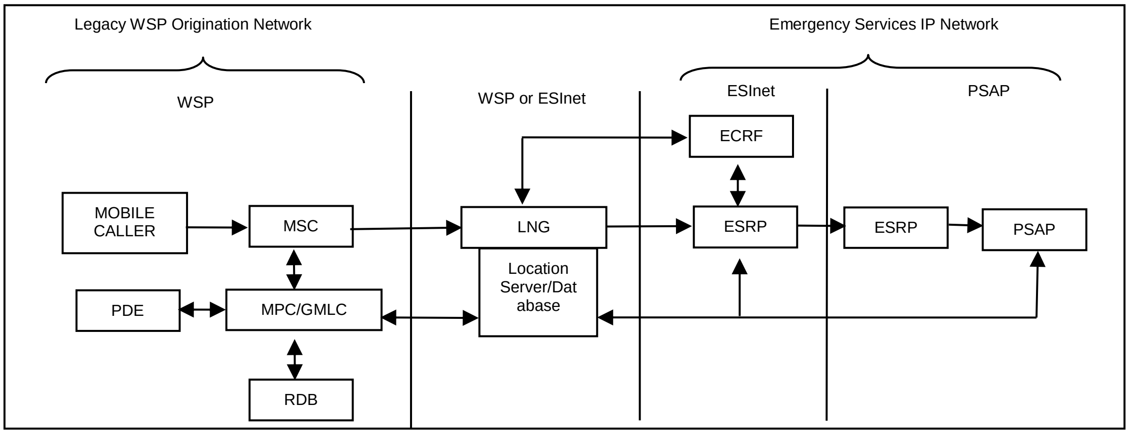

Figure 12-16 Next Generation 9-1-1 Baseline – Legacy Wireless (Origination)

- MSC - Mobile Switching Center
- MPC/GMLC - Mobile Positioning Center or Gateway Mobile Location Center
- RDB - Routing Database used by WSPs for caller's coordinates and cell site addresses
- LNG - A gateway to provide demark for WSPs to enter the ESInet and provide routing
- Location database/server - The location database/server is the replacement for the ALI database that passes through the ESRK
- ESRP -Emergency Services Routing Proxy is a Proxy server operated by the 9-1-1 Authority to process 9-1-1 calls
- ECRF - Emergency Call Routing Function contains Routing and Jurisdictional Management functionality

B.1.14 **Emergency Services Flows**

B.1.1.5 Call Flow

General Call Flow

The 9-1-1 call from the wireless handset originates from a cell site sector to the Mobile Switching Center (MSC) which communicates with the Mobile Positioning Center (MPC), for CDMA, or Gateway Mobile Location Center (GMLC), for GSM, to obtain an Emergency Services Routing Key (ESRK) for the call. The ESRK may be used by the MSC to select a gateway. The call is sent to the Gateway with the ESRK and the actual TN of the caller. The Gateway will use the ESRK to generate a request to an associated location database/server to obtain the current location of the caller. An associated location database/server, in turn queries the MPC/GMLC to get location. The location, which will often be the cell site/sector location, is then used in a query to the ECRF, which returns a URI of the Emergency Services Routing Proxy (ESRP). The Gateway forwards the call, with the ESRK imbedded in a Location-by-Reference to the ESRP which will then send the call to the PSAP. The ESRP is the proxy server that understands how to route calls within the ESInet. Based upon the network configuration, there may be multiple ESRPs in the call path. ESRPs will use the location reference, containing the ESRK to query an associated location database/server for location. The location will be used in a query to the ECRF for further routing instructions. The final route will be to the PSAP, and the call will arrive at the PSAP with the location reference and the call back information.

Detailed Call Flow

With this configuration the legacy WSP set up requirements still exist. Emergency Services Routing Keys (ESRKs) are pools of 10 digit numbers which were historically assigned to individual PSAPs for call routing identification. In i3, the ESRK is used to identify a specific 9-1-1 call, and forms part of the location reference (key) used with an associated location database/server. It is also used to correlate location queries between an associated location database/server and the MPC.

When a 9-1-1 call is initiated from a wireless handset, it originates on a cell site sector and the emergency call request is sent to the MSC. In CDMA networks, the MSC sends an Origination Request to the MPC with CBN and cell site information which will be the location used to identify the PSAP to receive the call. The MPC can use current processes to select an ESRK, but the ESRK itself is not used for routing. In GSM networks, the MSC sends a Subscriber Location Report (SLR) to the GMLC, containing the CBN and Cell Global Identity (CGI). The GMLC allocates an ESRK, which is used as above to identify a specific 9-1-1 call. In both CDMA and GSM networks, the ESRK is sent to the MSC.

Depending on the approach taken by the WSP Network for providing Phase I and Phase II E9-1-1 Service, the MPC will either provide an ESRK or ESRD to the MSC. The MSC will either populate a callback number and ESRD or an ESRK in outgoing call setup signaling to the LNG. Within the WSP Network typically the MSC detects a 9-1-1 call, then interacts with an MPC to request position information. i3 PSAPs will request Phase II data from all carriers. Phase II shall be supported as well as fall back to Phase I and Phase 0 (call to a 10 digit number), and all calling party location information shall be provided to the PSAP.

The key transition point takes place for the WSP to connect to the ESInet through an interface to the Legacy Network Gateway. Instead of the WSP connecting to the S/R or direct-trunked to a PSAP, the MSC connects to the Legacy Network Gateway to translate the TDM signaling to IP and process through the ESInet to the PSAP. The gateway provides signaling interworking from SS7 to SIP. The gateway synthesizes a location reference using the ESRK and/or ESRD. It queries the associated location database/server with this reference to obtain location information to query the ECRF.

The ECRF is used to route 9-1-1 calls to the correct ESRP, by the ESRP to route to the correct PSAP, and may be used by the PSAP ESRP to route to the correct Telecommunicator. The ECRF is also used by the Telecommunicator to choose the route to the appropriate responder(s). If a Telecommunicator needs to transfer a call to another PSAP, it will interrogate the ECRF for routing instructions and signal the call with associated data it originally received with the call. After the PSAP has received the call, the PSAP queries the MPC or GMLC via the associated location database/server for the location information. The MPC/GMLC in turn queries the PDE. The location is returned by the PDE to the MPC/GMLC, by the MPC/GMLC to the associated location database/server and by the associated location database/server to the PSAP.

B.1.1.6 Data Flow

The WSP Data Flow is as follows: The WSP and the 9-1-1 Authority and/or PSAP choose a location (typically a civic address or a latitude/longitude of the tower) for every cell site/sector. At call time, the route taken by the call must conform to the route obtained from the ECRF for the location chosen above. To facilitate ECRF routing while minimizing changes to the MPC, it is expected that the MPC would arrange a replica of the ECRF and use that to populate its RDB. To effect a change in route (such as in a disaster situation), the MPC must arrange for a change in the ECRF to result in a corresponding change to its RDB. Further, any changes to the ECRF must result in the MPC being able to choose a PSAP, and thus an ESRK pool which the MSC already has translations for. When a 9-1-1 call is initiated from a wireless handset, it originates on a cell site sector and the emergency call request is sent to the MSC. The MSC sends the MPC an OREQ. The MPC returns the orreq response, or the GMLC returns the SLR acknowledgement to the MSC with the pre-selected address. This address is used by the MPC to query its RDB (which is synchronized to the ECRF as above) for routing instructions. The MPC selects an ESRK corresponding to the route obtained from the RDB. The MPC returns the ESRK to the MSC. The MSC populates the ESRK as ANI to the call, and forwards to the gateway.

The gateway in turn, uses the ESRK to query the associated location database/server. The associated location database/server uses the ESRK to query the MPC. The MPC returns the location determined above for the cell site/sector and the CBN. The associated location database/server returns the location and CBN to the gateway. The gateway uses the location to query the ECRF. The ECRF returns the ESRP URI for the location. The gateway populates a SIP call with the ESRP URI, the CBN and a location reference derived from the ESRK[41] and the associated location database/server address.

When the PSAP receives the call, it dereferences the location reference, which is received by the location database/server associated with the Legacy Network Gateway. The associated location database/server queries the MPC, which queries the PDE and returns any location information available. Typically, this initial query for location will result in the address associated with the cell site/sector.

The Emergency Service IP Network Data Flow is as follows: The ECRF must be provisioned with location information, e.g. state boundaries, jurisdictional boundaries, PSAP boundary information, etc. Typically, this would be a GIS system, which would geocode a civic address (the cell site/sector location may be expressed as a civic location, and would have to be in the PSAP's, and thus the ECRF's database) and have polygons defining PSAP service areas. The same database can be used for the Location Validation Function. Any location that can be geocoded is a valid location and the location database/server associated with the Legacy Network Gateway can use the ECRF/LVF to validate location prior to entry into its database. The ECRF shall also support the transfer of emergency calls between PSAPs. Monitoring the performance of this call flow shall be performed being connected to both the gateways and at the PSAP.

[41] It is possible that the location value of the caller (either a cell tower/sector x,y, a quick-fix x,y or a civic address associated with the cell site/sector) as well as a reference will be provided. If BOTH are provided, both would be forwarded

The PSAP Data Flow is as follows: The PSAP receives the call from the ESInet and immediately dereferences the location and receives an initially available location for the caller. The PSAP will subsequently ask the location database/server associated with the LNG for a location update (via another dereference operation or a subscription to a location update service). As with all other calls received from the ESInet, the call may have references to additional information about the call, which the PSAP can obtain. The PSAP may forward the call to secondary PSAPs or other responder agencies exactly as it would any other call.

B.1.15 Operational Considerations

Network and Monitoring: The data network shall have redundant links and paths to ensure no single point of failure will take the network out of service, or allow isolation of a PSAP for call delivery or database access. Alarms shall also be present with user identified thresholds for optimized call routing as well as notification of any interruption in service.

Security: The legacy network and the ESInet have different notions of security, and interworking between mechanisms will be required. The i3 security mechanisms are described in Chapter 8 of the i3 Stage 2 specification[53].

WSP: The MPC/GMLC must choose a PSAP to get the call based on the data in the ECRF. An update in the ECRF must result in a corresponding change in the data (RDB) used to select an ESRK. i3 mechanisms to provide local replicas of the ECRF, automatically maintained by the 9-1-1 Authority may be of use to achieve this. If a civic location is used for a cell site/sector, that location must be validated against the Location Validation Function (LVF).

PSAP: When transitioning to i3, a PSAP must request and support Phase II service from all licensed Commercial Mobile Radio Service (CMRS) providers within its service area if they don't already have it.

Legacy Network Gateway: The Legacy Network Gateway operators must supply trunking arrangements to the MSCs they serve. They must arrange connections to the location server/database that connects it to the MPCs serving the MSCs. The gateway operators must arrange ECRF access and IP connections to the ESRPs they support.

B.1.16 References

[52] Enhanced Wireless 9-1-1 Phase II, Telecommunications Industry Association and Alliance for Telecommunications Industry Solutions, J-STD-036-C

[53] Functional and Interface Standards for Next Generation 9-1-1 Version 1.0 (i3), National Emergency Number Association, [8]

[54] Implementation of the Wireless Emergency Service Protocol E2 Interface, National Emergency Number Association, NENA 05-001

Next Generation 9-1-1 Baseline – 2 Party Wireline IP Origination

August 30, 2007
(0.1)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Ending Point Description

Ending Point Name: 2 Party Wireline IP Origination
Applicability to wireline calls from any IP origination device using SIP

B.1.17 Introduction

This document discusses the characteristics for a configuration where the end device (e.g. the SIP handset) is able to obtain its location information and initial emergency routing address. When an emergency call is made, the end device should refresh this information to assure it is the most recent available. Then the call is routed through the network(s) using the location provided from the end device in the call set up. This call origination may be any media type (e.g. voice, text, video, etc.).

B.1.18 Functional Elements

Figure 12-17 illustrates the reference model for this configuration. The Location Information Server (LIS) contains the location of the end device (User Agent [UA]). How it obtains the location is beyond the scope of this document. The Emergency Call Routing Function (ECRF) contains the mapping from location to an entity within the Emergency Services IP network. The Proxy is the SIP proxy within the calling network that forwards the call request to the Emergency Services IP network (ESInet). The Emergency Services Routing Proxy (ESRP) is the proxy that understands how to route calls within the ESInet. Based upon the network configuration, there may be multiple ESRPs in the call path. For example, the ECRF may have routing instructions that point to the first ESRP. Once the call arrives at the first ESRP, it interrogates the ECRF to determine the next step. The next step may be the target PSAP, or as shown in the figure an intermediate ESRP. This ESRP again interrogates the ECRF to determine the target PSAP and delivers the call request, including the location information.

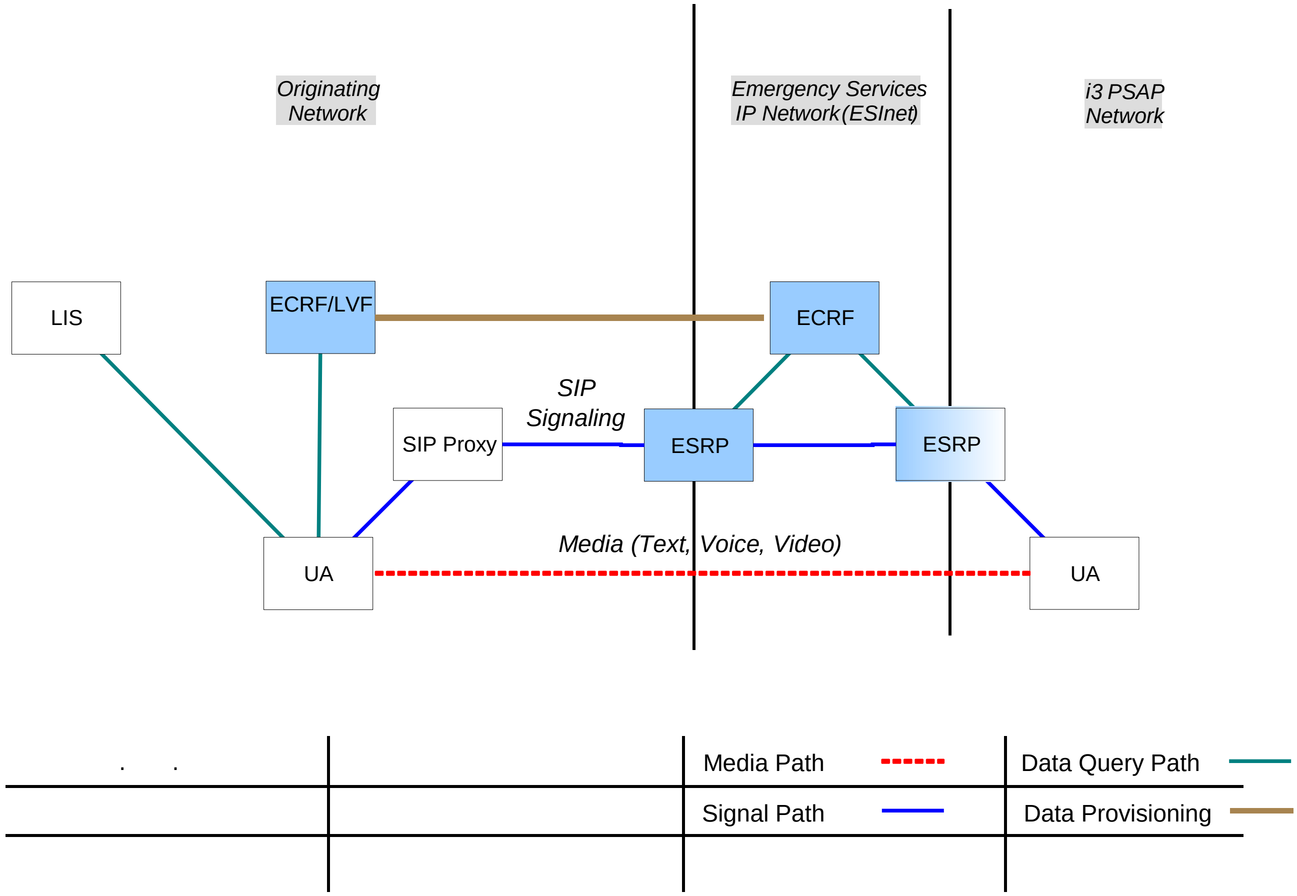

Figure 12-17 Next Generation 9-1-1 Baseline – 2 Party Wireline IP Origination

- ESInet - Emergency Services IP Network, an IP network that joins all public safety agencies, including PSAPs, together. 9-1-1 calls transit the ESInet
- Origination Network – an IP network bringing calls to an ESInet. Usually operated by a carrier, but could be the Internet. Multiple origination networks connect to an ESInet.
- UA – User Agent, the end device initiating a call to 9-1-1
- SIP Proxy – A Proxy Server, usually operated by a carrier processing a 9-1-1 call
- ESRP – Emergency Services Routing Proxy, a Proxy server operated by a state, regional or 9-1-1 Authority processing 9-1-1 calls
- ECRF – Emergency Call Routing Function, Emergency Call location-based routing function operated by the state, regional or 9-1-1 Authority
- LVF – Location Validation Function, which verifies that a location is recognized in the 9-1-1 system prior to use in an emergency call
- LIS – Location Information Server, database of location for endpoints, typically operated by the access network

B.1.19 Emergency Services Flows

B.1.1.7 Call Flow

User Agents (end devices) obtain location (or a reference to it) from a local LIS, typically operated by the broadband access network, and cache it for possible later use. Using that location, they obtain and cache a route from the ECRF. The ECRF also provides the local emergency call dial string (9-1-1).

The UA recognizes the emergency call dial string (i.e., 9-1-1) and identifies the call as an emergency call. It attempts to get a current location from the LIS, and a current route from the ECRF. Cached values are used in case of failure. The UA marks the emergency call with a Service URN (i.e. urn:service:sos) and includes location and a callback URI in the SIP signaling. Following the normal call flow, the UA sends the call to its carrier's Proxy Server (softswitch)

As an alternative, the Proxy Server can recognize the local dial string, add location to the call, and consult the ECRF for routing information using the location, if it knows, unambiguously, where the endpoint is.

In this situation, there are multiple ESRPs in the network. Therefore, the ECRF provides an address that points to the first (entry) ESRP in the ESInet. The calling network Proxy routes the call to that ESRP using the route obtained from the ECRF. Once the call is received at the first ESRP, it will interrogate the ECRF to obtain further routing information. In the network shown in the figure, the first ESRP will route to the second (intermediate) ESRP. Once the call request is received at the second ESRP, it will repeat the process and the ECRF will return the address of the target PSAP, or a specific PSAP Telecommunicator (where the terminal ESRP is at the PSAP boundary). Note: the number of ESRPs in the end-to-end flow depends upon the specific network architecture.

If a Telecommunicator needs to transfer a call to another PSAP, it will interrogate the ECRF for routing instructions and signal the call with associated data it originally received with the call.

B.1.1.8 Data Flow

The ECRF must be provisioned with location information, e.g. state boundaries, jurisdictional boundaries, PSAP boundary information, etc. Typically, this would be a GIS system, which would geocode a civic address and have polygons defining PSAP service areas. The same database can be used for the Location Validation Function. Any location that can be geocoded is a valid location and the LIS can use the ECRF/LVF to validate location prior to entry into its database.

Location information is provisioned in the LIS (validated as per above) against an identifier known to the endpoint.

The LIS may, instead of providing the actual location, provide a reference (in the form of a URI pointing back to the LIS). The reference may be used by the UA, Proxy, ESRP or Telecommunicator to obtain the current location.

The location (or reference) is carried in SIP signaling with the call. Callback information is also included with the call. The UA includes its notion of callback, and the carrier asserts its own call back data.

Along with the call request, there may be specific pointer information (e.g. URIs) that allows access to supplemental call related information. The URI may point to a service interface to get access to the data.

Further downstream processing of the call (for example, to a CAD system) will require making the information received with the call, as well as data accessed from supplemental data services, along with data created by the PSAP in its processing of the call available. This data is forwarded in the signaling, or as a service implemented by the PSAP to downstream systems.

B.1.20 Operational Considerations

9-1-1 Authorities must maintain the accuracy of the ECRF. Failures to find a location in the ECRF leads to default call routing conditions, which, in the case of IP-based origination, have much larger uncertainty than legacy wireline or wireless systems and thus the likelihood of, and severity of a misroute is larger than in current systems. 9-1-1 authorities must maintain mechanisms to report missing or incorrect data in the ECRF. NG9-1-1 assumes a single "master" GIS serving all functions, including the ECRF in public safety, and recommends an integrated GIS for all government functions to facilitate maintenance in high growth areas. The ECRF itself is likely a replica of the master GIS system with just the data needed for call routing. The ECRF is used by end devices and the calling network to route 9-1-1 calls to the correct ESRP, by the ESRP to route to the correct PSAP, and may be used by the PSAP ESRP to route to the correct Telecommunicator. The ECRF is also used by the Telecommunicator to choose the route to the appropriate responder(s).

The ECRF is distributed and replicated. It is possible, for example, that the access network will have a replica of the ECRF, and it is probable that ESRPs will have local replicas available for faster access. Any ECRF can refer non-local queries to an authoritative ECRF covering the location queried. This requires state and national coordination to maintain referral paths and to assure service area overlaps and gaps are properly handled. All endpoints and proxy servers must have access to the local ECRF (or a replica of it).

Calling Networks may provide direct or VPN connections to the ESRP, or more precisely, the Border Control (firewall) Function immediately before the first level ESRP. The BCF is the entry point to the Emergency Services IP Network. The BCF is also connected to the global Internet so that it can receive calls from roaming customers of calling networks located outside the service area of the ESRP.

LISs that issue references must assure that all ESRPs and Telecommunicators have access to the LIS for dereference under any reasonable failure condition including disaster situations. Since this is difficult to maintain, location value is preferred. Credentialing methods ("VESA") will be needed to allow the LIS (and the ECRF) to authenticate queriers.

B.1.21 References

[55] Functional and Interface Standards for Next Generation 9-1-1 Version 1.0 (i3), National Emergency Number Association, [8]

NG9-1-1 Baseline – 2 Party Wireline Legacy Origination

December 15, 2010
(0.2)

NENA Next Generation 9-1-1 Transition Planning Committee

Transition Ending Point Description

Ending Point Name: 2 Party Wireline Legacy Origination

B.1.22 Introduction

While it is expected that an increasing number of callers will be VoIP callers over time, PSTN callers must continue to be supported as the Emergency Services infrastructure migrates toward IP, and PSAPs gradually evolve to become IP-enabled. Gateway functionality to support signaling interworking and location determination will be a critical aspect of the architecture to allow legacy 2-party wireline emergency call originations to be delivered to IP-enabled PSAPs via an Emergency Services IP Network (ESInet).

Calls from legacy wireline networks must undergo signaling interworking (i.e. at a gateway system) to convert the incoming Multi-Frequency (MF) or SS7 signaling to SIP. Thus, a Legacy Network Gateway will be expected to be part of the architecture. The Legacy Network Gateway will terminate MF and SS7 trunks from wireline end offices. It will convert the MF or SS7 signaling into IP signaling (e.g., SIP), and pass the IP signaling to an ESRP in an ESInet, delivering to it some type of location information.

When a legacy wireline call is originated, the signaling delivered to the Legacy Network Gateway will include a 10-digit number, in the form of a calling number or Automatic Number Identification (ANI). This 10-digit number will provide the key to the caller's location. Since it is assumed that legacy wireline calls will be routed through the ESInet using i3 functional elements such as the Emergency Call Routing Function (ECRF), determination of call routing for legacy wireline emergency calls at the Legacy Network Gateway will actually involve two functions: a location retrieval function, and a routing determination function. The location retrieval function will be responsible for translating the information received with a legacy emergency call (i.e., calling number/ANI) into location information that can be used as input to the ECRF (i.e., a civic address or geo-location). It is assumed that this will require interaction between the Legacy Network Gateway and some type of associated location database/server. Detailed description of the specific system(s) that would serve as the "location database/server" is beyond the scope of this document. The routing determination function would then map the location information obtained via the location retrieval function to the address of an Emergency Services Routing Proxy (ESRP) in the ESInet.

Using this approach, all legacy wireline calls, regardless of origin, would be routed using the same ECRF as VoIP originated calls, based on information obtained via a location retrieval function, and arrive at an IP-capable PSAP as VoIP with location information.

B.1.23 Functional Elements

Figure 12-18 illustrates the reference model for this configuration. The Legacy Network Gateway uses the received location key (i.e., the calling number/ANI) as the basis for requesting location information from the location database/server. The location database/server contains the association between the location key and the civic or geo location of the caller's device (i.e., telephone). The location information in the location database/server is validated before being stored in it. The Legacy Network Gateway uses the location information obtained from the location database/server to generate a routing request to the ECRF. The ECRF contains the mapping from location to an entity within the Emergency Services IP network (i.e., an entry ESRP). An ESRP is a proxy that understands how to route calls within the ESInet. Once the call arrives at the entry ESRP, it must interrogate the ECRF to determine the next step in the routing. If the ESRP has received location information (i.e., a location value) in incoming signaling, it will use this information to interact with the ECRF. If the ESRP has received a location reference in incoming signaling, it must first interact with the location database/server to obtain location information and then query the ECRF using the location obtained from the location database/server. Based upon the network configuration, there may be multiple ESRPs in the call path. For example, the entry ECRF may obtain routing instructions that point to an intermediate ESRP (as illustrated below), or they may point to the target PSAP. In the example illustrated below, the intermediate ESRP again interrogates the ECRF to determine the target PSAP and delivers the call request, including the location information.

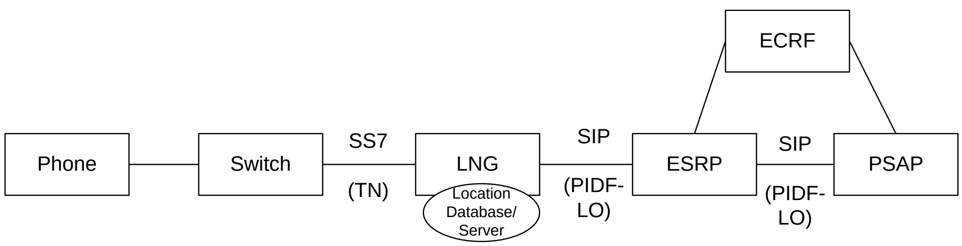

Figure 12-18 Next Generation 9-1-1 Baseline – Wireline Legacy Origination

- Legacy Network Gateway – A gateway responsible for performing signaling interworking, as well as location retrieval and routing determination. Associated with the Legacy Network Gateway is a location database/server that is essentially a replacement for the Automatic Location Identification (ALI) database that maps a location key in the form of a 10-digit calling number/ANI, or a location reference, to calling station location information.
- ESRP – Emergency Services Routing Proxy, a Proxy server operated by a state, regional or 9-1-1 Authority processing 9-1-1 calls
- ECRF – Emergency Call Routing Function – Emergency call location-based routing function operated by the state, regional or 9-1-1 Authority

B.1.24 Emergency Services Flows

Call Flow

The caller's serving switch detects an emergency call origination based on the digits dialed by the caller (i.e., '9-1-1"). Upon recognizing the originating call as an emergency call, the wireline switch uses normal trunk selection procedures to select an outgoing trunk over which the call will be routed to the Legacy Network Gateway. This trunk may be an MF trunk, or a trunk supported by Signaling System Number 7 (SS7) signaling. If the outgoing signaling is MF signaling, the Legacy Network Gateway will receive called number information consisting of the digits “9-1-1” (or “1-1,” or “1,” if the trunk is a dedicated trunk), and a 7 or 10-digit ANI. If the call is routed from the wireline switch to the Legacy Network Gateway over an SS7-supported trunk, the Legacy will receive a called number consisting of the digits “9-1-1” (or “1-1,” or “1,” if the trunk is a dedicated trunk), a 10-digit Calling Party Number, and optionally, a 10-digit Charge Number.

The Legacy Network Gateway interacts with an associated location database/server to determine the location of the caller’s station, and then uses the received location to query an ECRF. The ECRF maps the location information to an ESRP URI, and returns the ESRP URI back to the Legacy Gateway. Once the call is received at the ESRP, it will interrogate the ECRF to obtain further routing information. This is the flow illustrated in the figure above. It is also possible that the ESRP will only receive a location reference in incoming signaling from the Legacy Network Gateway. In this case, the ESRP must first interact with location database/server associated with the Legacy Network Gateway to obtain location information, and then query the ECRF using the location obtained from an associated location database/server. In this example, the ESRP receives the address of the target PSAP in the response from the ECRF. The ECRF then routes the call to the target PSAP along with the location information in the form of a PIDF-LO and the callback number (i.e., the calling number/ANI). If the ESRP signals a location reference to the PSAP instead of a PIDF-LO, the PSAP will have to dereference the information by interacting with the LIS to obtain the location of the caller’s station to support final routing and/or the dispatch of emergency personnel.

Note: the number of ESRPs in the end-to-end flow depends upon the specific network architecture.

B.1.1.9 Data Flow

The switch serving the caller must be provisioned to select a trunk group to a Legacy Network Gateway when an emergency call origination is detected.

The Legacy Network Gateway must be provisioned to generate a query to the (appropriate) location database/server when an emergency call is detected. The Legacy Network Gateway is expected be provisioned with the address of the ECRF that it will query for routing information.

The ECRF must be provisioned with location information, e.g. state boundaries, jurisdictional boundaries, PSAP boundary information, etc. The same database can be used for the validation of calling station location information (i.e., the i3 Validation Function).

The location database/server associated with the Legacy Network Gateway must be provisioned with calling station location information that is associated with the 10-digit key (i.e., calling number/ANI) provided by the originating switch in call setup signaling. This location information must be validated before being entered into the LIS. The i3 Validation Function is used for this purpose.

As described above, the location database/server may, instead of providing the actual location, provide a reference (in the form of a URI pointing back to the Legacy Network Gateway). The reference may be used by the ESRP or PSAP to obtain the current location.

The location (or reference) is carried in SIP signaling with the call. Callback information is also included with the call, based on the calling number/ANI provided by the originating switch in call setup signaling.

Further downstream processing of the call (for example, to a CAD system) will require making available the information received with the call, as well as data accessed from supplemental data services, along with data created by the PSAP in its processing of the call. This data is forwarded in the signaling, or as a service implemented by the PSAP to downstream systems.

B.1.25 Operational Considerations

The case described in this document assumes minimal impact on legacy wireline calling networks. The signaling generated by an originating wireline switch is assumed to be the same as would be generated if the call were to be routed via a traditional Selective Router. The only change required of the originating network is in the routing translations at the wireline caller's serving switch. Instead of routing emergency calls via a trunk group to a Selective Router, the wireline switch will route emergency calls to the Legacy Network Gateway for further processing.

The ECRF is a critical element in routing legacy emergency call originations via an ESInet to an IP-enabled PSAP. The ECRF is used by the Legacy Network Gateway to route 9-1-1 calls to the correct ESRP, by the ESRP to route to the correct PSAP, and may be used by the PSAP ESRP to route to the correct Telecommunicator. The ECRF is also used by the Telecommunicator to choose the route to the appropriate responder(s). 9-1-1 Authorities must maintain the accuracy of the ECRF, as well as mechanisms to report missing or incorrect data in the ECRF. NG9-1-1 assumes a single authoritative data source as the basis for the routing and validation functions performed by the ECRF in public safety. The ECRF accessed by the Legacy Network Gateway and/or ESRP may be a replica of a master system with just the data needed for routing. Any ECRF should be able to refer non-local queries to an authoritative ECRF covering the location queried. This requires state and national coordination to maintain referral paths and to assure service area overlaps and gaps are properly handled. The Legacy Network Gateway is typically provisioned with the address of the ECRF.

Location databases/servers that are associated with Legacy Network Gateways and that generate location references must assure that all ESRPs, and Telecommunicators have access to location database/server for dereferencing under any reasonable failure condition, including disaster situations. Since this is difficult to maintain, it is preferred that the Legacy Network Gateway be provided with a location value in response to a location request, which it can then pass on to other elements in the call path (i.e., ESRPs). Credentialing methods (i.e., the issuance of VESA certificates) will be needed to allow the Legacy Network Gateway and the ECRF to authenticate query originators.

B.1.26 References

[56] Functional and Interface Standards for Next Generation 9-1-1 Version 1.0 (i3), National Emergency Number Association, [8]

Appendix C: Data Transition Check List

The following lists do not necessarily represent a sequential listing of mandatory actions. Rather, it is intended as a guideline of likely activities which may occur during a migration towards a NG9-1-1 solution.

C.1 Reference Data

Action Item	Section Reference
• Perform quality assurance checks within GIS data [Potentially reference GIS WG work on GIS reconciliation]	
• Road Center Line (RCL) vs. ESZ Polygons	
• Address Points vs. RCL and ESZ	
• Topology	
• Reconcile MSAG vs. Postal	
• Create reconciliations between Postal Communities and MSAG Communities (modifying MSAG as needed)	
• Create reconciliations between Postal Streets and MSAG Streets (modifying MSAG as needed). Include all street components (e.g., pre-directional, post-directional, suffix)	
• Reconcile street range (including parity) issues.	
• Reconcile MSAG vs. GIS	
• Create reconciliations between GIS Communities and MSAG Communities (modifying MSAG as needed) for	
• Address points	
• Road Center Lines	
• Service Polygons	
• Create reconciliations between GIS Streets and MSAG Streets (modifying MSAG and GIS as needed). Include all street components (e.g., pre-directional, post-directional, suffix)	
• Address points	
• Road Center Lines	
• Service Polygons	

• Reconcile street range (including parity) issues.	
• Address points	
• Road Center Lines	
• Reconcile data across adjacent jurisdictions	
• Create LVF and ECRF database(s) Diagram that separates function from database	
• Validate ALI/LDB against LVF data	
• Each ALI record against address points (if available), else; • Each ALI record against RCL	
• Develop mechanism to extract tabular MSAG from LVF data for use by third parties.	
• Modify the database management process/software to utilize LVF based validation rather than MSAG.	

C.2 Source Data

Action Item	Section Reference
• Transform all ALI/LDB records to be PIDF-LO format capable.	
• Parse embedded pre-directionals, post-directionals, street suffixes, etc.	
• Change reference data (MSAG, GIS, and LVF) with every parsing correction.	
• Third party education	
• Re-validate all records against LVF data.	
• Decide whether to move forward with LDB model.	
• Create LDB	
• Migration Plan	
• Test Plan with MPCs, VPCs, and service providers	

C.3 Third Party Interaction

Action Item
• Notify service providers of upcoming usage of LVF.
• Enforcing validation and periodic re-validation
• Trend analysis to correlate "no location" calls vs. whether it was ever validated (and who are the offending service providers)
• Notify service providers of upcoming implementation of LNG/ESRP.
• Migration Plan
• Test Plan
• Notify service providers of enhanced PSAP capabilities.
• Develop data recovery mechanism for emergency notification systems if/when service providers move to LIS and VPC.
• Create metrics to examine records extracted from LIS's that are not LVF valid.
• Establish uptime and quality regulations for LIS and Additional Data providers.

C.4 Other Check List Candidates

- MSAG Conversion Service
- Mechanisms for extracting data for "Additional Data" sources. [Possibly use LDB as "additional data source" as subscriber records go to LIS/VPC. Look at Supplemental ALI model also].
- Adjustments to the SOI process.
- Migrating from LDB to LIS model
- Address who are the appropriate "actors" for each transitional activity, data source, and process. Responsibilities, actions, different models.
- Any recourse to maintain records in LDB vs. LIS?