Intelligent Transportation Systems
U.S. Department of Transportation

Next Generation 9-1-1 (NG9-1-1) System Initiative

Concept of Operations

Washington D.C.

April 6, 2007 | Version 2.0

Document Change History

Version	Publication Date	Description of Change
v1.0	December 2005	Preliminary
v2.0	March 2007	Update

Table of Contents

List of Tables

List of Figures

Notes

1 Scope

The purpose of this document is to provide a Concept of Operations for the Next Generation 9-1-1 (NG9-1-1) System (or "system of systems"). The U.S. Department of Transportation (USDOT) understands 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.

More specifically, USDOT views the NG9-1-1 System as an evolutionary transition to enable the general public to make a 9-1-1 "call"[1] from any wired, wireless, or Internet Protocol (IP)-based device, and allow the emergency services community to take advantage of Enhanced 9-1-1 (E9-1-1) call delivery and other functions through new internetworking[2] technologies based on open standards. By enabling the general public to access

1 *The term "call" is used in this document to indicate any real-time communication—voice, text, or video—between a person needing assistance and a PSAP call taker.*

2 *"Internetwork"—to go between one network and another; a large network made up of a number of smaller networks.*

9-1-1 services through virtually any communications device, the NG9-1-1 System provides a more direct ability to request help or share critical data with emergency services provider from any location. In addition, call takers at the Public Safety Answering Points (PSAP) will be able to transfer emergency calls to another PSAP and forward the location and other critical data, such as text messages, images, video, with the call.

The objective of the NG9-1-1 System Initiative, as a USDOT-sponsored research and development project, is to define the system architecture; develop a transition plan that considers responsibilities, costs, schedule, and benefits for deploying IP-based emergency services across the Nation; and implement a working proof-of-concept demonstration system. The NG9-1-1 Initiative is leveraging work from USDOT's earlier Wireless E9-1-1 Initiative, which promoted enhanced location capability for 9-1-1 calls placed from wireless telephones, as well as myriad other industry-wide requirements and technical approaches.

USDOT will monitor activities by Standard Development Organizations (SDO) that are currently working on requirements and standards related to NG9-1-1. For example, the Federal Communications Commission (FCC) Network Reliability and Interoperability Council (NRIC), National Emergency Number Association (NENA), the Internet Engineering Task Force (IETF), and the Alliance for Telecommunications Industry Solutions (ATIS) Emergency Services Interconnection Forum (ESIF) have consensus-based efforts underway to develop requirements and standards for public safety, 9-1-1, and other emergency services networks. USDOT expects that the products of these consensus efforts will form the foundation for NG9-1-1 Initiative engineering and demonstration projects.

USDOT recognizes several local and state jurisdictions have transitioned to IP-based networks using technology similar to what is envisioned within NG9-1-1, but on a more regional scale. As of early 2007, PSAPs in Indiana, Allegheny County PA, Texas, and Virginia are employing digital networks to

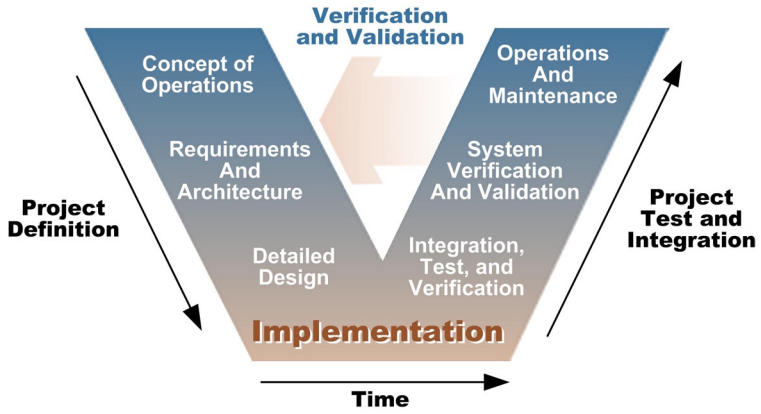

Figure 1-1. Systems Engineering Process

connect their PSAPs and originating subscriber services. These jurisdictions and other early adopters will help identify the NG9-1-1 system architecture and through use of their lessons learned, help streamline the transition to NG9-1-1.

This NG9-1-1 Concept of Operations is a formal document that provides a user-oriented vision of NG9-1-1 in the context of an emergency services internetwork[3] that can be understood by stakeholders with a broad range of operational and technical expertise. It is intended to communicate the vision of this system to stakeholders so that they can be actively engaged in its development and deployment. It also serves as the foundation for the development of the NG9-1-1 requirements and to drive the design of the overall system.

This document follows the guidance in the Federal Highway Administration (FHWA) pooled-fund study, *Developing and Using a Concept of Operations in Transportation Management Systems*,[4] which is based on the American National Standards

3 *"Emergency services internetwork" refers to a "series of secure local, regional, and national wireline and wireless [9-1-1] networks providing modern, integrated [emergency] information capabilities to support local, regional, and national needs, or a system of systems" (NRIC VII Focus Group 1D).*

4 *Version available at http://tmcpfs.ops.fhwa.dot.gov/cfprojects/new_detail.cfm?id=38.*

Institute/American Institute of Aeronautics and Astronautics (ANSI/AIAA) standard, *Guide for the Preparation of Operational Concept Documents*.[5] The Concept of Operations is the first step in the systems engineering process promoted by FHWA (see Figure 1-1). The Concept of Operations describes broad goals, user needs, and the operating environment. It forms the basis for developing system requirements. Note: common usage in systems engineering employs the terms "Concept of Operations Document" and "Operational Concept Document" as interchangeable terms.

The remainder of this document is divided into the following numbered sections:

2. User-Oriented Operational Description
3. Operational Needs
4. System Overview
5. Operational Scenarios
6. System Summary
7. Source References.

1.1 Purpose for Implementing a Next Generation 9-1-1 System

Trends in telecommunications mobility and convergence[6] have put the 9-1-1 system at a crossroads. The growing market penetration of both cellular and Voice over Internet Protocol (VoIP) telephony have underscored the limitations of the current 9-1-1 infrastructure. The Nation's 9-1-1 system, based on decades-old technology, cannot handle the text, images, and video that are increasingly common in personal communications and critical to future transportation safety and mobility advances. The current 9-1-1 system "…is an analog technology in an overwhelmingly digital world."[7]

Table 1-1. Comparison of Current and NG9-1-1 System Capabilities

Today's 9-1-1	Future 9-1-1
Primarily voice calls via telephones	Voice, text, or video from many types of communications devices
Minimal data	Advanced data capabilities
Local access, transfer, and backup	Long distance access, transfer, and backup

Table 1-2. Four Ways to Access 9-1-1 Today

Access Technology	Description
Landline telephone	Plain old telephone system. 9-1-1 call routing based on local exchange carrier (LEC) subscriber data, which is also the source of location information.
Landline TTY/TDD	Real-time, or "conversational," text. Uses landline telephone system infrastructure and 9-1-1 call routing. Requires a special TTY/TDD device for the caller and the PSAP call taker.
Wireless	Voice calls via mobile, radio-based telephones. 9-1-1 call routing is based on cellular tower location and/or mobile positioning equipment.
VoIP	Voice calls sent via IP-network access infrastructure. 9-1-1 call routing based on customer subscriber data. As of fall 2005, a few VoIP providers could deliver automatic number identification (ANI) and automatic location identification (ALI) information through the 9-1-1 network in some locations.

Many of the limitations of the current 9-1-1 system stem from its foundation on 1970s circuit-switched network technology. Presently, convoluted systems are used to deliver 9-1-1 calls and any location data for landline voice, landline teletype/ telecommunications device for the deaf (TTY/TDD), wireless/ cellular voice, and VoIP 9-1-1 to the PSAP. These access technologies are described briefly in Table 1-2. Each introduction of a new access technology (e.g., wireless) or

5 *Available (for a fee) at http://webstore.ansi.org/ansidocstore/product.asp?sku=G%2D043%2D1993.*

6 *"Convergence" is the integration of traditional telecommunications and newer information technology (IT) services.*

7 *Dale N. Hatfield, former FCC Office Chief; A Report on Technical and Operational Issues Impacting the Provision of Wireless Enhanced 911, October 2002, available at http://www.fcc.gov/911/enhanced/reports.*

expansion of system functions (e.g., location determination) requires significant engineering and system modifications.

There appears to be consensus within the 9-1-1 community on the shortcomings of the present 9-1-1 system and the need for a new, more capable system to allow the general public to make 9-1-1 calls and send text, image, and video; capabilities that are increasingly common in mobile communications devices and vehicles. There is general agreement on the need to take advantage of advances in information and communications technologies.

1.2 Major Goals and Objectives

The primary goal of the NG9-1-1 System is to save lives, health, and property by improving emergency services access and response in the United States. The state of the NG9-1-1 System also has a major effect on transportation security, mobility, and efficiency.

The NG9-1-1 System objectives that will lead to this goal include—

- Enable E9-1-1 calls from any networked communication device.
- Enable geographic-independent call access, transfer, and backup among PSAPs and between PSAPs and other authorized emergency organizations.
- Encourage a flexible, open, non-proprietary, and secure architecture to facilitate the implementation of an interoperable internetwork (system of systems).
- Foster increased coordination and partnerships within the public safety community.
- Encourage standards coordination and interoperability across the United States and with other emergency services network providers within North America (Canada and Mexico), recognizing the global impacts of routing emergency calls in an IP environment.
- Maximize emergency services capital, operating, and maintenance cost savings.

1.3 Assumptions

There are four major assumptions that influence the NG9-1-1 System. Assumptions are factors that are considered to be true and will affect the implementation of the NG9-1-1 System or the enabling of NG9-1-1 services and applications. These assumptions are listed in Table 1-3.

The first assumption is that the fundamental local institutional and operational frameworks for 9-1-1 services will remain in effect. That is, local government agencies will serve as answering points to receive, assess, and redirect 9-1-1 emergency calls from the general public to appropriate responders for help. In many cases, local agencies in rural areas of the country may transition directly to NG9-1-1 capabilities by implementing IP-based networking.

Table 1-3. Summary of NG9-1-1 Assumptions

• Local jurisdictions remain
• Communications = IP-based
• Open, non-proprietary standards and technology
• Inclusive of needs of special populations

The second assumption is that communications services will increasingly be delivered by digital devices over IP networks. The 9-1-1 community must react to the evolving trends in personal communications because the telecommunications market is not driven by 9-1-1 services.

The third assumption is that the NG9-1-1 system architecture will be based on open, non-proprietary standards and technology. The NG9-1-1 System will have the ability to adapt to ensure flexibility and support for upgrades to the architecture as IP data standards related to 9-1-1 networks evolve.

The final assumption is that the NG9-1-1 System will address the needs of special populations, such as the deaf and hard-of-hearing communities, who have been early adopters of advanced IP-based

technologies (video, interactive text, etc.), but are without a direct link to PSAPs. NG9-1-1 will inherently support these evolving digital communications devices, permitting non-voice communications directly with PSAP call takers, streamlining communications for this currently underserved community.

1.4 Constraints

There are five major constraints on the NG9-1-1 System. Constraints are applicable restrictions or limitations that will affect the implementation of the NG9-1-1 System or the enabling of NG9-1-1 services and applications. Table 1-4 summarizes the major constraints and lists potential mitigation strategies. These mitigation strategies provide a snapshot of current planning deficiencies and implementation gaps that public safety agencies may address as they move toward the ability to receive and transfer calls for service from a full range of IP-based voice, text, and video communication application services and technologies. Some local and state PSAPs have already upgraded to IP-based networking.

Table 1-4. Summary of NG9-1-1 Constraints

Constraint	Mitigation Strategy
• No degradation in current 9-1-1 services	• Strive to implement NG9-1-1 services to meet or exceed current industry standards and public expectations for 9-1-1 services
• Viability of services across both urban and rural areas	• Ensure NG9-1-1 transition plans and funding alternatives take into account populations served by PSAPs in urban and rural areas and the unique environments of both
• Not critically dependent on federal mandates	• Ensure stakeholder engagement and buy-in from policy makers and officials across all levels of government (local, state, and federal)
• Phased implementation	• Ensure a coordinated effort from stakeholders in the public and private sector as jurisdictions plan and transition to NG9-1-1 networks
• Limited by applicable federal, state, and local privacy and security regulations	• Establish planning mechanisms and Standard Operating Procedures (SOP) to ensure adherence to security mandates and guidelines

These implementations of NG-like networks provide an opportunity for other jurisdictions to understand best practices and apply lessons learned as they plan and transition to the NG9-1-1 System.

The first constraint is that there should be no degradation in current services and capabilities. In today's public safety environment, 9-1-1 networks are highly reliable for the customers they serve. These 9-1-1 networks use the Public Switched Telephone Network (PSTN) as the primary means for the public to request emergency services, and will remain a significant access method for many years to come. In addition, wireless E9-1-1 networks have been deployed in many local and state jurisdictions and have also proved to be highly reliable. Implementers of NG9-1-1 networks should strive to ensure NG9-1-1 services will meet or exceed industry standards for call completions, voice quality, and reliability. The NG9-1-1 System will provide an opportunity for all jurisdictions to transition to higher levels of 9-1-1 services and capabilities while maintaining and improving current reliability.

A second, related, constraint is that neighboring 9-1-1 systems must remain viable as NG9-1-1 is incrementally deployed by localities, including both urban and rural areas. The reliability, robustness, and security of the 9-1-1 system must not degrade as new access technologies and corresponding risks and challenges are introduced into the system.

The third major constraint is that federal regulatory actions should not be the primary driving force to implement NG9-1-1. That is, the operational and economic benefits should justify the public and private transition to NG9-1-1 and not critically depend on federal regulatory or funding incentives. Timely nationwide implementation, however, may depend on regulatory and/or funding policies.

The fourth constraint is that the NG9-1-1 System will be implemented based on a phased-implementation approach that is dependent on funding mechanisms and pricing models that address both public and private sector needs. Fundamental

budgetary and capital planning changes may be needed to encourage the full development of the NG9-1-1 System.

The final constraint is that implementing NG9-1-1 networks is dependent on the applicable federal, state, and local privacy and security policies and regulatory guidelines for the use and handling of 9-1-1 call data and other Personally Identifiable Information (PII). Careful consideration of public and citizen concerns about the possibility of unauthorized access, disclosure, and use of this personal information is necessary; defined SOPs must be established to guard against and respond to a privacy or data breach.

1.5 Intended Audience

The intended audience for this document includes the entities involved in current 9-1-1 system planning, operations, and technology; the organizations that will be involved in the development of NG9-1-1; and the organizations that will operate or produce NG9-1-1 elements. The general public is an implicit part of the intended audience because the NG9-1-1 System must ultimately serve its needs.

Figure 1-2 presents the USDOT NG9-1-1 Community Model, a graphical representation of the stakeholders and the associated operational and support elements that comprise the NG9-1-1 System. Stakeholders presented in this model are among the organizations, operators, entities, and individuals included in the

Table 1-5. Description of NG9-1-1 Community Model Segments

Community Model Layer	Description
Geographic Layer	• The Geographic Layer, depicted in the lower portion of the graphic as a map of the U.S., illustrates the decentralized nature of NG9-1-1 and the interconnected and decentralized local and regional emergency services networks (system of systems) depicting various boundaries of existing emergency services providers' areas of responsibility.
Emergency Services Internetworks Layer	• Compilation of 9-1-1 systems, applications, and information repositories that serve multiple governmental and non-governmental functions and seamlessly share emergency data to improve response.
Operational Layers	• Progression of emergency service requests from the general public, through the originating subscriber and access services, 9-1-1 networks, and dispatch operations to the emergency service responders.
Originating Subscriber Service Operations	• Access methods to enter the NG9-1-1 System from the public through various communications devices and are routed to the appropriate emergency service network and 9-1-1 authority through commercial networks.

9-1-1 Enterprise Operations	• Functions that describe the dissemination of location, nature, and status of the emergency to the appropriate first responder agencies. This layer comprises three segments:
	  • *9-1-1 PSAP Operations Segment* is primarily used by PSAP call takers to receive calls from the public, determine the location and nature of the call, and relay pertinent data to the appropriate public safety dispatch center for response.
	  • *9-1-1 System Administration Segment* describes the capabilities needed and rules for sharing information, collaborating, assigning work tasks, training, and configuring the 9-1-1 Enterprise.
	  • *9-1-1 System Operations & Network Support Segment* consists of activities and systems to manage, protect, administer, and operate the technology infrastructure supporting the 9-1-1 mission.

Dispatch Operations	• Distribution of emergency information to various responder organizations responsible for delivery of emergency services to the community.

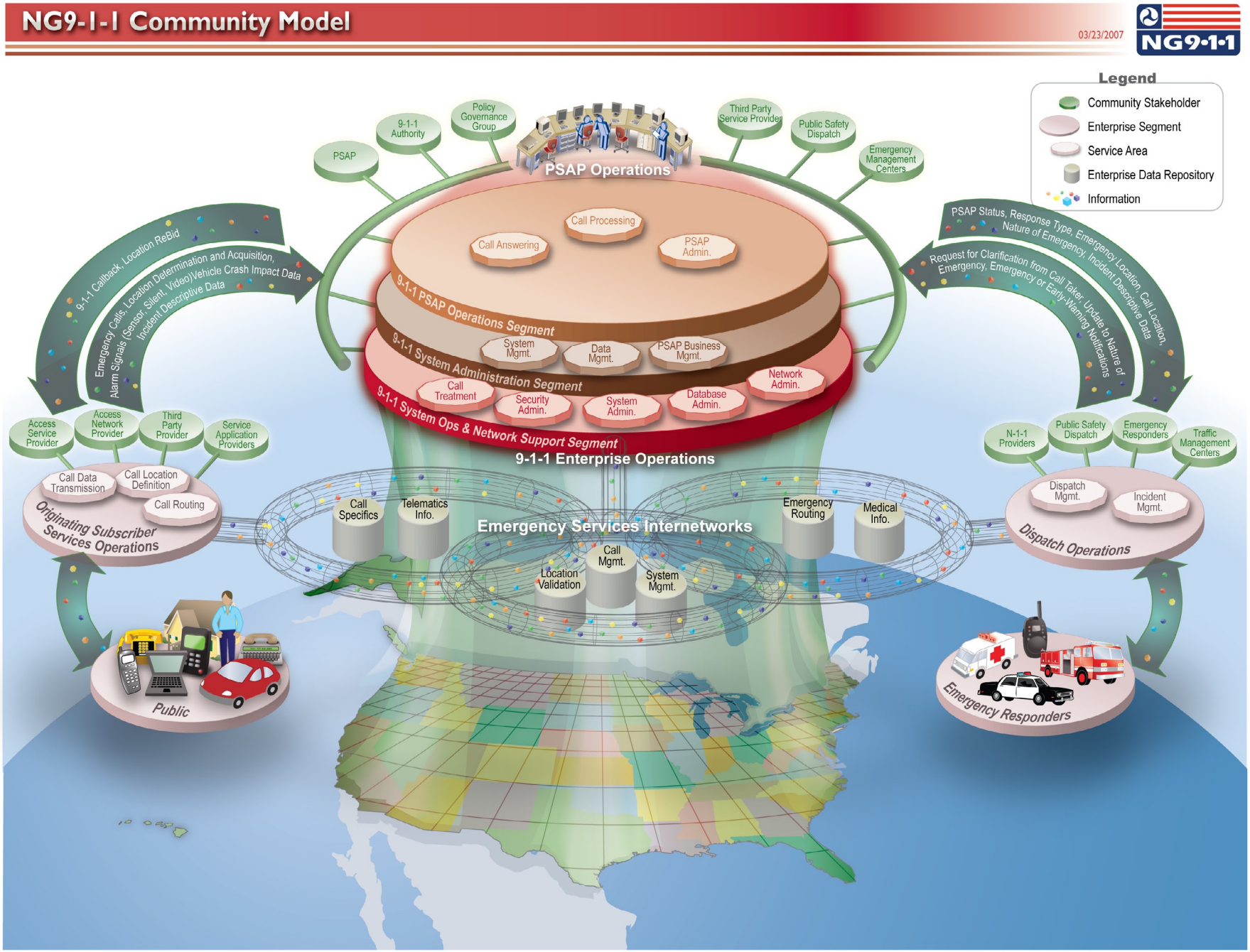

Figure 1-2. NG9-1-1 Community Model

intended audience of this Concept of Operations. The Community Model allows these groups to visualize how the NG9-1-1 System interacts with various stakeholders and how they fit into the emergency services community. Thus, the Community Model provides an overall enterprise view to capture, understand, and analyze the needs and operations of the various stakeholders in the context of the services the NG9-1-1 System provides to them.

The layers of the NG9-1-1 Community Model are used to illustrate geographic coverage, the operational elements of the emergency services community, and the operational elements of the NG9-1-1 System. Table 1-5 provides a brief description of each layer. Through the decomposition of the layers of this model, functional needs and capabilities can be identified that will drive the identification of requirements and inform later development efforts to support NG9-1-1. Section 4.4 of this document presents an initial description of the NG9-1-1 system functional capabilities.

1.6 System Boundaries for NG9-1-1

NG9-1-1 is expected to be an interconnected system of local and regional emergency services networks (system of systems). The boundaries of emergency service networks may vary, depending on local requirements and organizational frameworks. However, at the core, each local NG9-1-1 network would include one or more PSAPs and the corresponding public safety dispatching capabilities.[8] Network interfaces will be needed for incoming calls, call transfer to other PSAPs or dispatch centers outside the local network, and access to databases and services outside the network. Although location information may be provided by individuals or entities accessing the emergency services networks, the verification of this information is handled at the PSAP.

As is the case today, personal communications devices and their commercial networks will remain outside the emergency services internetwork. These devices and networks will play an integral role because they provide the access methods and interface with the NG9-1-1 System, but their deployment is beyond the scope of this project. Call access methods allowing access into the emergency services internetwork will be enabled by corresponding standards, protocols, policies, and operational procedures.

1.7 Overall Vision of NG9-1-1

USDOT believes that a technological transition to NG9-1-1 is essential as the Nation's public safety emergency service networks adapt to the general public's increasing use of wireless communications and digital and IP-based devices to make 9-1-1 calls, with the ability to transmit text, images, and video. Cellular service and most other commercial and public safety communications systems are transitioning to IP-based networks. These technologies should enable major advances in the ability of all users and public safety responders to send or receive useful information to, from, and beyond the emergency services internetwork, such as emergency calls in American Sign Language via video or medically relevant data transmitted from a vehicle crash.

The 9-1-1 System is, and will remain, primarily a local government and communications industry responsibility. However, this local focus has resulted, in the past, in fragmenting the 9-1-1 system capabilities and limiting the ability to develop and invest in new technologies. The NG9-1-1 System influences the way government agencies manage 9-1-1 calls that may include text, images, and video, as well as how call takers interface with and process these new types of information. The intent of USDOT is to promote the vision for the NG9-1-1 System and provide leadership, guidance, and resources to work with the public and private 9-1-1 stakeholders to lay out a path to achieve a phased migration of a nationally interoperable[9] emergency services internetwork.

8 *Increasingly, PSAP and dispatch functions are collocated at a single facility.*

9 *The emergency services internetwork will be "interoperable" in that the networks and systems that comprise the NG9-1-1 architecture system of systems will have the ability to work together using standard formats and protocols.*

USDOT's core vision for NG9-1-1 is that this new internetwork will provide the foundation for public emergency services in an increasingly mobile and technologically diverse society and ultimately enable E9-1-1 calls from most types of communication devices. Once implemented, the NG9-1-1 System will enable—

- Quicker and more robust information delivered to the general public as the result of making a 9-1-1 call
- Better and more useful forms of information (text, images, and video) from any networked communications device
- Transfer of 9-1-1 calls between geographically dispersed PSAPs (and from PSAPs to remote public safety dispatch centers) if necessary
- Increased aggregation and sharing of data, resources, procedures, and standards to improve emergency response
- Maximized public capital and operating cost savings for emergency communication services
- Promotion of increased coordination and partnerships within the emergency response community.

Notes

2 User-Oriented Operational Description

2.1 Operational Overview

The operational needs of 9-1-1 services must be reexamined in order to effectively incorporate them into the larger context of emergency communications. The NRIC VII Focus Group 1D, composed of a wide variety of industry stakeholders, stated—

"A critical weakness of the current emergency communications system is that agencies are isolated from each other. The only ubiquitous interoperability is via wireline telephones. That does not help emergency responders in the field, and it does not allow the sharing of data. Our emergency responders are being asked to do one of the most important jobs in our society, with communications and information technology that most businesses have moved beyond… We see the future emergency communications system as an "internetwork" – a series of secure local, regional, and national wireline and wireless networks providing modern, integrated information capabilities to support local, regional, and national needs, or a system of systems."[1]

1 *NRIC VII Focus Group 1D, Communications Issues for Emergency Communications Beyond E9-1-1, Report #1, December 6, 2004, available at http://www.nric.org/meetings/docs/meeting_20041206/FG1D%20Final%20Report.pdf.*

From this statement, it is clear that communications is an essential component in the ability of the emergency response triumvirate—the police, fire, and emergency medical disciplines—to be effective. Communications professionals are an integral part of the emergency response community.

Within the NG9-1-1 System internetwork, the mission of PSAPs remains the same—to receive emergency calls from the public; ascertain the nature, status, and location of the emergency; and relay the call to the appropriate public safety dispatch center to respond to the emergency or to dispatch the responders directly, depending on how the service is configured. The call-related expectations of the PSAPs also remain the same—"calls" should be delivered to the proper PSAP within the seconds typical at many locations in the United States and, along with the location information, arrive in standards-based formats that can be readily processed.

2.2 Operational Changes

NG9-1-1 changes the core definitions of emergency services in three areas—(1) types of calls received; (2) ability to receive voice, text, and images from PSAPs or services outside the local region, and ability to transfer or exchange voice and data[2] with other PSAPs and dispatch centers, as well as state or federal entities involved in the response; and (3) capability to accept or obtain access to additional sources of information designed to facilitate emergency services. These changes are expansions of current functions, not fundamentally new roles. Presently, most PSAPs can receive wireless and wireline 9-1-1 voice calls and TDD/TTY text calls and can transfer these calls to a limited number of local and regional alternate PSAPs and dispatch centers. However, there are notable differences among PSAPs regarding the information that can be accepted and processed with a call. For example, as of early 2007, more than 41 percent of counties in the United States could not receive the location of a wireless 9-1-1 call in their PSAPs.[3]

NG9-1-1, as a software, protocol-based, and distributed system, will also require all PSAPs and other partners in the emergency communications and response process to have computer-assisted systems. This will be necessary in order to process calls with their associated data, pull additional data from protected sources in other networks, and then transfer to or exchange it with other entities.

The interconnectivity and complexity described above will require some degree of authentication to control participation in the call delivery and emergency response process. More specifically, stakeholders providing critical and beneficial support services to both the delivery of 9-1-1 calls and the emergency response that ensues will need to be authenticated as appropriate, trusted, and contributing partners to the process.

2.3 Operational Impacts

These changes in core capabilities will have operational implications. While the present local and regional institutional framework for PSAP and public safety communications operations will likely continue, the new technical capabilities (e.g., remote call acceptance and transfer) remove some of the geographic constraints on current PSAP facility location and the associated limitations with current hardware, software and Commercial Off-the-Shelf (COTS) components. Likewise, the conceptual nature of a PSAP may change as well, as new, next-generation network capabilities allow a great deal of flexibility in call-taking arrangements and provide a greater ability to transfer emergency data to dispatch centers and remote PSAPs. Call takers no longer have to be physically located together in a communications center to receive and process emergency calls. Call-taking arrangements may change with the nature of the emergency, workload, and

2 *The term "data" refers to information (regardless of the form it takes, e.g., text, video, image) relating to the calling party and/or is descriptive of the location and nature of the emergency event, that may support emergency response and incident mitigation.*

3 *NENA 9-1-1 Fast Facts. http://www.nena.org/pages/Content.asp?CID=144&CTID=22.*

other incident-related factors and management requirements.[4]

Conversely, new technologies require that PSAP and emergency services personnel develop new and extended working relationships with diverse and unfamiliar agencies, organizations, and networks. This will require some degree of guidance and standardization. Enhanced operational processes and procedures will have to be developed to handle new types of calls and data. In addition, new and extended working relationships may be needed to coordinate the purchase, maintenance, and management of the new technology systems involved.

It is unclear how the changes described above affects the call taker[5] workload. The growth of the wireless telephone market in the mid 1990s led to an increase in 9-1-1 call volume. This was primarily the result of the phenomenon of multiple calls for some types of emergencies. For example, it is not unusual for a PSAP to receive 50 or more calls for a single motor vehicle crash. Although NG9-1-1 will permit many more ways to call 9-1-1, this will not necessarily result in more calls per emergency in the United States beyond what already occurs because of virtual ubiquity of landline and wireless telephones. In this context, NG9-1-1 may foster a replacement of some calls from one communication medium to another medium.

However, it is clear that access to emergency incident information and data will increase, perhaps significantly. Such information could range from additional calling party and incident scene intelligence to patient medical histories and automatic collision notification (ACN) data. Data characteristics will change as well, as geospatial information becomes more prevalent. Simply making all of this information available is not enough. How information is best accessed; how and when it is displayed, transferred, and used to facilitate emergency response and incident management; how it is stored; how public privacy is protected; and the training necessary to use it effectively are all operational issues. Not all of this new information and data should be provided to the call taker and dispatcher. Only information that best supports the processing of the call, and the dispatch of emergency services and enhancement of emergency response, needs to be available to these functions. Other types of information and data may best be applied or made available directly to the responding service itself to facilitate follow-up treatment and incident management.

Although there is a significant possibility of information overload at every level unless it is appropriately screened and focused, there is also the likelihood that the ability to share data will promote interoperability beyond what is conceived at present.

The current financing paradigm for the 9-1-1 system operations will likely prove inadequate in the future. Surcharges, fees, and taxes on telephone equipment and services fund a significant portion of the capital and operating costs for today's 9-1-1 system. Traditional landline telephone services are being replaced by wireless and VoIP services.[6] Consequently, the corresponding revenue stream for the 9-1-1 system is expected to decline. Moreover, there is reason to believe that telephony will eventually be a "free" application available to Internet users along with e-mail, instant messaging, and other communications applications.[7] This would further undermine the dependency on telephone-related revenues for 9-1-1 funding.

Although the historical 9-1-1 funding paradigm is likely to change, the opportunity for sharing costs through shared infrastructure and related operations will increase, as will

4 *"IP PSAP Features and Capabilities Operational Information Document," NENA, June 4, 2004, 58–501, available at http://www.nena9-1-1.org/9-1-1OperPractices/ops_info_docs.htm.*

5 *"Telecommunicator" and "communications officer" are other terms for these PSAP professionals.*

6 *Association of Credit and Collection Professionals (ACA) International reports that more than 8 percent of U.S. households have replaced landline telephone service with wireless service (http://www.acainternational.org/?cid=6488). According to the FCC, household telephone subscribership has declined by 3.1% from March 2003 to March 2005.(http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-258942A2.pdf).*

7 *September 2005, The Economist, Available (for a fee) at: http://www.economist.com/displaystory.cfm?story_id=4400704.*

economies of scale. As NRIC VII[8] reported, "a significant initial investment is required" to develop the infrastructure, upgrade the Nation's PSAPs, and interface with many new entities. New revenue sources will be needed, but recurring costs for 9-1-1 equipment and operations may decrease because of the potentially lower costs for IP-based equipment and infrastructure.

2.4 Primary System Users and Operational Processes

The quintessential operational processes for 9-1-1 will continue within the NG9-1-1 System. The general public, PSAP call takers, public safety dispatchers, and first responders will remain the primary users of the 9-1-1 system. However, NG9-1-1 will accept a broader range of public users. The person requesting help will no longer be limited to a telephone or TTY/TDD and may use multiple communications media in a single "call." Third-party service providers, such as telematics, medical alert, central alarm monitoring, N-1-1 services, and relay services, will now have direct access to the 9-1-1 system. Ultimately, "the users of the network will be any and all organizations that improve the safety of the public by being able to exchange information in emergencies."[9] This will include not only the police, fire, and emergency medical services (EMS) first responders but also additional important responders such as public works and transportation agencies, towing companies, hazardous material (HAZMAT) remediation teams, and state and federal response agencies as emergency incidents may warrant.

Table 2-1 lists the key operational capabilities of the NG9-1-1 System compared with the current system for the primary users, and the implications for new procedures.

8 *NRIC VII, a designated federal advisory committee, was specifically asked to address the future dependence of emergency communications networks on IP networks, and in particular, whether IP technologies should be used to transmit information to and from the PSAPs as communications networks continue to evolve.*

9 *Ibid, p.12.*

Table 2-1. Key Operational Capabilities of the NG9-1-1 System

User	Current Capabilities	Key Changes	New Process and Procedural Issues
General Public	• Call local 9-1-1 directly via telephone, cellular telephone, TTY/TDD, possibly VoIP • Call PSAP indirectly (not using the 9-1-1 system) via third-party emergency or relay service via a broader range of communication options • Deliver location and callback number, with various restrictions.	• More viable options for communicating directly with PSAPs • More capabilities for delivering data beyond location and callback • Direct support of third-party originated 9-1-1 calls • More options for receiving up-to-date information, warnings, and/or instructions on large-scale events • Greater ability to complete a "call" to someone who can help in disaster or other mass calling situations.	• Understanding/knowing whether device or service is E9-1-1 capable • Understanding/knowing qualitative differences in E9-1-1 capabilities (e.g., E9-1-1 via residential wireline provides more reliable location than cellular telephone from inside building) • Universal access code/symbol for emergency access from all (or most) devices. "9-1-1" is not the telephone access code used by most countries • New ways to obtain, represent, and convey location • New ways to route a call, given its location • New ways to obtain information related to the location, call, caller • Security-related factors (certification, authentication), threats (e.g., denial of service attacks), and potentially differing impacts on citizen access depending on access service • Privacy issues.
Service and Applications Providers	• Are responsible for routing and transfer of calls • Provide public access to emergency services • Help maintain data and information necessary to route and deliver emergency calls.	• Expanded call delivery network and management of databases • Several emergency service applications supporting the delivery and processing of emergency calls, and the subsequent emergency response.	• Need for credentialing/authentication for access to system functions, information, and data supporting service delivery.
Third-Party Service Providers	• Receive voice, text, data, images, and video via a full range of communication options • Must determine which PSAP to contact • Relay emergency service requests to PSAP via 10-digit administrative lines, not as "native" 9-1-1 calls • Able to transfer information only via voice conversations with the PSAP.	• More appropriate remote transfer capabilities as PSAP-to-PSAP (e.g., call delivery through the emergency services internetwork). • Ability to originate 9-1-1 calls on behalf of client, with routing based on location of client • Ability to supply additional data related to location, call, and client • Ability to have automatic conference with customer service representative (CSR), call taker, and client.	• Certification, authentication, and other requirements for access to public safety network(s).

User	Current Capabilities	Key Changes	New Process and Procedural Issues
PSAP/9-1-1 Authority System Management	• Manage human resource requirements and activities as appropriate to level of responsibility • Oversee service delivery • Oversee the funding and procurement of supporting infrastructure and services • Establish SOPs and operational policy • Provide limited locally developed public education programs (typically underfunded) • Has clearly defined liability protection • Is responsible for security at PSAP level.	• More complex human resource requirements • New SOPs and operational polices required • Expanded public education programs • Possibility of increased Critical Incident Stress by call takers and dispatchers commensurate with increased information and data about the incidents involved. • Need for emergency notification • Increased information that brings increased privacy expectations and liability • Expanded security needs in IP networks (e.g., access to information) • New interactive relationships with other stakeholders.	• Development of new training methods and programs • Change in SOPs/protocols for call takers and dispatchers • Focus on messages, target audiences, and delivery methods • New programs on Critical Incident Stress Management • Procedures for emergency notification • Liability protection • Clearly defined role of 9-1-1 authority and more complex institutional structure • Certification/authorization/accreditation processes for stakeholders.
PSAP Call Takers	• Receive local E9-1-1 calls from wireline telephone, cellular telephone, TDD/TTY, and possibly VoIP users • Have access only to voice, TTY/TDD text, and location data from callers • Transfer 9-1-1 call to/from a limited number of local PSAPs • Hand off a 9-1-1 call to a limited number of local public safety dispatch entities.	• Increased number of viable methods for receiving E9-1-1 calls (i.e., more accessible to the public) • More data available in addition to location • Capability for transferring calls to/ from any emergency service entity, independent of geographic location • Expanded concept of triage to include more entities beyond PSAP • Receipt of potentially traumatic multimedia data by call takers.	• Receiving, switching, logging, etc. of voice, video, and text media streams • Displaying, acting on, and forwarding new kinds of data • Training, policies, and procedural issues for “long distance” 9-1-1 activities • Confidentiality/privacy issues • Network security issues • Information triage issues—overload issue • How to deal with increased Critical Incident Stress.
Public Safety Dispatchers	• Can receive call, ALI/ANI data, and supplemental text provided by PSAP call taker • Can access and integrate additional data relevant to particular emergency, depending on computer-aided dispatch (CAD)/records management system (RMS) capabilities • Relay key information to responders verbally. (Depending on mobile data capabilities, some data can be transferred to responders.)	• Inclusion of additional data or links to relevant data resources with all “calls” • Receipt of potentially traumatic multimedia data by dispatchers.	• Information triage issues—overload issue • More devices initiate calls that could be abandoned before call taker response • Training, policies, and procedural issues • How to deal with increased Critical Incident Stress.

User	Current Capabilities	Key Changes	New Process and Procedural Issues
First Responders	• Typically receive voice instructions from dispatcher via radio • Increasingly, can receive and access additional data beyond the 9-1-1 call information via mobile data terminals (MDT) in vehicles.	• Possible inclusion of additional data or links to relevant data resources via MDTs and other wireless devices • Improved "mobility," i.e., improved response times (acknowledgement to transport) • Improved access to up-to-date information on events • Multimedia stream access (e.g., surveillance video).	• Information triage issues—overload issue • Confidentiality issues • Network security restrictions • Training, policies, and procedural issues • Privacy issues (transport/third-party access).
Additional Responders	• Include government and private responders (e.g., public works, transportation, towing and recovery), who are typically notified by public safety dispatchers via telephone • Also include state and federal response agencies, as emergency incidents may warrant • Have access to electronic notification and sharing of some incident data in a few locations.	• Possible inclusion of additional data or links to relevant data resources in electronic notifications • More integration into public safety incident networks • Improved "mobility," i.e., improved response times (acknowledgement to transport) • Improved access to up-to-date information on events.	• Information triage issues—overload issue • Confidentiality issues • Network security issues • Training, policies, and procedural issues • Privacy issues (transport/third-party access).

Notes

3 Operational Needs

The operational limitations of the current 9-1-1 system and related needs of NG9-1-1, noted or implied in previous sections of this document, are presented with more detail below. These limitations define the new desired capabilities that form the basis for developing system requirements.

1. Ability to receive 9-1-1 calls from technologies other than wireline telephone, cellular telephone, TDD, and some VoIP.

The public demand for non-traditional telecommunications services is increasing. These services—VoIP, instant messaging, short message service (SMS), video relay, telematics, and more—cannot use the telephone network and consequently cannot access PSAPs. Although traditional voice and TDD text will remain at the core of emergency communications for the near term, expanded nontraditional services will be demanded by the public and can offer new information options for improving response. New devices for callers with disabilities will supplant existing systems, offering improved information and access to PSAPs and responders. These changes will require additional training so that call takers can be equipped to handle new types of calls and make optimal use of expanded information about emergency situations.

2. Ability to readily add new services or capabilities.

Significant modifications to the 9-1-1 system were required when each of the four access technologies—wireline telephone, cellular telephone, TDD, and VoIP—was added. PSAPs and commercial communications service providers had to make convoluted network and database changes to accommodate antiquated legacy 9-1-1 infrastructure. Moreover, local public infrastructure is slow to be upgraded. The protocol and network architecture between the PSAP and the location data servers has not changed substantially since its introduction approximately 30 years ago. Advancing emergency services, along with the development and introduction of new features and capabilities must accommodate legacy protocol, network architecture, and historical service provider relationships.[1]

3. Ability to receive or forward "long distance" 9-1-1 calls.

The routing of emergency calls needs to be greatly improved. Current 9-1-1 systems have limited ability to route calls to backup PSAPs. The backup and overflow capability that exists is almost always provided by neighboring facilities. Third-party call centers (such as telematics services) and VoIP applications have requirements to route an emergency call anywhere in the country. Remote calls to PSAPs are now made using 10-digit administrative lines, not as 9-1-1 calls. Technology is needed that will support location-independent call transfer and give any centralized emergency call-taking entity the ability to transfer calls to location-appropriate PSAPs as native 9-1-1 calls. All emergency calls should be delivered as native 9-1-1 calls. Nationally accepted operational protocols need to be in place to ensure that this process occurs in a standardized way across the country.

4. Ability to receive, obtain, or forward supplemental data other than ALI/ANI.

There is a great deal of information that could be made available to call takers, dispatchers, and responders that could improve response; however, currently there is no way to know what data is available or how to route and forward the data. PSAPs and public safety dispatch centers usually cannot share supplemental data (e.g., call taker notes, telematics data) electronically unless they are using the same CAD system. Third-party service providers that often have valuable supplemental information on emergency status and history cannot transfer such information to PSAPs or dispatch centers. The NG9-1-1 System will provide technological advances to human-machine interfaces (HMI) to improve the call taker's ability to support new types of information and facilitate a more effective and appropriate emergency service response.

5. Ability of location information methods and sources to match the capabilities of newer systems and the needs of public safety.

In a non-emergency context, location is irrelevant for most Internet communications applications (e.g., VoIP, instant messaging, email). However, location is central to how 9-1-1 works. Location is used to determine which PSAP to direct a call to, which responders to

1 *Emergency Services Network Interfaces Task Force ("Task Force 34"), available at http://www.atis.org/esif/esmiarchives.asp.*

dispatch, and where to dispatch them. The original system assumed a fixed relationship between a telephone number and a street address. There is great variability from community to community in how location is represented. All of these assumptions greatly limit how location can be determined, carried, and reported, and do not match current capabilities or need. Newer systems allow location to be delivered in the signaling with the call. Complex enterprise and service provider relationships greatly complicate designation of responsibility for who determines location and also require that routing information be available on a global basis. Civic (street address) or geospatial (latitude/longitude and elevation) forms of location may occur in any device or service, and routing must be supported in either form in any service.

6. Ability to address security concerns and challenges inherent in IP-based infrastructure.

The current telephone network system for 9-1-1 has had few hacker and denial of service attacks but is nevertheless vulnerable. Call delivery, in IP formats, and from Internet and private networks, will present new security risks. However, IP offers a wider range of tools and procedures to address and mitigate attacks. For instance, current thinking is that all messaging internal to NG9–1–1 should be positively authenticated, by instance, rather than depending on "`trusted'" sources that receive only initial or periodic validation. A balance that accommodates both access and security must be determined, and technology to support both needs must be deployed as part of the NG9-1-1 System.

7. Ability to address coordination, partnership, and planning needs and requirements.

Operations for 9-1-1 are rooted in long-standing working relationships among 9-1-1 system service providers, i.e., the LECs, and PSAPs. 9-1-1 systems are largely limited and closed. Within the traditional model, service providers furnish the network infrastructure, which is largely the ALI database, and often also provide the PSAP customer premises equipment (CPE). Dispatching is considered a separate function, although often both call-taking and dispatching are performed by the same telecommunicators. Traditionally, 9-1-1 service is funded through a type of telephone service surcharge, which the telephone companies collect from their subscribers and remit to the governmental entity charged with the responsibility of funding 9-1-1 service. Service providers bill the PSAP or 9-1-1 authority for the service, and the PSAP or 9-1-1 authority pays the bill using surcharge revenues.

NG9-1-1 functions quite differently in that it involves many more stakeholders, and a more complex network infrastructure. The NG9-1-1 networks are a portion of a larger shared emergency communications internetwork that supports dispatch, the responders, and a wide variety of other health and safety entities such as emergency management, hospitals, and departments of health and homeland security. NG9-1-1 requires coordination among diverse stakeholders involved in a wide variety of related efforts for the purposes of planning, service provision, and cost sharing.

Notes

4 System Overview

4.1 System Scope

The geographic scope of NG9-1-1 is the United States; however, some international connectivity should be feasible and desirable, especially at international borders. Because IP technologies are not limited geographically, the 9-1-1 front end (telephones and carrier systems) must evolve to a single international standard. International roaming and nomadic operation must be taken into account, and in fact, both already occur. Consequently, detection and routing of some IP-based emergency calls to the proper PSAP will be provided by systems that are not U.S.-based. Evolution to single-domain, multinational IP-based communication systems is expected; indeed, in enterprise environments, such systems already exist. This will require that the primary signaling and network protocols be based on international standards (e.g., IETF).

The institutions and organizations that have roles in the deployment and operation of NG9-1-1 include—

Government Agencies
Responsible for establishing policies and funding, promoting coordination and communications between agencies and organizations, and overseeing the operation of PSAPs and emergency response services.

- Local, state, regional, and federal policy, regulation, and funding agencies
- Local and state emergency communications agencies
- Local, state, regional, and federal emergency response agencies

Non-Governmental Organizations
Responsible for overseeing the development of key ubiquitous components of next generation systems, and for representing the interests and needs of stakeholder communities in that development.

- Professional and industry associations
- Standards Development Organizations
- Citizen and special interest advocacy organizations
- Private emergency response and recovery organizations
- Research and academia

IT/Telecommunications Service Providers
Responsible for functional services essential to the operation of next generation systems and the access to those systems by the public, emergency communications personnel, and responders.

- "Traditional" telecommunication service providers
- "Public safety/emergency" service providers
- "Other" IT/telecommunication application service providers
- IP-network access infrastructure/service providers

IT/Telecommunications Equipment Providers
Responsible for the manufacture and provision of equipment essential to the operation of next generation systems and the processing of 9-1-1 calls.

- Equipment and support service suppliers to "traditional" telecommunications companies
- Equipment and support service suppliers to IP network providers
- "Public safety/emergency services network" equipment providers
- Personal communication device providers

Third-Party Emergency Call Centers
Represent specific public communities or consumer groups responsible for providing access to emergency services and/or data.

- Third-party service providers such as telematics, poison control, medical alert, central alarm monitoring, relay services, and N-1-1 services.

The high-level diagrams provided in Figure 4-1 and Figure 4-2 allow comparison of the components of today's 9-1-1 system with those for NG9-1-1 System. In the following text each figure is a description of the call and data flow represented in that figure.

Legacy E9-1-1 call and data flow (see Figure 4-1) can be described as follows:

- A caller dials 9-1-1 through one of a few possible communication technologies.
- The call is recognized and passed, along with limited data such as calling (callback) number and location-related codes, across dedicated trunking or Internet paths to the E9-1-1 Selective Routing switch.
- The Selective Routing switch consults a specialized database that relates telephone number to a predefined location and jurisdiction code to determine proper PSAP routing.
- Third-party call centers may access the PSAP via a 10-digit number or via the Selective Router.
- After the call arrives at the selected PSAP, the 9-1-1 CPE at the PSAP delivers the call and call-related data items to a call taker position for answering.

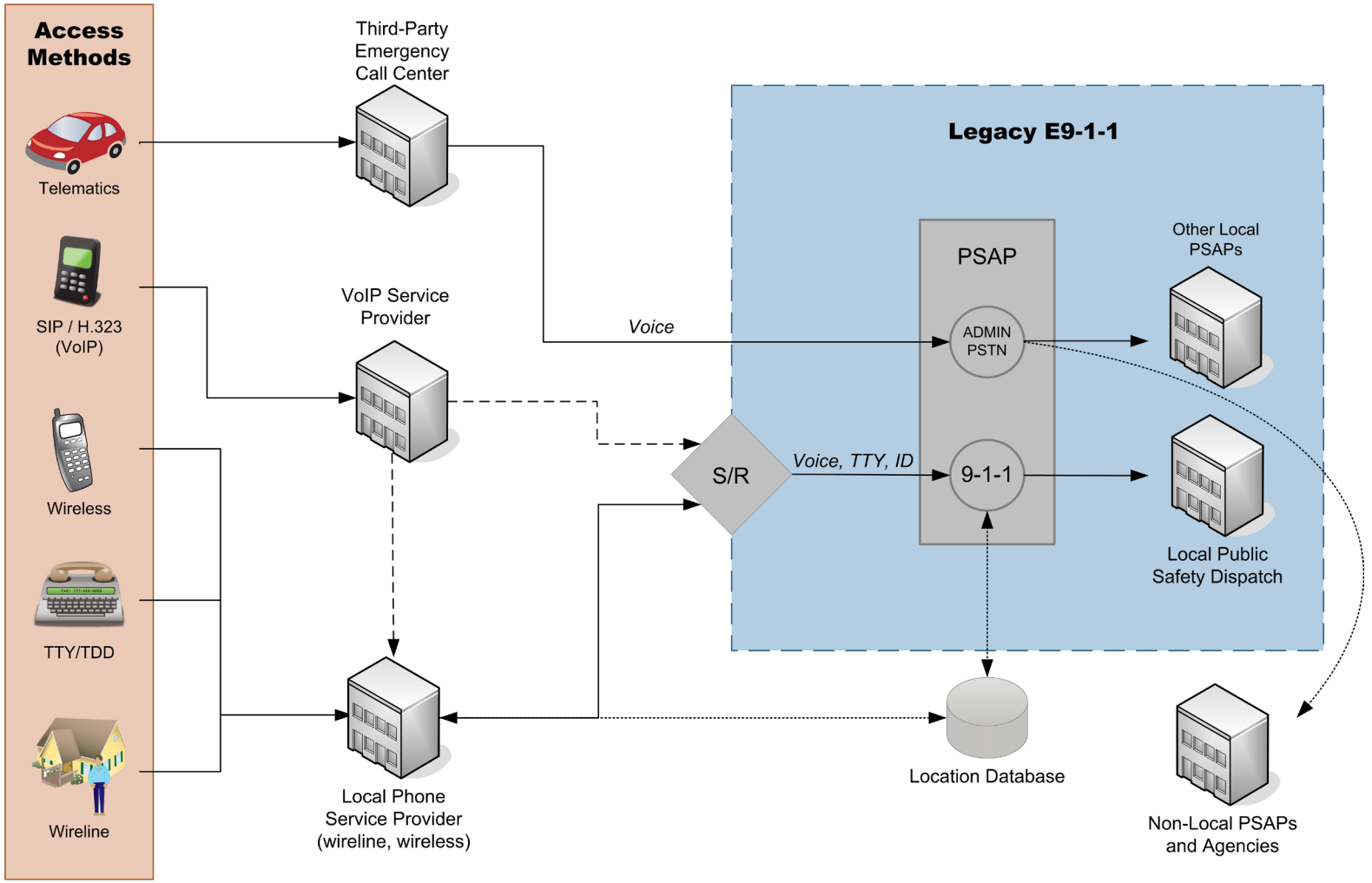

Figure 4-1. Call Flow and Elements in Today's 9-1-1

- At the same time that the call arrives at the PSAP, the location-related code is passed to location database servers, and the caller location and related data is returned to the PSAP equipment for display to the call taker.
- Depending on the nature of the call and any related emergency situation, the primary PSAP may transfer the call to another PSAP or dispatch point, which may again access the location database, and/or other external databases for additional information, or populate dispatch systems, such as CAD for public safety response.

Underlying this call-related process are significant data management and system control management processes.

NG9-1-1 call and data flow (see figure 4-2) can be described as follows:

- A caller dials 9-1-1 or initiates an emergency message through one of many possible communication technologies.
- The call is recognized and passed, with limited (but expanded compared with legacy E9-1-1) data, such as callback number and location or location-related code, through a related access network or portal into the emergency services IP networks through security and firewall mechanisms.
- The access network involved in connecting to the emergency service IP network may be IP based, may include the Internet, or may be a combination of analog, digital, and/or IP, with multimedia conversion.
- Within the NG9-1-1 functions, IP-based routing protocols are used to identify and direct the call/message to the proper PSAP or to a dynamically selected alternate PSAP identified by call routing hierarchy tables.
- After the call arrives at the selected PSAP, the 9-1-1 CPE at the PSAP delivers the call and call-related data (e.g., location, callback number) to a call taker position for answering.
- At the same time that the call arrives at the PSAP, the caller location and related data is displayed to the call taker.
- Depending on the nature of the call and any related emergency situation, the primary PSAP may transfer the call and data to another PSAP or dispatch point, which may access other external databases for additional information, or populate dispatch systems, such as CAD for public safety response.

Underlying this call-related process are significant data management and system control management processes, some of which will be new or modified for NG9-1-1.

4.2 System Operations

The system operations processes necessary to manage functional elements of NG9-1-1 include network management, security management, management of component operations, PSAP management, and various types of data management. Overall service operations among all sources of calls and messaging, as well as the dispersed functions and capabilities of the NG9-1-1 System, must be managed as a coordinated whole.

In particular, the management of data processes to ensure data integrity and accuracy is critical to the consistent routing and delivery of calls/messages with related data to the proper PSAP and to the ability of PSAPs to interact with each other for misrouted, overflow, and backup call handling. Databases associated with location validation, routing tables, data use, and access rights management are among the data sources that must be properly maintained and administered for effective systems operation. Use of data interoperability standards is critical to enable common use of data among multiple users.

Overall NG9-1-1 system management must be organized and administered to maintain duplicated functions dispersed throughout the physical network structure so that no critical NG9-1-1 function can be affected by single failure cases. It is expected that system design will include authentication of each IP message at each

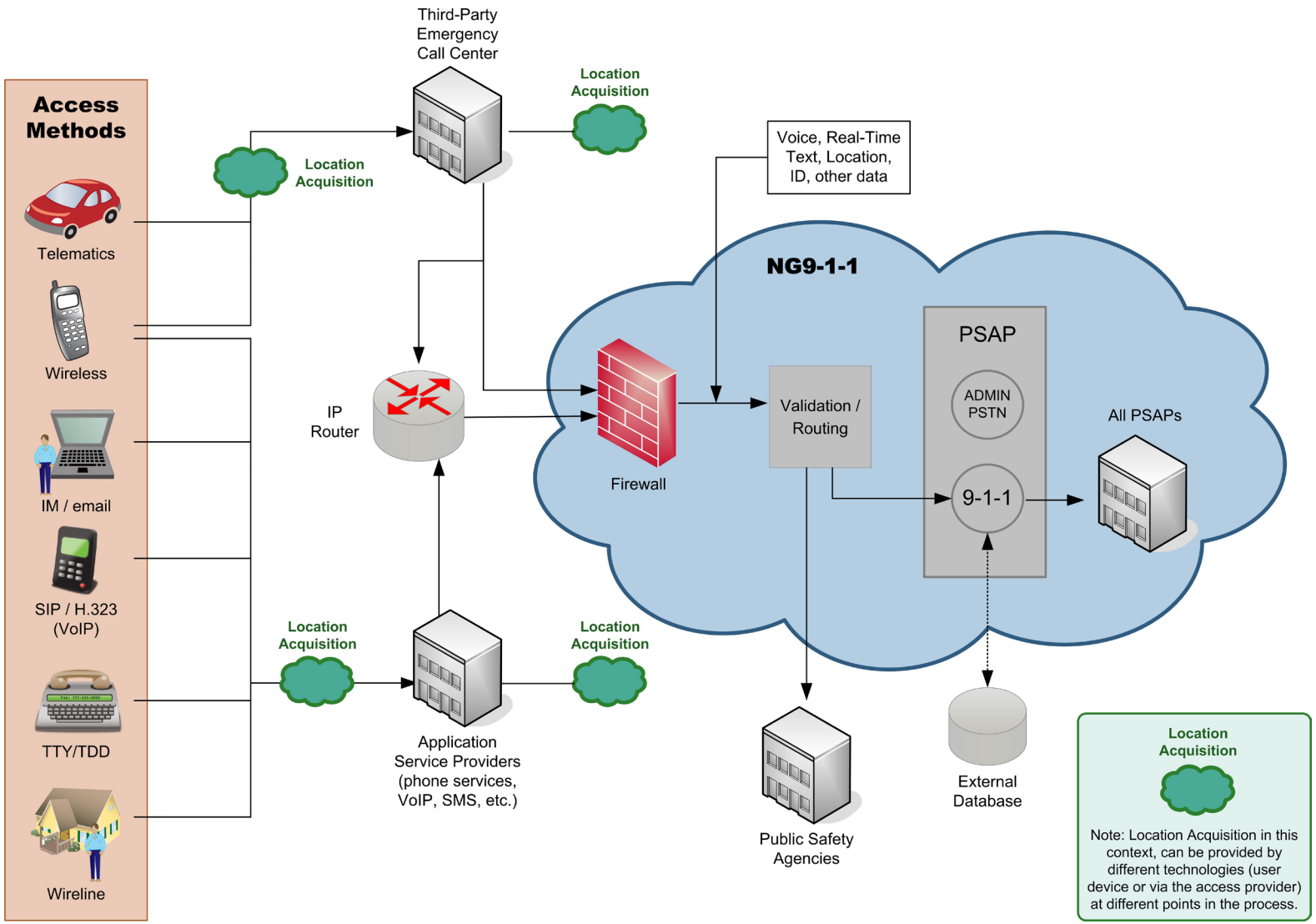

Figure 4-2. Call Flow and Elements in NG9-1-1

major step in the progress of a call, message, or data transmission, rather than dependence on "trusted" sources, in order to minimize "spoofing" opportunities where falsification of identity and/or data items could occur as the result of the efforts of disruptive agents.

In addition, enhanced operational processes and procedures will have to be developed to handle new types of calls and data received or acquired via NG9-1-1 and the related IP internetwork. Specifically, new types of data provided with the call/message, or acquired post-call by the PSAP call taker, must be coordinated with CAD data management processes, and the resulting availability of additional data may require changes to CAD management procedures and CAD-related operational interfaces. For 9-1-1 and dispatch locations that do not use CAD, appropriate call taker data use procedures will be required.

In summary, it is important to recognize that data and data management control the functionality of NG9-1-1 networks and component subsystems, and are fundamental to the accuracy of call/message and data delivery. Error correction, in tandem with adjustments for location validation and source data corrections, is key to maintaining proper NG9-1-1 operation as geographic, addressing, and jurisdictional changes occur.

4.3 System Interfaces

The internal interfaces between the components of the NG9-1-1 network elements and the external interfaces to components outside of the core NG9-1-1 System are identified in this section and illustrated in Figure 4-3. Assumptions regarding whether a component is internal or external may change as system development progresses.

Internal interfaces include—

- Interface between PSAP CPE and the emergency services internetwork. IP-capable PSAPs would have a direct connection to the network.
- Interface between PSAP CPE and internal data sources, such as mapping software and geographic information systems (GIS).
- Interface between the emergency services internetwork and system-related data sources, such as identity and access management information, as well as location validation and routing data.
- HMI between call takers and CPE (e.g., microphone, headset, keyboard, video).

External interfaces may include—

- Interface between IP communications applications and devices and NG9-1-1 emergency services internetwork (through a service provider's network) for call routing to the appropriate PSAP. This network IP interface implies a number of additional interfaces outside of the NG9-1-1 network. The interface between the NG9-1-1 emergency services internetwork and personal IP communications device further implies that "9-1-1" or some emergency access code can be entered via the device and application.
- Interface between legacy (i.e., PSTN) communications applications and the emergency services internetwork. Ultimately, the legacy service will be expected to provide its own internal IP conversion gateway and then link to the IP router/gateway interface. During the transition to "full" NG9-1-1, local 9-1-1 authorities may opt to maintain existing connections to PSTN selective routers. A gateway between the selective router and the emergency services internetwork may be required.
- Interface between third-party emergency service providers and emergency services internetwork.
- Interface between IP-capable PSAP and external data/information sources (e.g., telematics data, GIS data, medical information).
- Interface between IP-capable PSAP and public safety dispatch/responder agencies systems.
- Interface between legacy PSAPs and emergency services internetwork. Legacy PSAPs would connect via an external gateway that would provide signal conversion to/from the NG9-1-1 System and IP-capable

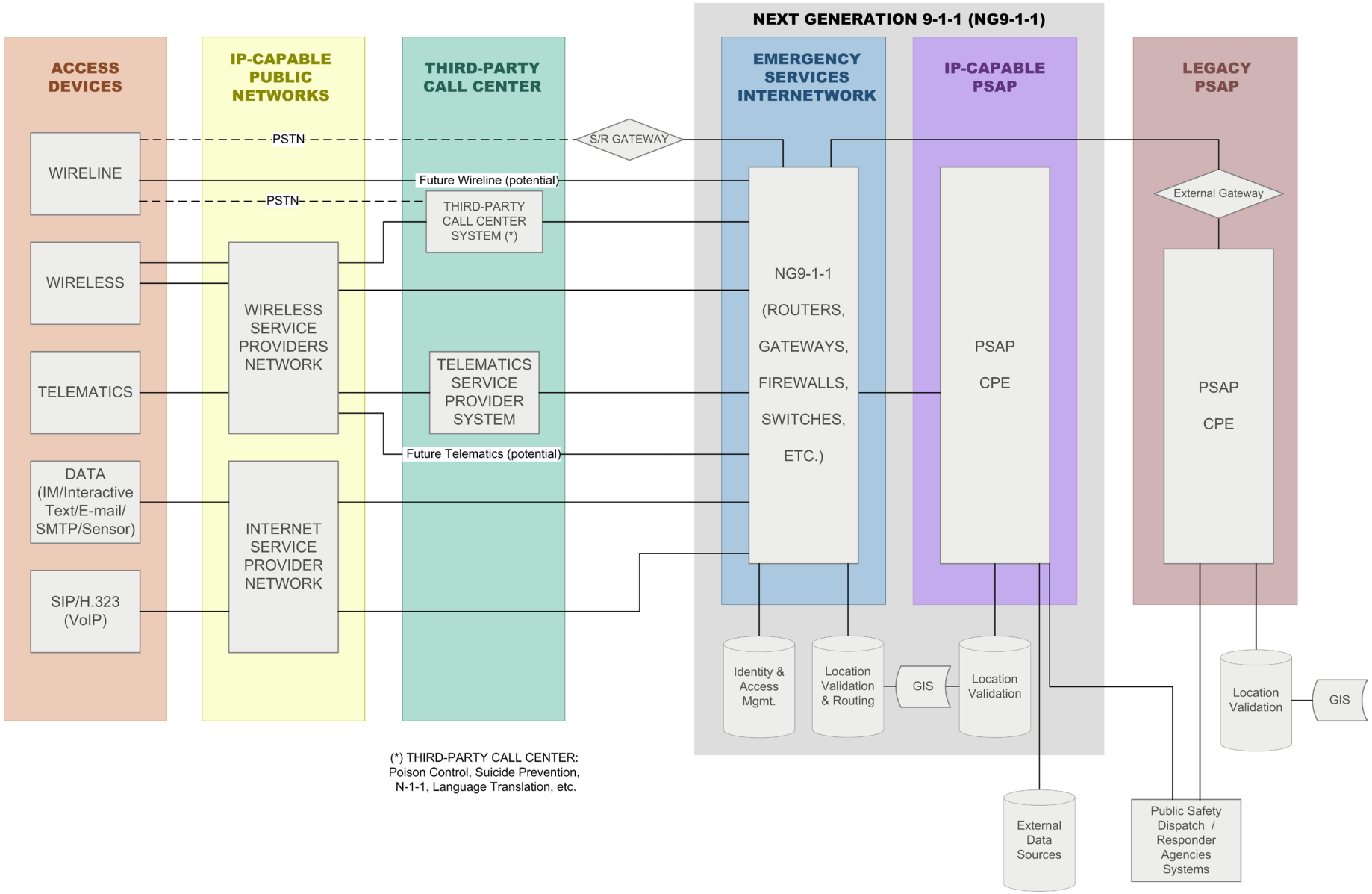

Figure 4-3. System Interfaces in NG9-1-1

PSAPs and other emergency services entities.

National and international standards will be required for many of the interfaces noted in this concept. The subject of standards related to IP-networks, applications, and protocols is new to 9-1-1 systems. Potential standards for implementation will likely be developed by SDOs and related entities including, but not limited to, IETF, ATIS/ESIF, International Telecommunications Union (ITU), Telecommunications Industry Association (TIA), 3rd Generation Partnership Project (3GPP), the Association of Public-Safety Communications Officials International (APCO), and NENA.

Potential exists to create international standards for many or all of these interfaces. This would improve the ability of the Nation to respond to cross-border incidents, as well as create a much larger market for the same systems, which would lower overall costs and increase choice. To do so would require cooperation with other standards bodies, such as the European Telecommunications Standards Institute (ETSI).

4.4 System Capabilities (Functions)

1. Call Initiation

Calls, along with some "callback" and location-related information, will be delivered by a communications service application and an access network to the emergency services network. Legacy services, such as wireline and cellular/personal communications services (PCS), will likely continue to send routing/location data access codes used to acquire location information separately from the call initiation process. Calls and messages will come from a multiplicity of sources, including wireline, cellular/PCS, VoIP over wired networks, VoIP over the Internet, call centers such as ACN/telematics or health monitoring centers, WiFi and WiMAX wireless sources, satellite services, and others. Each of these sources may provide varying types and levels of identifying data with the call, or via access to data sources.

2. Call Routing

Based on caller location and PSAP operational status, the call will be routed to the most appropriate PSAP.

3. Call Congestion Control

Call volume can exceed the ability of PSAP staff to respond ideally. PSAPs should decide call treatment in overload situations, including, but not limited to, dynamically rerouting to other suitable and available PSAPs, using interactive voice response, providing a busy tone, or generating other automatic, informative replies to callers.

4. Call "Presentation"

Call content and related information is currently presented to call takers via headphones, computer screens, and TTY/TDD screens. For NG9-1-1, additional communications media (e.g., instant messaging [IM], video) will need to be presented. Multiple communication and information sources will need to be integrated into the communication officer's display system. Call volume and workload will need to continue to be balanced among call takers.

5. Call Location and Address Validation

Location determination is and will remain the responsibility of entities outside of the 9-1-1 emergency services network. Currently, location of E9-1-1 calls is determined by the LEC through subscriber records for the landline telephone number or by the wireless carriers through positioning technologies placed in their networks, handsets, or some combination. For new emergency access communication applications, the user, application service, and/or access infrastructure provider will need to determine and input location data to support call routing and emergency response.

The PSAP CPE and call taker will receive location information data directly in the call data transmission or via a pointer/link

to an outside database for location information retrieval. The PSAP CPE and call taker will receive or interpret information to ensure the location is valid for emergency dispatch.

Civic (street address) location information must be validated before it is used for routing or dispatch. New mechanisms, and more standardized and commercially viable representations for location, must be developed. More specific location information (e.g., building, floor, room) will be provided for most larger facilities. Geospatial information from wireless providers may be converted to street address text, displayed with mapping, GIS software, or some combination at the PSAP.

6. Callback Ability

The PSAP call taker will be able to initiate a callback to the initiating party in the event the original connection is lost. Currently, a callback number is provided in the landline and wireless E9-1-1 call transmission. Newer systems may present callback information that is not a telephone number, and that information may be for any nation or domain (due to roaming and nomadic operation).

7. Call Transfer to Responder Dispatch Center

Calls may be transferred to a dispatch center (when that function and organization is different from the PSAP/call taker) to dispatch police, fire, medical, or other emergency services. Currently, call information and supplemental data can be transferred only to entities, usually local, connected via the same information systems. Calls may arrive with new media forms (e.g., video, IM). New information and media sources will be available to dispatchers, responders, and their management.

8. Call Transfer to Other PSAPs and Other Emergency Service Entities

Incorrect location or routing data or other factors could result in call delivery to an inappropriate PSAP. IP-based systems could potentially misroute calls anywhere, even to other countries. The PSAP should have the ability to transfer this call and any associated data to any other PSAP. Currently, this is possible to PSAPs connected to the same selective router and ALI database.

In the future NG9-1-1 and emergency communications environment, interaction on a voice, video, and text basis with many other types of emergency entities will be possible. Although not directly in the scope of this project, those interfaces must be recognized as active participants in NG9-1-1 system operations.

9. Dispatch Data Entry for Non-local PSAPs

In disasters or other major incidents, call takers, as well as responders, can be overwhelmed. IP-based routing will allow calls to be answered by any PSAP; however, without any way to get relevant information to responders or to provide important information from responders to callers (such as evacuation orders), there is little point in exploiting these capabilities. Today, a random set of callers gets through to the PSAP, and the rest (a very small percentage) receive a busy tone. The busy tone tells callers no help will be forthcoming, but does not let responders decide how best to deploy scarce resources. NG9-1-1 will permit call takers in distant PSAPs to answer the call, determine basic caller information, enter it into databases accessible to local responders, and provide information from responders to be given to callers. Responders can retrieve information from these databases to make triage decisions and deploy their resources most effectively.

10. System Management and Control

Addressing data and its validation before actual call initiation is critical for non-wireless services in order to support accurate routing and location identification to the PSAP call takers. The trend for both address-based and geocoordinate-supported service types is toward GIS-based database systems. Even when GIS-based data is available from external sources, its use in 9-1-1 applications typically requires specific procedures managed within the public safety authority environment. A

rights management process and maintenance of its content is critical to automatic and queried data distribution among PSAPs and other emergency entities. Public safety authorities will be required to manage databases that control dynamic alternate and default routing of calls when the target PSAP is unavailable because of load or access issues. IP network and systems security processes, whether handled at local or higher governmental levels, will be significant parts of the operational environment.

4.5 Maintenance and Technical Support Environment

The core operating environment for PSAP call takers is not expected to fundamentally change in a NG9-1-1 System—interacting one-on-one with persons in need of help, working from call centers, and identifying and facilitating emergency response, while using similar hardware interfaces. However, there will be new capabilities and redundancies. From the operational and maintenance perspective, many changes will be needed in technical staff skills, equipment, and vendor requirements. System operations, across many new functional organizations with little E9-1-1 experience, must be designed and tested before transition to live service. Processes, procedures, and regulations will need to be established to support the changing technology. The emergency services community, including new providers of systems and system operations, will not have the luxury of learning how to run NG9-1-1 over months and years, as was the case with the simpler current E9-1-1 system.

Either directly or via integration vendors, public safety authorities will be faced with multiple management challenges, such as IP network management, including security and recovery from failures and impairments; subsystems and overall service management; databases of various types; and revised and new aspects of PSAP equipment and operations management. Management of public expectations for 9-1-1 service will continue to be required and possibly expanded because of the new capabilities of NG9-1-1.

5 Operational Scenarios

Scenarios are used here to illustrate the NG9-1-1 concept by describing key users' perspectives in different circumstances. Although the overall NG9-1-1 System is designed for use by every PSAP throughout the Nation, the scenarios are not intended to be an exhaustive list or description of all NG9-1-1 access methods, technologies,[1] or functionality, but rather an indication of how NG9-1-1 will change the fundamental landscape of emergency communications delivery.

Below each scenario, a table lists specific capabilities and functions and how they are handled in both today's 9-1-1 (E9-1-1) and in NG9-1-1. The capabilities are in priority order, with the most important feature described first. In addition, the NG9-1-1 column includes some criteria of expected performance.

1 *NG9-1-1 capabilities detailed in these scenarios are expect to be met through a combination of today's standards and those likely to be developed by SDOs and related entities to include, IETF, ATIS/ESIF, ITU, TIA, 3GPP, APCO and NENA.*

5.1 Telematics Scenario

Dorothy Jones is a 75-year-old diabetic attending her grandchild's birthday party in rural Rockville County, PA. Despite inclement weather and approaching darkness, Dorothy ignores the wishes of her family and friends, and decides to head home that same evening. "Don't worry," says Dorothy, "I'll take the back roads. And I'll stay far away from those maniacs on the highway," reassuring other guests on her way out the door. On a desolate rural road halfway home, however, Dorothy suddenly feels weak and shaky, symptoms she recognizes as a warning of impending insulin shock. She reaches for her purse, which contains her emergency glucose and realizes that she left her purse and her cellular telephone at the party.

Dorothy presses the emergency button on her vehicle's telematics system, which automatically dials a third-party private emergency call center, also known as a telematics call center. Currently, mayday systems do not automatically dial 9-1-1, minimizing "false alarms" for PSAPs. Lucky, the car is not resting in a wireless "dead zone," and her call can be completed through the nearest wireless tower. Upon pressing the button, a voice channel is opened between the third-party center and the driver. The telematics call center specialist immediately knows the woman's name, the operating status and make/model of her vehicle, and her exact location from Global Positioning System (GPS) satellites or other wireless location technologies. The specialist—a trained call taker—talks with Dorothy, going through a comprehensive protocol to determine what has happened.

With a call established between Dorothy and the telematics service provider (TSP), the specialist initiates a third-party 9-1-1 call. Because it is a third-party call, it is routed based on Dorothy's location and not the location of the TSP. The call is automatically established as a three-way conference call with Dorothy, the specialist, and the Rockville County PSAP call taker. The PSAP call taker sees on her screen that the call is a third-party call, and it identifies Dorothy (and her location), as well as the specialist and the TSP. Although located in a different state, the TSP Call Center (as a trusted party) delivers Dorothy's voice call, vehicle GPS location, and other important data via the IP-based emergency services internetwork using established network protocols and communication standards. Working hand-in-hand with the private call center specialist, the PSAP call taker notifies and transfers all pertinent response data to the nearest EMS dispatch center, which immediately sends an ambulance to Dorothy's location. If there had been a crash, other data about the incident would also have been transmitted electronically. Whether Dorothy calls from her vehicle, her handheld cellular telephone, or her home telephone, the system can identify Dorothy as the same person. Dorothy has opted into a database that contains a summary of her medical information, and the call taker can access it directly. In addition, Dorothy's database entry includes a request to automatically notify her son, and the system places a call to her family to notify them of the situation. The son can be automatically added to the conference call if desired. At all times, the victim's privacy is secure.

As EMS arrives, Dorothy is losing consciousness. The ambulance has no problem locating Dorothy because the TSP ensures her car's lights are flashing and periodically sounds the horn. Already aware of Dorothy's diabetic condition, the paramedic can rapidly evaluate her situation, provide Dorothy with emergency medical care, and transport her to the hospital, where her data has been received and medical professionals are awaiting her arrival. She is treated and released to her family, who meet her at the hospital and take her home.

In the NG9-1-1 environment, calls from mayday systems like Dorothy's will be handled more quickly and accurately because the TSP can electronically transfer important data, like GPS coordinates and medical information, directly to the PSAP. This results in measurable improvements in call processing time, call data accuracy, responder agency response time, and most important, patient outcome.

Table 5-1. Capabilities/Functions Demonstrated in the Telematics Scenario

Capability/Function	Today's 9-1-1/E9-1-1	NG9-1-1
Call Initiation	• TSP is able to make a voice call only via 10-digit number and no ANI/ALI is provided • Transfer of any available data is performed via voice • Increased call processing time is required	• TSP connects to the NG9-1-1 internetwork and an emergency response requested electronically • The call is correctly identified as originating from the TSP and includes callback information • Voice call and telematics data are transferred over the emergency IP network automatically • Decreased call processing time is required
Call Routing	• Routing is manually performed, based on TSP lookup for that location • System is prone to errors • There is no awareness of PSAP availability/ operational status	• Routing is automatically performed, based on GPS location information obtained directly from the vehicle • System automatically routes to the appropriate (available) PSAP
Call Location and Address Verification	• Location and verification is performed locally at the PSAP based on the geographic location provided orally by the TSP	• Vehicle coordinate data is automatically transferred to PSAP and used for location determination
Call Presentation	• Call appears to the call taker as a non-9-1-1 call and no supplemental data is seen	• Call appears to the call taker as a third-party TSP call and includes callback data • Additional information is provided by the TSP, which could include subscriber data, medical information, GPS location of the vehicle, and other pertinent information
Dispatch Data Entry for Non-local PSAPs	• There is no capability for non-local PSAPs to handle the call	• Non-local PSAPs could handle this call as an overflow call

5.2 Multimedia Scenario

Just after sunrise on a June morning, Joe is taking his dog Ivan on their usual walk through his neighborhood in the outskirts of Smithfield County, TN. Joe notices that quite a bit of smoke is coming out of the *Paint and Detailing Unlimited* garage. He immediately grabs his wireless personal digital assistant (PDA)/cellular telephone. While most of Joe's neighbors would have placed a voice call in this situation, Joe is profoundly deaf, and interactive text is his medium of choice. Now that the Smithfield County PSAP is on the emergency services internetwork, a 9-1-1 text stream is delivered as an E9-1-1 call with the usual location and callback information included in a wireless call. After calling 9-1-1, the PSAP call taker, through interactive text, asks Joe for more details about the situation and relays the information to the fire dispatcher. Concerned about the potential for a HAZMAT-related incident, the PSAP asks Joe to use the camera feature on his PDA/cellular telephone to quickly take some pictures of the garage and transmit them via the 9-1-1 link.

Joe heads for home after the fire department arrives, reflecting on how his option for communicating with emergency services has improved. Joe has a Voice/Text-over-IP telephone at home that both he and the hearing members of his family use. He also uses sign language via his IP-video system whenever appropriate. Video Relay Services (VRS), which allow a hearing call taker to visually interpret sign language and relay via voice, are essential when Joe has to communicate with someone who has only a plain old voice telephone. All VRS providers are able to deliver an emergency call as a native 9-1-1 call to any IP-PSAP in the United States.[2]

Joe notes how useful VRS would have been when he was 5 years old and his Mom slipped on rug, knocking herself unconscious. Even if Joe's household had had a TTY/TDD device, he could not read or write well enough to have used it. However, he could certainly sign and had the presence of mind to run to a neighbor who called 9-1-1. Similar mechanisms are used to automatically engage language translation services when the language preference of a caller is not English.

With NG9-1-1, non-voice callers have more choices for accessing 9-1-1 to request emergency services and can use standard consumer-oriented communications devices. As a result, there will be a marked improvement in call processing time and a substantial increase in customer satisfaction on the caller's part, because of a smoother communications process and reduced anxiety for the caller.

2 *When a 9-1-1 call is placed from a videophone, a Video Remote Interpreter (VRI) is added by the PSAP call taker as a third party to the call. The VRI service is an interactive (fee-for-service) video teleconferencing system that uses a sign language interpreter at a video interpreter agency to interpret calls from sign language users to standard telephones. These interpreters are specially trained to relay conversations between hearing individuals and deaf or hard-of-hearing individuals whose primary language is American Sign Language. Instead of using TTY-to-voice and voice-to-TTY (used by the traditional voice relay services), conversations are relayed from sign language-to-voice and voice-to-sign language using video equipment.*

Table 5-2. Capabilities/Functions Demonstrated in the Multimedia Scenario

Capability/Function	Today's 9-1-1/E9-1-1	NG9-1-1
Call Initiation	• Although deaf and hearing-impaired individuals can dial 9-1-1 from a cellular telephone, they are unable to communicate with the 9-1-1 call taker using the current system	• NG9-1-1 provides the ability for deaf and hearing-impaired callers to access 9-1-1 directly, using alternate access methods, including text messaging
Call Presentation	• There is no current ability to handle non-voice, non-TTY/TDD callers	• With NG9-1-1, various communication media are supported, including interactive text, and are presented in real time to the call taker
Call Transfer to Responder Dispatch Center	• Forwarding of callers can be performed via 10-digit numbers, but without important caller data	• Transfer of callers and caller data to Responding Dispatch Centers is provided
Call Transfer to Other PSAPs and Other Emergency Service Entities	• If this call had been a TTY/TDD call, transferring the caller to another PSAP would have been difficult and most likely handled via voice from PSAP to PSAP	• Using IP capabilities, "data-only" callers (like an interactive text caller) could be transferred from one PSAP to another

5.3 PSAP Backup/Overload Scenario

Hurricane Laurie, a Category 3 storm, is cutting a swath through Louisiana. At the height of the storm, the PSAP in Richfield Parish is taking the hardest hit. Telephone lines and power lines are down in much of the southern part of the state. Even though the center is fully staffed and its communications systems are still operational, more cellular telephone and Internet messages are coming in than can be handled. Fortunately, PSAPs in the northern part of Louisiana and in Mississippi and Texas can handle the overflow, and can completely take over for the Richfield Parish PSAP if it should be rendered inoperable by the hurricane. Location information arrives with most calls, and even though the call may be received anywhere in a three-state region, the calls can be transferred to the appropriate emergency responder dispatch center. During the height of the storm, response must be triaged. However, emergency management personnel have provided a common, distributed database/GIS that contains and charts each ongoing emergency and its status. Call takers at any answering PSAP put data into the database and can advise callers of evacuation recommendations for the area from which they are calling. Immediate access to the database is invaluable to the public safety agencies throughout the course of any large-scale event. Used during the actual response, identifying routes of travel, evacuation points, and inventory and vendor lists are just a few examples of how having access to "just in time" data will benefit the overall response.

Unfortunately, the Richfield Parish PSAP takes a direct hit from the storm and is completely destroyed. The personnel are able to evacuate to safety in time, but the emergency communications equipment is a total loss. Years earlier, when Hurricane Katrina hit Louisiana, some PSAPs were off-line for almost a week or more. Standards-based IP emergency service networks were subsequently installed in the Gulf Coast states, and intercounty and interstate procedures and protocols were established for emergency and disaster backup operations. As a result, backup PSAPs are able to continue answering inbound 9-1-1 calls and routing the information to the correct dispatch centers. This is the exact scenario that was tested during the regional disaster preparedness training session held prior to hurricane season. For a portion of that training day, PSAPs handle the 9-1-1 calls for their backup facility. Issues are reported and addressed, and the overall process is refined in preparation for an actual disaster.

Shortly after the storm passes, a temporary trailer is delivered to the parish that contains all the telecommunications and computer equipment to run the emergency communications center until a more permanent solution is rebuilt. Once the trailer is connected to power and the emergency communications internetwork, the PSAP is back up and running, able to answer emergency calls for the parish. The robust, fault-tolerant internetwork and cooperative procedures made all the difference this time.

Inherently, the NG9-1-1 system will provide the ability to route and reroute inbound 9-1-1 callers to the most appropriate and available PSAP, based on predefined business processes. As a result, there will be an increase in call completion rates (especially in those areas affected by catastrophic events) and call routing and delivery accuracy.

Table 5-3. Capabilities/Functions Demonstrated in the PSAP Backup/Overload Scenario

Capability/Function	Today's 9-1-1/E9-1-1	NG9-1-1
Call Routing Call Congestion Control	• There is no assurance of failover to a single, predefined alternate PSAP if a catastrophic event causes a PSAP to be unavailable	• Calls are forwarded to the most appropriate and available PSAP, regardless of physical geographic location
Call Location and Address Validation	• LEC determines location validation for wireline calls or positioning technologies for wireless calls	• Location acquisition is accomplished via various technologies (user device, access provider or other location aware devices)
Dispatch Data Entry for Non-local PSAPs	• There is no capability of non-local PSAPs to handle the call	• Non-local PSAPs can handle overflow calls using IP-based routing • Responders can provide callers important information • System supports entry of data to be forwarded to local responders

Notes

6 NG9-1-1 System Summary

The NG9-1-1 System presents an opportunity to improve delivery of high-quality emergency communications services for the Nation's population that requires an emergency services response. In addition to providing the principal ability to communicate with new technologies and most any communications device, NG9-1-1 will enable location-independent call access and transfer between and redundancy of PSAPs throughout the country. Employing an open-architecture, interoperable systems-of-systems, it will allow PSAPs to share information more quickly and with greater accuracy, and to deliver access to crucial data at a level not currently available.

By enabling access to newer communications devices, the NG9-1-1 System will provide a faster, more direct response to the "nontraditional" caller. Deaf and hearing-impaired callers, telematics-equipped vehicles, and central-station emergency alarms will be able to pass along text and video data, in addition to or in place of a voice call to 9-1-1.

Telecommunications and networking equipment will be designed to be location-aware, automatically providing key data about the caller's location. This feature eliminates current problems with

devices that do not (or cannot) disclose their location when calling 9-1-1. Using the emergency communications internetwork, PSAPs will be able to transfer emergency callers from one PSAP to another and forward calling and location information with the call.

With NG9-1-1, the physical location of a PSAP becomes immaterial. Using IP-based technology, emergency calls can be routed to the call center responsible and capable of handing that caller, via the network. The PSAP could be the local center that routinely handles calls in the nearby geographical area. However, when disaster strikes or a spike of callers occurs, other properly staffed PSAPs can absorb the overflow as a normal course of business. This redundancy improves the level of service that any PSAP can provide to its callers.

This Concept of Operations document is the result of input sought from a diverse group of stakeholders, including 9-1-1 and public safety agencies and related industries; information standards organizations; consumer, research, academic, and consortia communities; technology and consulting industries; telematics, third-party, Internet, and wireless service providers; and transportation, government, regulatory, and professional associations. These stakeholders are involved in all aspects of the creation, delivery, receipt, and management of 9-1-1 calls. The scope, functional capabilities, and operational scenarios all stem from current limitations, evolving technology that is not currently supported, and the strong desire to inherently support future technologies.

Development of the Concept of Operations document in this manner builds a foundation of consensus throughout the overall stakeholder group and ensures that the NG9-1-1 System is "being built the right way, the first time." Only with this consensus, can the NG9-1-1 transition legacy technology and systems into an advanced nationwide emergency communications internetwork.

7 Source References

Primary sources of information used in this document were published and working draft documents from the FCC, NENA, the IETF, and the ATIS-ESIF.

- *Network Architecture Properties in 2010, Extending E9-1-1 to Satellites, and Generic Architectures to Support Video and Advanced Service*. NRIC VII Focus Group 1B, FCC. June, 2005. *Long Term Issues for Emergency/E9-1-1 Services* (Draft)—These documents are designed to provide a set of specific recommendations regarding future emergency communications network properties, and their capabilities by 2010 to support the exchange of voice, data, text, photographs, and live video through the emergency services internetwork to the PSAP and beyond.

- *Communication Issues for Emergency Communications Beyond E911: Final Report—Properties and network architectures for communications between PSAPs and emergency services organizations and personnel.* NRIC VII Focus Group 1D, FCC. December 2005. http://www.nric.org/meetings/docs/meeting_20051216/FG1D_Dec%2005_Final%20Report.pdf—The purpose of these documents is to describe the properties that network architectures for communications between PSAPs and emergency services personnel must meet.

- *NENA i3 Technical Requirements Document*. NENA VoIP/ Packet Technical Committee Long-Term Definition Working Group. September 2006. http://www.nena.org/media/files/08-751_20060928.pdf—This document provides requirements for a NENA-recommended standard for the i3 architecture for end-to-end emergency calling over IP networks.

- *Requirements for Emergency Context Resolution with Internet Technologies*. Internet Engineering Task Force. August 2006. http://www.ietf.org/internet-drafts/draft-ietf-ecrit-requirements-12.txt—This document enumerates requirements for emergency calls placed by the public using VoIP and general Internet multimedia systems, where Internet protocols are used end-to-end.

- The ATIS-ESIF Next Generation Emergency Services (NGES) Subcommittee will define a new messaging and interaction protocol between PSAPs and Emergency Services Networks that goes significantly beyond the paradigms that exist to provide those services today. Various summaries and briefing materials are available at the NGES Subcommittee website at http://www.atis.org/esif/nges.asp. The NGES messaging and interaction protocol will be specified as an American National Standard (ANS). Messaging interfaces have been adopted for trial use.

- *IP PSAP 9-1-1 System Features and Capabilities Operational Information Document (OID)*. NENA VoIP PSAP Operations Features/Capabilities Work Group. June 2004. http://www.nena.org/9-1-1OperPractices/OpsInfoDocs/NENAopsOIDipPSAP060404final.pdf—This OID contains a list of capabilities or features that are expected to be supported in a PSAP using IP-based 9-1-1 equipment and software developed in an open architecture environment that will allow interoperability at all levels of the 9-1-1 network, regardless of vendors.

Appendix A: Acronyms

3GPP	3rd Generation Partnership Project
ACN	Automatic Collision Notification
ALEC	Alternate Local Exchange Carrier
ALI	Automatic Location Identification
ANI	Automatic Number Identification
ANS	American National Standard
ANSI/AIAA	American National Standards Institute / American Institute of Aeronautics and Astronautics
APCO	Association of Public Safety Communications Officials
ATIS-ESIF	Alliance for Telecommunications Industry Solutions – Emergency Services Interconnection Forum
CAD	Computer Aided Dispatch

CAP	Competitive Access Provider
CLEC	Competitive Local Exchange Carrier
CMRS	Commercial Mobile Radio Service
COTS	Commercial Off-the-Shelf
CPE	Customer Premises Equipment
CSR	Customer Service Representative
E9-1-1	Enhanced 9-1-1
EIA	Electronics Industry Alliance
EMS	Emergency Medical Services
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
FHWA	Federal Highway Administration
GIS	Geographic Information Systems
GPS	Global Positioning System
HAZMAT	Hazardous Material
HMI	Human-Machine Interface
IETF	Internet Engineering Task Force
ILEC	Independent Local Exchange Carrier
IM	Instant Message
IP	Internet Protocol
IT	Information Technology
ITU	International Telecommunication Union
LAN	Local Area Network
LEC	Local Exchange Carrier
LSP	Local Service Provider
MDT	Mobile Data Terminal

NENA	National Emergency Number Association
NG9-1-1	Next Generation 9-1-1
NGES	Next Generation Emergency Services
NRIC	Network Reliability and Interoperability Council
OID	Operational Information Document
OSI	Operating System Interface
PCS	Personal Communications Services
PDA	Personal Digital Assistant
PII	Personally Identifiable Information
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network
RMS	Records Management System
SDO	Standards Development Organization
SMS	Short Message Service
SOP	Standard Operating Procedure
TCP	Transmission Control Protocol
TIA	Telecommunications Industry Association
TSP	Telematics Service Provider
TTY/TDD	Teletypewriter / Telecommunications Device for the Deaf
USDOT	United States Department of Transportation
USTA	United States Telephone Association
VoIP	Voice over Internet Protocol
VRI	Video Remote Interpreter
VRS	Video Relay Services

Appendix B: Glossary

9-1-1	A three-digit telephone number to facilitate the reporting of an emergency requiring response by a public safety agency.
9-1-1 Enterprise Operations	The set of functions performed to fulfill the mission of the 9-1-1 community. The 9-1-1 Enterprise Operations layer is an element of the NG9-1-1 Community Model that illustrates the collection of the enterprise segments identified for NG9-1-1.
9-1-1 PSAP Operations Segment	The element of the NG9-1-1 Community Model that represents the set of activities used by PSAP call takers to receive, process, and relay emergency calls and data.
9-1-1 System	The set of network, database, and customer premises equipment (CPE) components required to provide 9-1-1 service.
9-1-1 System Administration Segment	The element of the NG9-1-1 Community Model that represents the set of activities needed to accommodate functions such as collaboration, task assignment, training, and configuration of the 9-1-1 Enterprise.
9-1-1 System Operations & Network Support Segment	The element of the NG9-1-1 Community Model that represents of activities and systems to manage, support, and protect the 9-1-1 technology infrastructure.
Activity	See "Functional Activity."

Alternate Routing	The capability of directing 9-1-1 calls to a designated alternate location(s) if all 9-1-1 trunks are busy or out of service. May be activated upon request or automatically, if detectable, when 9-1-1 equipment fails or the PSAP itself is disabled.
American Sign Language	System of hand and body movements used to communicate concepts rather than complete sentences. The grammatical structure is different from standard English.
Analog	A representation of an object that resembles the original. Analog devices monitor conditions, such as movement, temperature, and sound, and convert them into comparable electronic/mechanical patterns. For example, an analog watch represents the planet's rotation with the rotating hands on the watch face.
Association for Public Safety Communications (APCO)	APCO International is a not-for-profit organization established in 1935 and is the world's largest organization dedicated to public safety communications. Members rely on APCO for their professional needs—from examining standards and issues to providing education, products and services, and frequency coordination services.
Automatic Collision Notification (ACN)	The process of identifying that a motor vehicle has been involved in a collision, collecting data from sensors in the vehicle, and communicating that data to a PSAP.
Automatic Location Identification (ALI)	The automatic display at the PSAP of the caller's telephone number, the address or location of the telephone, and supplementary emergency services information.
Automatic Location Identification (ALI) Database	The set of ALI records residing on a computer system.
Automatic Number Identification (ANI)	Telephone number associated with the access line from which a call originates.
Backup Public Safety Access Point (Backup PSAP)	Typically, a disaster recovery answering point that serves as a backup to the primary PSAP and is not collocated with the primary PSAP.
Busy Tone	An audible signal indicating a call cannot be completed because the called access line is busy. The tone is applied 60 times per minute.
Call	For the purposes of this NG9-1-1 Concept of Operations document, any real-time communication—voice, text, or video—between a person needing assistance and a PSAP call taker.
Callback	The ability to recontact the calling party.
Callback Number	A telephone number used by the PSAP to re-contact the location from which the 9-1-1 call was placed. The number may or may not be the number of the station used to originate the 9-1-1 call.

Call Delivery	The capability to route a 9-1-1 call to the designated selective router for ultimate delivery to the designated PSAP for the caller's ANI/KEY.
Call Routing	The capability to selectively direct the 9-1-1 call to the appropriate PSAP.
Call Taker	As used in 9-1-1, a person (sometimes referred to as a telecommunicator) who receives emergency and non-emergency calls by telephone and other sources, determines situations, elicits necessary information, and relays essential information to dispatches, staff, and other agencies as needed using telephony and computer equipment.
Call Transfer	The capability to redirect a call to another party.
Circuit-Switch	The establishment, by dialing, of a temporary physical path between points. The path is terminated when either end of the connection sends a disconnect signal by hanging up.
Community Model	A graphic tool used to build technical, operational, and policy understanding of the high-level system interfaces and information flows between system stakeholders. The Community Model aids in the capture and analysis of stakeholder needs.
Computer Aided Dispatch (CAD)	A computer-based system that aids PSAP call takers by automating selected dispatching and record-keeping activities.
Customer Premises Equipment (CPE)	Communications or terminal equipment located in the customer's facilities; terminal equipment at a PSAP.
Database	An organized collection of information, typically stored in computer systems, composed of fields, records (data), and indexes. In 9-1-1, such databases include the master street address guide, telephone number, and telephone customer records.
Digital	Traditionally, the use of numbers; the term comes from digit or finger. Today, digital is synonymous with computer.
Disaster	Any event that can cause a significant disruption to emergency calling capability.
Dispatch Operations	The distribution of emergency information to responder organizations responsible for delivery of emergency services to the public.
Dispatcher	As used in public safety, a person responsible for receiving and transmitting information pertaining to requests for emergency service and other related activities, tracking vehicles and equipment, and recording other important information using a phone, radio and other communications resources.
Emergency Call	A telephone request for public safety agency emergency services that requires immediate action to save a life, to report a fire, or to stop a crime. May include other situations as determined locally.

Emergency Medical Service (EMS)	A system providing pre-hospital emergency care and transportation to victims of sudden illness or injury.
Emergency Services Internetworks Layer	The element of the NG9-1-1 Community Model that illustrates the 9-1-1 systems, applications, and information repositories that seamlessly share emergency data to improve response.
Enhanced 9-1-1 (E9-1-1)	An emergency telephone system that includes network switching, database, and CPE elements capable of providing selective routing, selective transfer, fixed transfer, caller routing and location information, and ALI.
Enterprise	A set of services created to fulfill the mission of an organization or community. The highest level of system functionality.
Enterprise Operations	See "9-1-1 Enterprise Operations."
Enterprise Segment	High-level grouping of related system services that address major and distinct portions of the system or enterprise.
Fixed Transfer	The capability of a PSAP attendant to direct a 9-1-1 call to a predetermined location by depressing a single button.
Firewall	The primary method for keeping a computer secure from intruders. It allows or blocks traffic into and out of a private network or the user's computer.
Functional Activity	Bounded piece of work to be performed on or with the system that describes the people involved, the process workflow steps, and the technology used.
Gateway	The point at which a circuit-switched call is encoded and repackaged into IP packets; equipment that provides interconnection between two networks with different communications protocols; two examples are packet assembler/disassemblers and protocol converters.
Geographic Information System (GIS)	A computer software system that enables one to visualize geographic aspects of a body of data. It contains the ability to translate implicit geographic data (such as a street address) into an explicit map location. It has the ability to query and analyze data in order to receive the results in the form of a map. It also can be used to graphically display coordinates on a map (i.e., latitude/longitude) from a wireless 9-1-1 call.
Geographic Layer	The element of the NG9-1-1 Community Model that illustrates the geographic scope of a system or enterprise. In the NG9-1-1 Community Model, the Geographic Layer is depicted as a map of the U.S., emphasizing the decentralized nature of the system of systems.
Global Positioning System (GPS)	A satellite-based location determination technology.

International Telecommunications Union (ITU)	The telecommunications agency of the United Nations established to provide worldwide standard communications practices and procedures. Formerly CCITT.
Internet Engineering Task Force (IETF)	The lead standards-setting authority for Internet protocols.
Internet Protocol (IP)	The set of rules by which data is sent from one computer to another on the Internet or other networks.
Internetwork	To go between one network and another; a large network made up of a number of smaller networks.
Interoperability	The capability for disparate systems to work together.
Landline	Colloquial term for the Public Switched Telephone Network access via an actual copper or fiber optic transmission line that travels underground or on telephone poles. Used to differentiate the "wireless" connectivity of a cellular or personal communications services system. Also referred to as "wireline."
Local Exchange Carrier (LEC)	A telecommunications carrier under the state/local Public Utilities Act that provides local exchange telecommunications services. Also known as Incumbent Local Exchange Carrier (ILEC), Alternate Local Exchange Carrier (ALEC), Competitive Local Exchange Carrier (CLEC), Competitive Access Provider (CAP), Certified Local Exchange Carrier (CLEC), and Local Service Provider (LSP).
National Emergency Number Association (NENA)	A not-for-profit corporation established in 1982 to further the goal of "One Nation-One Number." NENA is a networking source and promotes research, planning, and training. NENA strives to educate, set standards, and provide certification programs, legislative representation, and technical assistance for implementing and managing 9-1-1 systems.
Network	An arrangement of devices that can communicate with each other.
Originating Subscriber Service Operations	The processes by which the public accesses NG9-1-1 through commercial networks, via various communications devices.
Overflow	The telecommunications term for the condition when there are more calls than the primary network path is designated to handle. This condition invokes the need to perform some form of call treatment, such as busy signals or alternate routing.
Packet	Logical grouping of information that includes a header containing control information and (usually) user data. Packets are most often used to refer to network layer units of data. The terms datagram, frame, message, and segment are also used to describe logical information groupings at various layers of the Operating System Interface (OSI) reference model and in various technology circles.

Packet-Switch	A network technology that breaks up a message into small packets for transmission. Each packet contains a destination address. Thus, all packets in a single message do not have to travel the same path. As traffic conditions change, they can be dynamically routed via different paths in the network, and they can even arrive out of order. The destination computer reassembles the packets into their proper sequence.
Personal Digital Assistant (PDA)	Small, handheld device used to store address book information, telephone numbers, personal contacts, and other personal information.
Protocol	A set of rules or conventions that govern the format and relative timing of data in a communications network. There are three basic types of protocols: character-oriented, byte-oriented, and bit-oriented. The protocols for data communications cover such activities as framing, error handling, transparency, and line control.
Public Safety Answering Point (PSAP)	A facility equipped and staffed to receive 9-1-1 calls; a generic name for a municipal or county emergency communications center dispatch agency that directs 9-1-1 or other emergency calls to appropriate police, fire, and EMS agencies and personnel.
Public Switched Telephone Network (PSTN)	The network of equipment, lines, and controls assembled to establish communication paths between calling and called parties in North America.
Redundancy	Duplication of components, running in parallel, to increase reliability; A backup system (either a device or a connection) that serves in the event of primary system failure.
Requirement	A statement describing what the system must possess in order to be acceptable; the system is defined as one that fulfills all of the requirements.
Router	An interface device between two networks that selects the best path to complete the call even if there are several networks between the originating network and the destination.
Selective Routing (SR)	Direction of a 9-1-1 call to the proper PSAP based on the location of the caller.
Selective Transfer	The capability to convey a 9-1-1 call to a response agency by operation of one of several buttons typically designated as police, fire, and emergency medical.
Service Provider	An entity providing one or more of the following 9-1-1 elements: network, CPE, or database service.
Short Message Service (SMS)	A text message service that enables messages generally no more than 140–160 characters in length to be sent and transmitted from a cellular telephone. Short messages are stored and forwarded at SMS centers, which means you can retrieve your messages later if you are not immediately available to receive them.
Spatial	Concept of describing a space or area of space.

Stakeholder	An individual or group with an interest in the success of a project in delivering intended results.
Telecommunications Device for the Deaf (TDD)	Also known as TTY (see Teletypewriter [TTY]).
Telecommunications Industry Association (TIA)	A lobbying and trade association, the result of the merger of the USTA (United States Telephone Association) and the EIA (Electronic Industries Association).
TCP (Transmission Control Protocol)	The set of rules within the TCP/IP protocol suite that ensures that all data arrives accurately and 100-percent intact at the destination.
Telematics	The system of components that supports two-way communications with a motor vehicle for the collection or transmission of information and commands.
Telephony	The electronic transmission of the human voice.
Teletypewriter (TTY)	Also known as TDD. A device capable of information interchange between compatible units using a dial-up or private-line telephone network connections as the transmission medium.
Transfer	A feature that allows the PSAP call takers to redirect a 9-1-1 call to another location.
Transmission Control Protocol/ Internet Protocol (TCP/IP)	A layered set of protocols (sets of rules) used to connect dissimilar computers together. TCP provides the transport service required by the application layer. The TCP layers in the two host computers that are sending data will communicate with each other to ensure reliable data packet transport. IP provides the service user to deliver the datagram to its destination. This layer provides the routing through the network and the error messages if the datagram is undeliverable.
Voice over Internet Protocol (VoIP)	A set of rules that provides distinct packetized voice information in digital format using the Internet Protocol. The IP address assigned to the user's telephone number may be static or dynamic.
Wireless	In the telecommunications industry, typically refers to mobile telephony and communications through hand-held devices that make a connection using radio frequency (in particular frequency bands often reserved for mobile communications) for personal telecommunications over long distances.
Wireline	Standard telephone and data communications systems that use in-ground and telephone pole cables. Also known as landline or land-based.

Notes