Task Force on Optimal Public Safety Answering Point Architecture (TFOPA)

Working Group 3 Report: Funding Sustainment Model

December 2, 2016

Table of Contents

Contents

1 Introduction

The Task Force on Optimal PSAP Architecture (TFOPA) is a federal advisory committee chartered under the Federal Advisory Committee Act (FACA) to provide recommendations to the Federal Communications Commission (FCC). In its Charter promulgated by the Commission, TFOPA was asked to " . . . examine the current structure and architecture of the nation's Public Safety Answering Points (PSAPs) in order to determine whether additional consolidation of PSAP facilities and architecture would promote greater efficiency of operations, safety of life, and cost containment, while retaining needed integration with local first responder dispatch and support."[1] TFOPA organized itself around three workgroups:

- Optimal Approach to Cybersecurity for PSAPs
- Optimal Approach to Next Generation 9-1-1 (NG9-1-1) Architecture Implementation by PSAPs; and
- Optimal Approach to NG9-1-1 Resource Allocation for PSAPs

In January 2016, TFOPA adopted a final consolidated report reflecting the work of all three workgroups.[2]

Workgroup 3 observed that "existing fee collection systems unquestionably are under increasing strains," as states " . . . continue to face challenges in fitting emerging services into existing funding mechanisms."[3] In researching these challenges, the workgroup studied a variety of factors relating to an "optimal approach to NG9-1-1 resource allocation," ranging from previous studies on the same subject, diversion of 9-1-1 funding, the potential role of federal grants, effective state and regional coordination, and potential future funding options. The adopted final report provided a set of recommendations to help public safety leadership and local leaders make informed decisions about such matters.

As part of the second year of its Charter, TFOPA (and, specifically, Workgroup 3) was asked by the Commission to "develop a funding sustainment model that can be used by state and 9-1-1 authorities to calculate their financial needs to support a transitional NG9-1-1 implementation." That model should

- Enable 9-1-1 authorities and state and local decision makers to identify current contribution sources; and
- Factor in other potential sources, like the network connection fees described in initial report

Also, to the extent possible, the model should also include a breakdown of "common costs" for PSAPs, recognizing that a funding model should be sensitive to the nature and type of costs the mechanism would fund.

To undertake its task, Workgroup 3 organized itself around two subgroups: one dealing with common costs, and the other with a sustainment-funding model. This report is organized in that fashion. Cost components cover a wide range of legacy and potential categories, while the funding sustainment section works from the funding policy principles articulated in the first-year report, and covers the current 9-1-1 funding environment, along with potential new funding mechanisms. The latter moves beyond the first-year report, and provides specific recommendations on federal and state implementation grants, along

[1] FCC, "Charter of the Federal Communications Commission's Task Force on Optimal PSAP Architecture," Washington DC, 2014. *See* https://transition.fcc.gov/pshs/911/TFOPA/FAC_Optimal_PSAP_Architecture_Charter_101014.pdf.
[2] FCC, Task Force on Optimal PSAP Architecture, "Adopted Final Report," January 29, 2016. *See* https://transition.fcc.gov/pshs/911/TFOPA/TFOPA_FINALReport_012916.pdf
[3] Ibid, 153.

with options for a "network connection fee" to address emerging communication technology that has the capability to access 9-1-1 services.

2 TFOPA Working Group 3 Members

Name	Organization Representing	Title	Sub-Group Participation
John Adams	FCC	FCC Liaison	
Work Group Leadership			
James D. Goerke	Texas 9-1-1 Alliance	CEO	Voting Member Chairman WG3
Mary Boyd	West Corporation	VP	Voting Member Leader Subgroup 1
Donald Brittingham	Verizon	VP Public Safety Policy	Voting Member Leader Subgroup 2
Workgroup Members			
Alicia Burns	The Digital Connection		Voting Member SG1, SG2
Brad Ramsay	NARUC	General Counsel	SG2
Brian Fontes	NENA	CEO	Voting Member SG1, SG2
Brian O'Hara			
Cheri Lynn Rockwell	City of Tracy, CA Police Department	Supervisor	SG1
Chris Littlewood	Center for Public Safety Innovation, St. Petersburg College	Instructional Technology Coordinator	Voting Member
Dan Sawicki	Motorola Solutions	Dir of Applications, Product Strategy/NG9-1-1 Solutions	Voting Member SG1, SG2
Dana Wahlberg	Dept. of Public Safety, Emergency Comm. Networks, State of Minnesota	9-1-1 Program Manager	Vice Chair TFOPA
Dave Sankey	Nebraska Public Service Commission	NG9-1-1 Director	SB2
Gene Hand (Retired)	Nebraska Public Service Commission	Director, NPSC Communications Department	SG2
Gerald Jaskulski	US Dept. of Homeland Security	OEC, Policy and Planning Branch	SG1

Name	Organization Representing	Title	Sub-Group Participation
Jeff Wittek	Airbus DS Communications	Chief Strategic Officer	Voting Member
Jody Farnsworth			
Joe Benkert	Boulder Regional Emergency Telephone Service Authority	Attorney	SG1, SG2
Joe Heaps	National Institute of Justice, US Dept. of Justice	Program Manager	Voting Member SG2
Larry Hatch	Oregon APCO/NENA	Assistant Director (Retired) Washington Co. Oregon 9-1-1	Voting Member SG1, SB2
Laurie Flaherty	NHTSA USDOT	Coordinator, National 9-1-1 Program	Voting Member SG1
Leah Missildine			
M. Teresa Hopkins	Telecom Regulatory Commission, Navajo Nation	Acting Executive Director	
Mark Fletcher	AVAYA	Chief Architect, Public Safety Solutions	Voting Member
Rebecca Beaton	WUTC	Infrastructure Analyst	SG1
Sean Petty	iCERT	Senior Technology Specialist, MCP	Voting Member
Steve Souder	Fairfax County VA	Director Dept. of 9-1-1/Public Safety Comm.	Chairman TFOPA
Tim Schram	NARUC, Nebraska Public Service Commission	Commissioner	Voting Member SG1, SG2
Tracy Felty	Saline County, IL	E9-1-1 Director	Voting Member
William Anderson			
William Haas	T-Mobile	Senior Corporate Counsel, Legal Affairs	SG2

3 Executive Summary

As the "First TFOPA Report" observed, "[o]ur nation's 9-1-1 system for emergency communications constitutes a remarkable achievement over the past half-century."[4] But, those systems supporting today's emergency communications are over 48 years old, and are lagging behind communications technology that continues to evolve away from an historical "circuit switch" environment into a more mobile array of Internet Protocol (IP) services that represents both challenges and opportunities to 9-1-1 communications. As a result, the public safety community and 9-1-1 communications industry are actively pursuing the "next generation" of 9-1-1 (NG9-1-1) that both addresses the nature of today's communications technology, and takes advantage of the above opportunities to improve critical public safety services.

However, that migration to NG9-1-1 requires financial resources sufficient to support existing services, along with the cost of the transition itself. As the TFOPA Final Report also pointed out,

> *Some argue that current funding mechanisms are too complex and inconsistently applied across both (i) jurisdictions and (ii) the services capable of connecting callers to the 9-1-1 systems. States continue to face challenges in fitting emerging services into existing funding mechanisms.*[5]

As part of the second year of its Charter, TFOPA (and, specifically, Workgroup 3) was asked by the Commission to "develop a funding sustainment model that can be used by state and 9-1-1 authorities to calculate their financial needs to support a transitional NG9-1-1 implementation."[6] This report reflects that study.

Section 4, *The Nature of 9-1-1 Cost and Cost Recovery*, represents the technical and operational elements within a 9-1-1 system that a 9-1-1 Planning Authority must consider as costs when developing a strategic plan for the implementation of NG9-1-1. While 9-1-1 features, functionality and PSAP operational costs have a variety of cost recovery funding sources that vary from state to state, all costs and revenue sources should be factored into the development of such planning. The First TFOPA Report provides a good foundation for understanding the technical aspects of 9-1-1 and NG9-1-1. This report expands on the original report to provide a more thorough understanding of both the legacy 9-1-1 system components that drive cost, as well as NG9-1-1 enhancements that should be included through the various stages of the NG9-1-1 Maturity Model.

Section 4 is essentially designed to help educate stakeholders on the nature of Cost within the 9-1-1 Ecosystem, while providing the reader with insight into the policy, governance and planning that structures the deployments and management of 9-1-1 throughout the United States. The section identifies the cost components associated with the various governmental entities involved in the planning and operations of 9-1-1; and documents the government roles and responsibilities that factor into planning and managing 9-1-1 costs. With the NG9-1-1 Maturity Model as a framework, Work Group 3 expanded the original report to go beyond the overview of NG9-1-1 Architecture and includes additional details of the

[4] First TFOPA Report, 152.
[5] Ibid, 153.
[6] Ibid

Legacy and NG9-1-1 Network and Call Routing cost components, as well as significant detail on the equipment and associated costs necessary to answer and operate a 9-1-1 PSAP.

In Section 5, TFOPA examines the various funding components that comprise its *Funding Sustainment Model*. Using its earlier analyses from the First TFOPA Report and its G*uiding Policy Principles for 9-1-1 Funding* as a guide,[7] this report provides a closer examination of current 9-1-1 funding mechanisms by evaluating how market trends have impacted, and can be expected to impact, the 9-1-1 fees on communications services that are relied on for 9-1-1 funding support. Our examination confirms that consumer preferences for communications services have changed dramatically in recent years, and can be expected to continue to change in the future, as market demand shifts from traditional voice services to voice-over-IP services and data services. This market shift creates significant variability in the amount of funds available for 9-1-1 services, making it difficult to rely on such funding mechanism for long-term sustainability. TFOPA recommends that state and local 9-1-1 authorities regularly review the impacts of the changing communications market on 9-1-1 funding, and we make some recommendations as to how such information might be included in a *Funding Sustainment Model*.

In consideration of the increasing variability of current funding mechanisms, TFOPA evaluated other potential funding options that could provide additional sources of funding for federal, state, local and tribal, authorities as they transition to NG9-1-1 services. First, recognizing the challenges that such new mechanisms may present, we believe that federal, state, local and tribal 9-1-1 authorities should make an effort to maximize funding from widely accepted funding mechanisms before instituting new ones. For example, we reiterate our earlier recommendation to establish 9-1-1 fees for prepaid wireless and VoIP services where they are not currently authorized, as this would provide additional 9-1-1 funding while promoting parity with comparable services. TFOPA also recommends the authorization of additional funding through federal and state grants, noting that the availability of such funds would act as a catalyst to spur NG9-1-1 deployment and provide the additional capital funds required for new NG9-1-1 system components including those that may be shared among federal, multiple state, local and tribal jurisdictions. Finally, we continue our analysis of the Network Connection Fee concept identified in the First TFOPA Report. While we do not make any specific recommendations regarding the use of such a fee, we identify several potential options for its use and examine the impacts of each of these options on consumers, competition, and available 9-1-1 funding.

In Section 6, TFOPA presents a *Funding Sustainment Model* that federal, state, local and Tribal 9-1-1 authorities might use as a tool to more effectively evaluate their current and future funding requirements. This model includes the various cost components of 9-1-1 and NG9-1-1 that are identified in Section 4, and which are likely to be incurred as systems transition through the various stages of the NG911 Maturity Model, and the various funding components described in Section 5, including current mechanisms and potential new sources of funding. By regularly assessing future estimates of costs and available funds, federal, state, local and Tribal authorities will be in a better position to plan for future deployments and address funding shortfalls in advance of when they are needed.

[7] *See* First TFOPA Report, 154.

4 Common Costs of 9-1-1 Systems

This section of the Report provides a broader description of the common costs that are incurred in the deployment of 9-1-1 and NG9-1-1 systems, and thus, should serve as a useful tool for 9-1-1 authorities engaged in strategic planning. The development of such plans requires a thorough understanding of the plan elements and their associated costs, and this report is designed to aid 9-1-1 authorities in understanding both the historical and current cost elements of Enhanced 9-1-1 systems, referred to in this report as legacy 9-1-1 systems, as well as new cost elements incurred as these systems transition towards fully functional Next Generation 9-1-1 (NG9-1-1) systems. Importantly, this report does not identify specific cost amounts as such costs are determined based on specific design criteria of a 9-1-1 system. Federal, state, local and tribal 9-1-1 authorities should consider a process whereby cost estimates can be obtained to meet their specific design requirements.

To achieve the end state of a fully functional NG9-1-1 system, 9-1-1 authorities must transition their legacy 9-1-1 systems through various stages of development and implementation. To account for each of these stages, TFOPA used the *NG911 Maturity Model* that was developed in conjunction with an NG9-1-1 cost study being undertaken by the National 911 Program.[8] The *NG911 Maturity Model* uses the stages of NG9-1-1 deployment identified by the National 911 Program in its 2009 NG911 Transition Plan but adds additional stages to provide a broader view of the state of NG9-1-1 implementation. TFOPA believes this model will help to provide state and local 9-1-1 authorities with better information about NG9-1-1 components and their associated costs.

This *NG911 Maturity Model* includes five stages of NG9-1-1 implementation, which can be described as follows:

- **Legacy** – The Legacy stage is characterized as the point in time where 9-1-1 services are provided by the traditional incumbent local exchange carrier (ILEC) with circuit-switched infrastructure and Automatic Location Identification (ALI) circuits. Planning for NG911 has yet to occur and technology serving the PSAP provides no advanced feature functionality.
- **Foundational** - The Foundational stage is where the groundwork and planning for NG911 implementation is initiated. NG911 feasibility studies are performed, Geographic Information System (GIS) data preparation commences, and IP networks may be implemented. NG911 systems are not yet operational, and system procurement is either planned or underway.
- **Transitional** – The Transitional stage is the tipping point where services have migrated partially from the legacy environment and the 9-1-1 services are enabled by an IP infrastructure. This marks the first stage where NG9-1-1 call routing services are implemented. The Emergency

[8] The National 911 Program is housed within the National Highway Traffic Safety Administration (NHTSA) at the U.S. Department of Transportation, and is a joint program of the National Telecommunications and Information Administration at the U.S. Department of Commerce. Based upon the Middle-Class Tax Relief and Job Creation Act of 2012, the National 9-1-1 Program is currently conducting a NG9-1-1 migration cost study. As part of that effort, the Project has generated a draft document outlining the "NG911 Functional and Technical Requirements" that describes the NG911 Maturity Model cited here. This is an ongoing project, and the descriptions and definitions involved may change before they are adopted for the next phases of the Project. The "NG911 Maturity Model" also uses the *PM ISE Information Interoperability Framework* as a foundational guide, as well as other common frameworks (e.g., SAFECOM's *Interoperability Continuum*). For more information on the *PM ISE Information Interoperability Framework*, see https://www.ise.gov/resources/document-library/ise-information-interoperability-framework. For more information on SAFECOM's *Interoperability Continuum*, see https://www.dhs.gov/sites/default/files/publications/interoperability_continuum_brochure_2_1.pdf.

Services IP Network (ESInet) is in place and delivering calls and location data to the PSAPs. At this point, a governance model has been established and a detailed NG911 roadmap will be developed.[9]

- **Intermediate** – The Intermediate stage developed the infrastructure and applications to incorporate call and data delivery interfaces. Business and performance elements are maturing and are reviewed in regular intervals to optimize operations.
- **End State** – The End State is the stage where the PSAPs are served by standards-based systems, from call origination to call handling at the PSAP. ESInets are interconnected and the call continuum can selectively deliver rich data to first responders in the field. The nation's 911system is fully interoperable with well-established policies and procedures to support operations. Early adopters of NG911 technologies may be on their third or fourth generation of core systems.

The *NG911 Maturity Model* is also based on an NG9-1-1 framework that encompasses various functions and systems that are transitional steps towards NG9-1-1. This framework, as outlined by the National 9-1-1 Program, consists of six domains, described as follows:

- **Business Domain** – The Business Domain consists of those planning and procurement activities that must take place to lay the groundwork for a transition to NG9-1-1. In addition to, for example, the development of statewide NG9-1-1 plans, this domain would also include certain governance and policy activities.
- **Data Domain** – The Data Domain captures the data management responsibilities of PSAPs, states and national-level authorities as they prepare for and implement NG9-1-1. This domain includes a shift from tabular location data to full dependency on geospatial data for the verification of caller location and routing of 911 calls.
- **Application and Systems Domain** – The Application and Systems Domain is used to describe the applications, systems and other core functions of the NG9-1-1 systems.
- **Infrastructure Domain** – The Infrastructure Domain is used to describe the infrastructure elements that interconnect the next-generation core services of the Applications and Systems domain.
- **Security Domain** – The Security Domain encompasses the network, facility, and personnel security associated with the implementation of NG9-1-1 services. Specifically, this domain focuses on the systems and applications required to develop a security posture appropriate for each stage of the NG9-1-1 Maturity Model.
- **Operations/Performance Domain** – The Operations/Performance Domain is used to describe the policies, procedures, and programs that are needed to effectively operate NG911 systems.

4.1 The Nature of 9-1-1 Costs and Cost Recovery

Understanding the nature of 9-1-1 costs requires a close examination of how 9-1-1 systems and services are funded and 9-1-1 costs are recovered. While there are efforts within each state to establish consistent statewide funding models, the way state and local 9-1-1 authorities recover the costs of 9-1-1 systems

[9] Governance is an evolving process within the path to NG9-1-1. An initial governance structure may well be setup during the foundational stage to help provide a foundation for system planning and coordination. On the other hand, that may not be the ultimate governance structure adopted to oversee and manage an operational system – a structure that may be naturally adopted later in the process.

varies significantly from one jurisdiction to another, and many states still maintain local funding of 9-1-1 through home-rule city ordinance authority or through local general revenue funds.

Historically, public safety services that utilized traditional 10-digit emergency telephone numbers relied on local tax revenues for funding. The implementation of Enhanced 9-1-1 (E9-1-1) systems significantly increased the costs incurred by these agencies, and most local communities throughout the United States found it difficult to support these higher costs through general revenue budgets. As a result, special funding models were created to cover the costs of these new technologies. In 1984, for example, Harris County, Texas, introduced the concept of placing a "special purpose" fee on telephone bills that resulted in "special purpose legislation" for the funding and operations of E9-1-1 systems. This funding concept, novel when introduced, led to the 9-1-1 funding policies and mechanisms that are largely used today by state and local authorities throughout the country.

Today, 9-1-1 funding mechanisms typically include a tax, fee, or surcharge (hereafter collectively referred to as "9-1-1 fees") on certain commercial communications services, and may include other public resources directed to 9-1-1, PSAP operations and the transition to NG9-1-1. The allowed uses of the proceeds of 9-1-1 fees are usually prescribed by state statute or rule. The National Association of 9-1-1 Administrators (NASNA) has provided TFOPA with a summary of 9-1-1 fees applicable in each state, and this information is provided in Appendix C. For a more detailed discussion of these 9-1-1 fees and 9-1-1 funding generally, see Section 5 of this report.

In some states, 9-1-1 fees were initially used to recover the costs incurred by the 9-1-1 System Service Providers (SSP) for delivering 9-1-1 calls, or aggregating, routing and delivering 9-1-1 calls to the PSAP. As IT systems were integrated into PSAPs, including 9-1-1 telephone systems, call recording systems, computer-aided dispatch (CAD) and other systems to add or improve PSAP functionality and efficiency, some jurisdictions permitted use of 9-1-1 fees to fund the purchase and maintenance of these systems. Some jurisdictions have permitted proceeds of 9-1-1 fees to be used only for routing, transport, recording and processing of 9-1-1 calls, but not for the "dispatch-side" of PSAP operations, including the costs of radios used by police, fire, and EMS officials in the field. Conversely, some jurisdictions are permitted to use 9-1-1 fees to recover costs for the aforementioned "dispatch side" of the 9-1-1 call continuum. Different jurisdictions also have different policies with respect to the use of 9-1-1 fees to recover PSAP personnel costs. Regardless of the policies that establish what costs can be covered through 9-1-1 fees, governmental accounting for those expenses are traditionally recognized as either non-Recurring or recurring, and these costs are described further in the sections that follow.

With the transition to NG9-1-1, costs, which may not have traditionally been associated with 9-1-1 services, may now fall within the purview of such services. This includes additional systems that are needed to support the additional types and formats of data which may be transmitted to PSAPs. CAD systems may include mobile functionality which provides access to CAD information to in-vehicle and handheld wireless computing devices for first responders. In addition, the transition to digital IP telecommunications technology has facilitated the delivery of multi-media information to first responders over broadband mobile networks, while also making PSAPs more vulnerable to cyber-attacks and requiring investments in cybersecurity. A closer integration of 9-1-1 call routing and transport functions with evolving dispatch and cybersecurity requirements may result in some jurisdictions deciding that it is reasonable and logical to fund such initiatives out of the proceeds of 9-1-1 fees.

4.1.1 Non-Recurring Cost

Generally, the state laws that promoted the planning, funding and deployment of 9-1-1 systems also established specific provisions for the collection and use of 9-1-1 fees. While the policies that govern the use of the funds vary from state to state, most 9-1-1 programs adopted a funding approach where the

capital costs associated with 9-1-1 system deployments were recovered at the time of deployment and commonly referred to as "Non-Recurring Cost". Capital costs associated with the 9-1-1 implementation include expenses of the networks, databases, 9-1-1 PSAP customer premise equipment, and other related ancillary equipment. Ancillary equipment is described in more detail later in this report but can include items such as back-up power resources, digital call recording equipment, and mapping systems. Governmental entities follow General Accounting Rules for documentation of all disbursements of funds.

It is also important to note that there may be other components required to make a PSAP operational and efficient, including, for example, CAD. In areas where 9-1-1 funding does not cover the non-recurring capital costs, government agencies, at all level, may find it necessary to purchase the necessary equipment from other revenue funds. In some areas of the country, PSAPs are turning to "Software As A Service" (SaaS) to avoid the significant investment in capital of some equipment purchases.

In an NG9-1-1 environment the historical methods of how the legacy 9-1-1 systems were funded should be re-evaluated to ensure the traditional models support regional or state-level strategic planning initiatives.

4.1.2 Recurring Cost

As 9-1-1 authorities transition from legacy to NG9-1-1 systems, they will incur recurring capital, operational and maintenance costs for various aspects of the 9-1-1 systems. Those costs typically include capital expenses for the 9-1-1 networks, database management, and customer premise equipment that also include vendor maintenance. Based on the experience of 9-1-1 authorities participating in TFOPA WG3, on average, 9-1-1 authorities could plan on spending 12% of the overall cost of the system annually on recurring maintenance expense. This expense could increase over the life of the systems.

Operational costs vary widely depending on the structure of the PSAP, though all PSAPs or 9-1-1 authorities incur personnel costs. Based on the policies specific to each PSAP, some entities may have personnel responsible for finance, training, technical support, and other functions, in addition to 9-1-1 telecommunicators, and supervisors, that need to be considered as budgets are developed for the recurring costs of the NG9-1-1 system. Planning for all costs, whether they are funded through dedicated special purpose 9-1-1 funding, fees, or through other taxing sources, need to be identified and included in the overall 9-1-1 budget.

4.2 Components/Elements of 9-1-1 Cost

4.2.1 Business Domain

Historically, 9-1-1 systems were developed in response to a desire by governmental and/or non-profit entities to simplify and improve the public's ability to obtain public safety assistance in the event of an emergency. Over the ensuing decades, this desire for improved emergency response has spawned the establishment of governing bodies, planning and procurement processes, local operational policies and procedures, and an array of ever-evolving state laws, local ordinances, and other public policies that are all aligned with that vision. The Business Domain consists of those activities that must take place to lay the groundwork for a transition to NG9-1-1, including governance, planning, policy, procurement, and implementation. For the purposes of this section, we consider the legal and public policy framework that supports 9-1-1 to be a component of Governance (Section 4.2.1.1), while Policy (Section 4.2.1.3) refers to those local policies and procedures that are employed in the operations of 9-1-1 systems and services.

4.2.1.1 Governance

As 9-1-1 systems have evolved, formalized governance frameworks were developed to ensure effective planning, support and oversight, as well as compliance with applicable laws and regulations. These governance frameworks were designed to ensure fair and equitable representation for the various governmental entities responsible for the planning and operations of the 9-1-1 systems, and those agencies engaged in emergency response efforts.

Local public safety agencies have played a critical role in the development of 9-1-1 systems throughout the U.S., and early governance structures were designed to meet the unique needs of these local governmental entities. They maintained control of local operating budgets and generally made all decisions as to the telephone services, radio systems, and other public safety systems to purchase and deploy, including when to implement 9-1-1 services in their area. The operational policies and business practices that guide these local entities are driven largely by state law, local ordinances, and other policies of the governmental agencies they support and to whom they dispatch emergency response service.

As 9-1-1 services have increased in importance and 9-1-1 systems evolved to include enhanced capabilities, the governance frameworks that guide those services and systems have also evolved. While only a very few states have a single state-level PSAP, the role of state governmental entities in the governance process has increased. The transition to NG9-1-1 will also likely involve additional changes to these governance frameworks to oversee and support the multijurisdictional arrangements made possible with IP-based technology. This shift to new governance structures will introduce new cost elements to support the planning, implementation and operation of NG 9-1-1 systems and services through the foundational, transitional and intermediate stages.

4.2.1.2 Planning

Planning for legacy 9-1-1 systems historically was accomplished by committees that included representation from public safety agencies (police, fire, EMS) and other local or regional planning entities with governing authority over 9-1-1 services. A 9-1-1 Coordinator led the Planning Committee, served as the plan facilitator, and worked with the vendor community to implement the 9-1-1 Plan. In addition to the 9-1-1 Coordinator, communities also hired specialists to support 9-1-1 database management and related address conversion projects. Planning efforts throughout the United States took place at the local, regional and state level of governments. A summary of the planning cost elements in the Legacy state included, but was not limited to the following:

- 9-1-1 Coordination (Local, Regional, State)
- Database Management (Local, Regional, State)
- Addressing Coordination

Today, many states have moved away from the local county-by-county planning model that was prevalent with legacy 9-1-1 systems, and are now engaged in regional and statewide planning initiatives. This includes the development of a statewide plan that outlines the transition to new systems and services, while also maintaining the partnerships with local and regional governmental entities. State-level planning can add new responsibilities at all levels of government, and can also bring efficiencies through the application of new technologies.

Planning becomes even more important as systems and geographic areas transition to the next generation of 9-1-1. By nature, NG9-1-1 fosters larger scale system arrangements that require effective planning and coordination among potentially multiple jurisdictions. Developing an effective NG9-1-1 transition plan is considered a “foundational” requirement, that naturally evolves through a concept of operations in a next

generation environment, and ultimately an adopted plan that address both the institutional and technical requirements necessary for an end-state NG9-1-1 system.

4.2.1.3 Policy

PSAPs utilize a variety of standards and policies in operating their 9-1-1 systems and public safety communications centers. These policies were established to promote effective processing of 9-1-1 calls and timely emergency response, and they have evolved significantly as the nation's 9-1-1 systems have evolved. They include: (a) call management policies such as call answering, handling, routing, and transfers; (b) data management policies such as call logging, recording and archiving; (c) accessibility policies including the use of Text telephone (TTY) and Telecommunication Device for the Deaf (TDD), relay services, and language translation; and (d) disaster recovery policies such as development of contingency plans, diversity facilities and the use of back-up PSAPs. Policies that support dispatch procedures of police, fire, and EMS personnel and any other response agencies served by the PSAP often include procedural details unique to each discipline and agency.

These policies may be developed locally in response to specific local needs, or they may be directed by state or local government agencies, and may be based on legal statutes, broader state policies, or local ordinances. Often, they are guided by standards or guidelines that are developed by state, regional, or national organizations that represent the public safety community. The National Emergency Number Association (NENA), for example, develops standards and procedures in a variety of areas related to 9-1-1 systems and services, with support from a committee structure comprised of public safety professionals and other experts.[10]

The transition to NG9-1-1 will require PSAPs, federal, state, local and Tribal 9-1-1 administrators, and other government officials to assess new standards of service made possible by NG9-1-1, identify the gaps involved with current standards, and implement the transition to the new standards in accordance with the overall transition. This transition will require that existing policies and procedures, including those identified above, be amended to account for the different operating environments and capabilities of NG9-1-1 consistent with the increased expectations of elected officials and the public. The development and implementation of these new policies will result in additional costs that must be considered by 9-1-1 system planners.

4.2.1.4 Procurement

Currently 9-1-1 systems are undergoing a fundamental change in infrastructure, technology, operation and culture. Legacy PSAPs accustomed to operating as relatively independent entities, must now consider uniformity, consistency, cooperation and collaboration in a way that was not previously important or required. If every PSAP and every 9-1-1 system is to successfully function as a part of a seamless system-of-systems, then those responsible for procurement of 9-1-1 technology and services must be cognizant of those 9-1-1 systems immediately adjacent, as well as those of the nationwide 9-1-1 system overall, and the procurement processes and contract language of others within that system. Procurement of technology and services that enables true interoperability is essential.

Planning for the initial purchase, replacement or upgrade of such equipment requires specific knowledge of the equipment, as well as an understanding of the procurement processes, knowledge of contracts and the ability to negotiate them. Ensuring that contractors can be held accountable for delivering the required equipment and services once a contract is awarded requires an understanding of what specific steps need to occur as part of the procurement process and a working knowledge of the essential role of

[10] *See* http://www.nena.org/?page=Standards

contract language. The importance of establishing contract terms and conditions "up front" cannot be overstated. Knowing and understanding the procurement process and the importance of contract language can have significant ramifications. Many PSAP managers and 911 authorities have learned from experience that implied understanding of contract language and a cursory understanding of procurement process are not sufficient to ensure success.

Two documents that provide some basic background on 9-1-1 procurement and contracts are "the NG911 Procurement Tool Kit"[11] and the "Next Generation 911 Procurement Guidance"[12] produced by the National 9-1-1 Program. While these documents provide basic introductory information, PSAP managers and 9-1-1 authorities are strongly encouraged to pursue all opportunities to learn about the procurement process, and the specific nuances of their jurisdiction.

An understanding of the potential challenges and benefits of collective procurement – i.e., multiple jurisdictions taking on the procurement process as a group – is also important to the procurement process. While governance issues may seem complicated and must be clearly delineated, and some controls must be surrendered, the benefits of cost sharing and the resulting cost reductions may make the challenges worth overcoming. Collective procurement may ensure that the interoperability made possible with NG9-1-1 is actually achieved. To illustrate several examples of statewide procurement, the State 911 Administrators of three states (New Hampshire, Texas and Massachusetts) shared their experiences in establishing contracts to build and operate components of their respective 9-1-1 and NG9-1-1 systems. This information, included in Appendix A, is provided to allow others to benefit from those experiences and to utilize the lessons these states have learned.

4.2.1.5 Implementation Roles and Cost Considerations

The adoption and implementation of telecommunications and information processing technologies for 9-1-1 have been evolutionary in response to the requirements of public safety authorities and the ever-changing communications market. Historically, each telephone service provider in a state delivered 9-1-1 calls from their customers directly to the PSAPs in the areas they serve. As more efficient call delivery techniques became available, a single 9-1-1 system service provider (SSP) was used to aggregate 9-1-1 calls from all telephone service providers, provide selective routing, and transport of the calls to the appropriate PSAPs. This fundamental change in the delivery of 9-1-1 services led to new service arrangements, new regulations, and the establishment of 9-1-1 fees to cover 9-1-1 system costs.[13] This change in market structure, which included the establishment of an SSP, was a significant development in 9-1-1 services, and led to the standardization of the 9-1-1 PSAP service architecture (PSAP components and services), and laid the groundwork for the development of a standard for NG9-1-1 and deployment of NG9-1-1 systems and services.

The transition to NG9-1-1 represents the next major evolution in 9-1-1 services. Just as the rate of adoption and implementation of 9-1-1 technologies and services varied widely among 9-1-1 authorities and states based on local or state 9-1-1 program planning requirements, the transition to NG9-1-1 will also occur at different rates for different PSAPs. Utilizing the NG911 Maturity Model outlined in this

[11] "The NG911 Procurement Tool Kit," http://www.its.dot.gov/ng911/pdf/USDOT_NG911_Procurement_ToolKit_2009.pdf.
[12] *See* http://www.911.gov/program_initiatives.html
[13] A significant portion of the costs of 9-1-1 service in rural areas in an SSP/Selective Routing environment was the distance-sensitive cost of analog transport of 9-1-1 calls to the Selective Router and back to the local PSAP. With the transition of much of the network to fiber and digital transmission techniques that are bandwidth sensitive and distance-insensitive, at least in pricing, the requirement of for such implicit subsidies has been questioned by some stakeholders.

report, and taking into account the political and governmental issues applicable to each jurisdiction, federal, state, local and Tribal 9-1-1 authorities will be better able to understand and evaluate the costs of the NG9-1-1 system.

Because decisions regarding PSAP system purchases, personnel and training, and policy and operations are often made at the local level, there is a wide variation among PSAPs in many of these areas. Urban PSAPs have different needs and often greater funding than rural PSAPs. PSAPs serving coastal jurisdictions may respond to different types of incidents and have different needs than PSAPs serving agricultural areas in the Midwest, mining communities, or mountainous areas. While there are common elements of training for personnel, training must also be customized for the CAD and other systems employed by the PSAP, and the business rules, policies and procedures unique to the PSAP and the agencies they dispatch. All the variations of NG9-1-1 system components, including staffing and training, have a direct impact on budgets and cost of 9-1-1 systems regardless if those costs are covered by dedicated 9-1-1 revenues streams, or general fund budgets. As 9-1-1 authorities advance through the various stages of the NG9-1-1 Maturity Model, government officials and 9-1-1 planning entities should partner to ensure that all appropriate costs are identified and revised as appropriate throughout the strategic planning process.

4.2.1.5.1 State Government Roles

States or state-level 9-1-1 authorities play a critical role in the planning and deployment of 9-1-1 services throughout their respective jurisdictions. Established by state or local statute in most areas of the country, these entities are responsible for the planning and deployment of various 9-1-1 program services. Program services include deployment of the legacy 9-1-1 systems, upgrades and integration of wireless or VoIP services as part of the 9-1-1 infrastructures, and deployment of NG9-1-1 (where it has occurred). Other program services supported by 9-1-1 authority agencies include 9-1-1 funds distribution, database management, mapping and addressing, training, public education, and other critical responsibilities as outlined by law. The costs of the program services offered by state or state-level 9-1-1 authorities are allowable by law and should be considered as part of the overall strategic plans for 9-1-1 and NG9-1-1 services implemented through various stages of the NG9-1-1 Maturity Model.

4.2.1.5.2 Federal Facilities

While most 9-1-1 systems are designed to support city, county or state public safety jurisdictions, there are communities where federal facilities, reservation, and military bases exist and house PSAP facilities consistent with other systems within an area. The federal PSAPs may be included as part of the critical infrastructure of a local 9-1-1 system design and may have costs that could be included as part of annual strategic plans and 9-1-1 budgets. Federally funded PSAPs such as those operated by the Department of Defense and the Department of Interior generally do not utilize surcharge funds to support their operation. However, a predictable and stable source of funding should be identified, to ensure that ALL PSAPs nationwide achieve an equitable level of technology and operations, to ensure a consistent level of service to ALL 911 callers.

4.2.2 Data Domain

The Data Domain addresses those data management responsibilities of PSAPs, states, and national-level authorities in the provision of 9-1-1 services. Fundamentally, it includes various types of location data used to identify the location of 9-1-1 callers, to route 9-1-1 calls, and to dispatch first responders to an incident, and it necessarily addresses the transition from tabular location data to full dependency on geospatial data. This domain also includes other data that is used, or is expected to be used, by first responders to improve situational awareness and emergency response.

4.2.2.1 MSAG, ALI and GIS

Initial location data developed and maintained by many first responders and PSAPs was the Master Street Address Guide ("MSAG"). The MSAG is a tabulation of street names and segments and addresses assigned within a street segment, and is used by the ANI/ALI database provider to validate that a service address (ALI data) associated with an ANI actually exists. As discussed earlier, a Selective Routing Database (SRDB) is used to identify the PSAP to which a 9-1-1 call from any service address should be routed, and which can also indicate the unique combination of first responder agencies to be dispatched to incidents at or around a specific location.

In addition to populating the SRDB when service is installed or activated at a given service address, the exchange carrier also populates an Automatic Number Information (ANI)/Automatic Location Information (ALI) database with the service number and service address when service is installed or activated. This is because it is not possible to transmit the service address information with the call over the traditional analog facilities used by an SSP to terminate 9-1-1 calls to PSAPs. Only the calling party's telephone number is available to PSAPs with traditional facilities and networks. Therefore, the service address is entered in a second database keyed to the telephone number in service at the address. When a 9-1-1 call is transmitted to a PSAP, a basic telephone modem and dedicated line is used to automatically access the ANI/ALI database, and retrieve the service address associated with the telephone number (ANI) from which the call was made.

For wireless calls, a pseudo-ANI (or p-ANI) associated with the location of the wireless system tower or antenna through which the call was placed is used to route the call. When the PSAP accesses the ANI/ALI database, the tower/antenna location as well as the caller's actual wireless telephone number (for use by the PSAP to reconnect the call if it is dropped) is retrieved. The ANI/ALI database is updated with the caller's actual location when the wireless provider determines it, and the location will be continually updated as the caller travels throughout the area.

Transition to NG9-1-1 essentially reflects the shift away from this tabular location data environment to full dependency on geospatial data used for the verification of caller location and ultimately the routing of 9-1-1 calls. This is not a small undertaking, and is a critical step in the transition process. The transition process itself ranges from collecting and maintaining the GIS data involved, to formatting the data to align with MSAG and ALI data and ultimately to provisioning the GIS data sets necessary to geospatially verify caller location and route 9-1-1 calls. The latter step is likely an intermediate/end-state process, though there may be transitional database resources along the way that support both legacy and next generation functions and protocols.

Because the development of MSAG and GIS data for 9-1-1 services is driven by PSAPs or other local agencies at the city and county level, it is believed that states have not played a significant role in development of GIS data for public safety purposes (and of public-safety quality), in the context of *legacy* 9-1-1. Moreover, even where jurisdictions have developed GIS data using the same GIS system and geodetic revision date, there may still be inconsistencies in their database structures and policies which will require conversion to be usable on a statewide scale, and require some parties to change their database structures and policies. For example, different database fields and abbreviations may be used. Where the GIS data is used by multiple departments within a jurisdiction for multiple purposes, this can pose additional complications and impose additional costs.

GIS is a critical part of NG9-1-1 deployment. Improved GIS data is necessary, because the implementation of end-state NG9-1-1 will require that selective routing be replaced with geospatial routing, which will allow the caller's location to be determined in real-time by the NG9-1-1 system and have that location compared to the geo-mapped jurisdictions of PSAPs to determine call-routing. As 9-1-

1 authorities advance through the various stages of NG9-1-1 implementation, the appropriate roles of MSAG, legacy ALI database management and GIS with advanced geo-spatial call routing will also evolve. This evolution will define the appropriate roles of these technologies and all costs associated with call routing and advanced data management, as well as the maintenance costs of those systems.

4.2.2.2 Additional Data (Local or Proprietary)

There is a variety of additional data maintained by or available to PSAPs and first responders to help facilitate emergency response. This includes data developed by PSAPs and first responder agencies, as well as data developed on a broader scale and accessed by PSAPs. PSAP and agency-developed data includes CAD incident and premise data (discussed in detail later in this report), which is retained for a period of years and may be flagged or accessible upon receipt of a call from the subject premises or a nearby location.

Fire departments will generally develop pre-plans for fighting fires at significant structures. These will start with the building plans, but the fire officials will remove information not relevant to emergency response at the structure, and add additional data such as where to position vehicles, location of sprinkler valves, elevator keys, etc. However, this data is usually loaded into firefighters' mobile data computers and not provided by the PSAP.

Other data sources include services such as CopLink and Smart911. CopLink is a service which allows law enforcement agencies to share data, and provides analytical tools. Data available through CopLink can include information on recent police stops, and other data, which is either too recent to have been incorporated into state or national databases or is not of a type which would be included in those databases. Smart911 allows residents of a jurisdiction that has subscribed to Smart911 to enter personal data into a database that will be available to the PSAP when the resident places a 9-1-1 call. TFOPA expects that additional information services and "apps" will be developed and marketed in the future as PSAPs transition to NG9-1-1.

Traditional data sources also include FBI and state criminal justice information systems (CJIS) databases including the National Crime Information Center database maintained by the FBI, wants and warrants databases, computerized criminal history systems and database and vehicle registration and driver's license databases maintained by the FBI and state criminal justice/law enforcement entities. These databases are typically accessed through secure dedicated digital IP-based networks. Network and data security for these sources is regularly audited such as the National Law Enforcement Telecommunications System (Nlets) and comparable state level secure networks and systems.

NG9-1-1 potentially provides the opportunity for a wide variety of data regarding a 9-1-1 call, the caller and the caller's location – data that can be used to improve situational awareness and emergency response. Such data may come from a variety of sources, both proprietary and public. There potentially will be costs associated with accessing such data, processing it, and storing it. In the early stages of transition (from legacy to transitional levels), much of this data may come from independent, single sources, and be propriety. Later, as system deployments migrate through intermediate to end-state levels of NG9-1-1, this data will become standards-based in nature, and allow sharing among system resources.

4.2.3 Applications/Systems and Infrastructure Domains

As described in the *First TFOPA Report*, "[t]he new paradigm of NG9-1-1 will be based upon system roles in an emergency services ecosystem . . ." as depicted in the diagram below.[14]

[14] *First TFOPA Report*, Figure 3-2, 23.

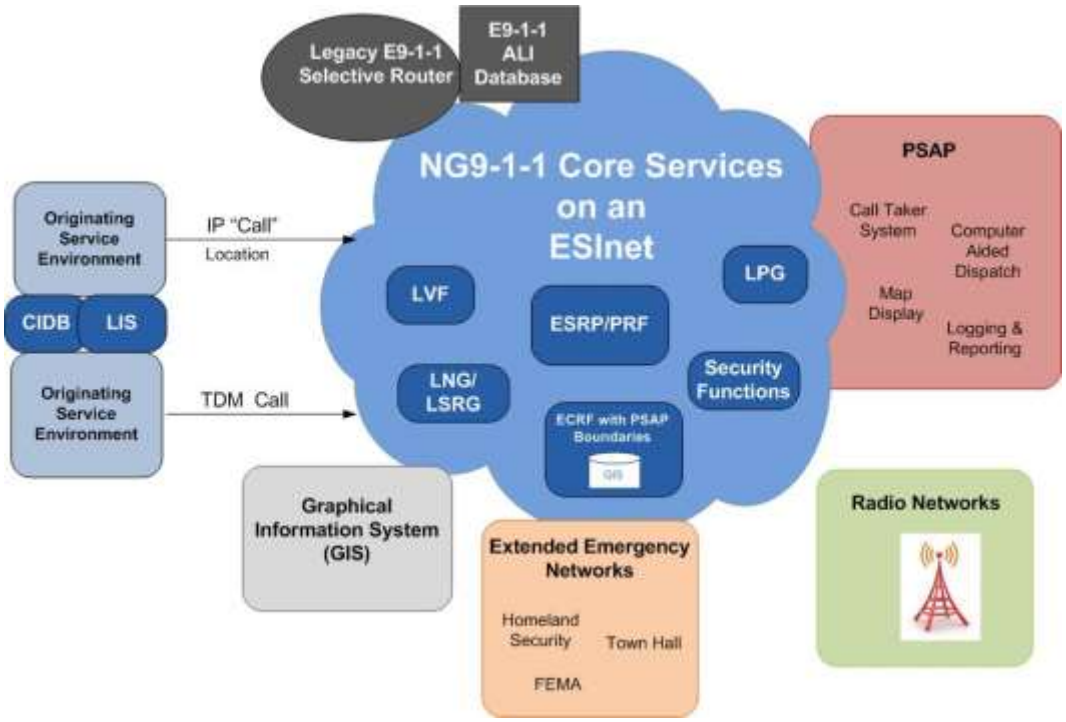


Figure 4-1: Next Generation 9-1-1 Emergency Services Ecosystem[15]

The Applications and Systems Domain is used to describe the applications, systems, and other core functions of the NG9-1-1 system as reflected above, while the Infrastructure Domain is used to describe the infrastructure elements that interconnect those core services. For the purposes of this report, we have combined these two domains into one section. For a more complete description of the components and functions involved, see the referenced report.

4.2.3.1 Physical Facilities and Related Costs

The PSAP is the 9-1-1 Call Center, equipped with special systems to efficiently process and record 9-1-1 calls and dispatch first responders. There are both primary and secondary PSAPs that are designed to support the needs of the local governmental jurisdictions. Primary PSAPs are responsible for answering and/or dispatching all 9-1-1 calls, or for answering all calls and transferring certain calls on to a secondary PSAP for dispatch. Where there are secondary PSAPs, all 9-1-1 calls are initially routed to a Primary PSAP, which may dispatch for law enforcement agencies, and in many primary/secondary PSAP implementations fire or emergency medical services (EMS) calls for assistance are transferred to a secondary PSAP which dispatches for those agencies. In a smaller number of cases, a fire and medical PSAP is the Primary PSAP, and calls for police assistance are transferred to a law enforcement PSAP.

The United States is served by over 6000 Primary and Secondary PSAPs, most of which have five or fewer telecommunicator/ dispatch positions. The range of facilities, personnel requirements and training varies within the communities served by the PSAP based on the amount of available funding and the needs of the public safety community. The 9-1-1 planning authorities need to be mindful of the vast amount of PSAP real estate established to support the thousands of police, fire and EMS responders.

[15] First TFOPA Report, 23.

While much of the physical facilities and real estate costs are absorbed by governmental agencies owning/operating the PSAP, 9-1-1 planning authorities should verify any facilities costs that may need to be supported through the 9-1-1 program in place. As 9-1-1 agencies migrate from the Legacy stage of the NG911 Maturity Model towards more shared IP-based technologies, consideration should be given to any economies of scale that could be realized through sharing of PSAP and/or training facilities. In addition to the facilities expenses, Section 4.2.3.3 provides information regarding the equipment that is needed to support the PSAP and its personnel.

There are several forms of other facilities, or outside plant, that require planning and consideration as 9-1-1 authorities migrate from legacy 9-1-1 systems towards achieving the end-state of a fully functional NG9-1-1 system. Facilities such as SSP networks and data facilities are critical elements of the 9-1-1 ecosystems, but the costs to support those facilities are not typically passed on to a 9-1-1 authority. The 9-1-1 networks and data services depicted in Figure 4-1, however, will be key factors within a 9-1-1 budget for non-recurring and recurring costs. 9-1-1 authorities should routinely monitor service provider costs and projections for enhancements as community's advance between the Legacy, Foundational, Transitional, Intermediate, and End-State stage of the NG911 Maturity Model. Facilities costs that could and should be considered in the 9-1-1 planning budget are those associated with the PSAPs, training facilities and data centers, as well as any administrative offices needed to accommodate personnel not considered part of the PSAP operations.

4.2.3.2 9-1-1 Network and Call Routing

9-1-1 networks are designed to operate as private, dedicated networks designed to meet the specific needs of 9-1-1 jurisdictions. The networks are designed based on requirements established by state and local government authorities, which require SSPs to aggregate 9-1-1 traffic from all (or almost all) telephone service providers within the state, and to route each 9-1-1 call to the appropriate PSAP. This required implementation of selective routing for all jurisdictions, and not just those that purchased selective routing, is an advanced feature of 9-1-1 service. Notwithstanding the general selective routing architecture of the 9-1-1 system, there are some local exchange service providers that continue to route 9-1-1 calls directly to the PSAP via trunk lines between the service provider switch and the PSAP. This generally occurs with small local exchange service providers whose service areas lie entirely within a PSAP's jurisdiction.

With statewide selective routing, each originating service provider (OSP) is generally required to deliver all 9-1-1 calls to the selective router(s) operated by the SSP, or the SSP is required to provide for transport of 9-1-1 calls from the OSP to the selective router.[16] In some more rural states, the SSP is required to provide the transport from local exchange providers to the 9-1-1 Selective Router(s). One reason an SSP would be required to provide for the transport would be to include the transport costs in the SSPs statewide-averaged rates, and effectively reduce the costs of transport and 9-1-1 service in high-cost rural areas. Because traditional analog, wireline-based transport costs can be distance-sensitive, rate averaging of transport costs by the SSP would provide an implicit subsidy for 9-1-1 services in these high cost areas, and thus, would serve the interest of achieving ubiquitous 9-1-1 service.[17]

[16] The FCC requires CMRS and VoIP providers to deliver 9-1-1 calls to the SSP Selective Router, although some states continue to require the SSP to provide the transport between even CMRS and VoIP OSPs and the Selective Router, notwithstanding FCC requirements.

[17] These implicit subsidies may remain even though the transport facilities have generally been replaced by fiber, and digital transmission modes which are priced by bandwidth rather than distance.

Once 9-1-1 calls reach the selective router, the switch looks up the caller's number (ANI) to access the "Emergency Service Number" (ESN) on which the call should be terminated in order to route the call to the correct PSAP.[18] The 9-1-1 calls are then transmitted over dedicated 9-1-1 trunks to the PSAP, via the end-office serving the PSAP. Some states have paired the 9-1-1 selective router(s) with a second switch on which the emergency services software package has been installed, to provide redundancy and diversity. Redundant and diverse transport facilities to the selective router(s) are also provided. PSAPs may also contract with service providers to provide redundant and diverse routing for 9-1-1 calls to the PSAP through two separate end offices, typically with the PSAP entrance facilities for the redundant transport facilities being on opposite sides of the building in which the PSAP is located.

The transport facilities between the end office serving the 9-1-1 caller and the 9-1-1 selective router are the same facilities by which the OSP exchanges intercarrier traffic with the LEC serving as the SSP. Once the 9-1-1 calls reach the PSAP, PSAP equipment automatically accesses the ANI/ALI database via modem interconnected over a dedicated line.

Since statewide 9-1-1 selective routing has been implemented, LECs (including the SSPs) have upgraded interoffice and intercarrier facilities to digital and fiber-based facilities. Deployment of NG9-1-1, which may require the deployment of digital IP-based network between the PSAP's serving end office(s) and the PSAP, will likely leverage these investments in newer technologies.

Wireless providers generally rely upon fiber facilities to connect their cell sites to their Mobile Switching Centers ("MSC"), where the wireless provider identifies the call as a 9-1-1 call and routes it to the selective router. FCC rules require that wireless service providers bear the cost of delivering 9-1-1 calls to the selective router, although some states require that SSPs bear this cost as with 9-1-1 calls from LEC customers.

Similarly, the FCC requires that VoIP providers bear the cost of transmitting 9-1-1 calls to the selective router. As is the case with wireless 9-1-1 calls, some states require that SSPs bear the cost of delivering VoIP-based 9-1-1 calls to the selective router. Some wireless and VoIP service providers contract with companies such as West Safety Services (formerly Intrado), Comtech (formerly TCS) and Bandwidth.com to manage their 9-1-1 traffic and transport 9-1-1 calls to the selective routers in the appropriate states.[19]

All costs for legacy 9-1-1 call routing, its networks and database have been identified and should be included as part of annual 9-1-1 authority budgets. However, as described above, the future of 9-1-1 call routing will ultimately be guided by geospatial resources that begin with location verification and ends with the routing of a 9-1-1 call to an appropriate PSAP. As the technology shifts from legacy architecture and system management costs are realigned, it is critical that 9-1-1 authorities plan for and accommodate the commensurate changes in associated costs.

4.2.3.2.1 IP Infrastructure and NG9-1-1

Some PSAPs currently employ and use IP-based infrastructure to access data in their internal operations. They likely use IP-based infrastructure for their internal computer/data networks. Their internal 9-1-1

[18] In the Public Switched Telephone Network (PSTN), a selective router is generally a Class 4 telephone switch or tandem office operated by a Local Exchange Telephone Company servicing the area. The switch is fitted with special software to support 9-1-1 routing and call delivery.

[19] A significant portion of the costs of 9-1-1 service in some rural areas in an SSP/selective routing environment was the distance-sensitive cost of analog transport of 9-1-1 calls to the selective router and back to the local PSAP. With the transition of much of the network to fiber and digital transmission techniques that are bandwidth sensitive and distance-insensitive; some stakeholders may which to examine the cost components as they transition to NG9-1-1.

telephone systems and non-9-1-1 telephone systems may well be digital and run on IP-based networks. As PSAPs prepare for the transition to NG9-1-1, those that already have IP-based networks in place for these internal systems will be NG9-1-1 ready as they replace and upgrade their 9-1-1 phone systems, call-logging systems, CAD systems, and other assets.

PSAPs use IP-based networks to access Nlets, FBI NCIC and other CJIS resources and other databases, and they may use the Internet to access data as well as browser-based text-to-911.

Some smaller and rural PSAPs are already subscribing to "hosted" PSAP systems/services, accessed through thin clients at the PSAP.[20] These PSAPs are likely subscribing to these systems primarily due to several cost benefits: (i) paying for the service through an affordable monthly per-seat fee, rather than having to amass the resources to meet the capital costs of procuring an on-site system; (ii) spreading the costs of the CAD system among multiple PSAPs that subscribe to the service; and (iii) avoiding the personnel costs for the variety of skilled IT personnel which may be required to maintain the PSAP system(s). In most, if not all cases, the hosted service is provided over digital IP-based facilities (possibly including the Internet).

As described elsewhere in this report, NG9-1-1 is a nationwide, standards-based, all-IP emergency communication solution to deliver voice and multimedia communications from a caller to a 9-1-1 center/PSAP, and ultimately responders in the field.[21] It will require high availability IP-based infrastructure to support both the delivery of requests for assistance, and to best process and respond to those calls. This will, in turn, require equipment and software to support IP communications. At the network level, resources must be provisioned (e.g. data centers) to house the equipment, data and software necessary for the transmission of calls and data in digital format over IP-based networks. For PSAPs that are not yet ready to transition to NG9-1-1, Legacy PSAP gateways will enable the NG9-1-1 system to emulate the current selective router-based system and work with legacy PSAP systems.

The transition to full IP-based 9-1-1 can or will occur as described above, and many PSAP systems today employ IP network infrastructure to support a variety of functions. Some of that network infrastructure may be successfully upgraded to serve as a full function NG9-1-1 Emergency Services IP Network (ESInet). ESInet architectures utilizing IP network capabilities are deployed based on public safety's needs and readiness. Today, ESInets are used to replace legacy selective router and ALI functionality, and will evolve over time to provide the full functionality of End State NG9-1-1. As shown in the NG911 Maturity Model, the implementation of IP selective routing may occur initially at the Foundational and Transition stages using more traditional data resources. However, geospatial routing is not likely to occur until the intermediate level and may not be fully functioning until End State NG9-1-1 is realized. Additional information regarding the NG9-1-1 architecture is documented in the *First TFOPA Report*.

As 9-1-1 call delivery and processing migrates from legacy 9-1-1 services to NG9-1-1, functions and related cost components will need to transition as well. Call routing functions will need to transition from trunk or selective routing to IP selective routing and ultimately to geospatial routing. Call handling functions will need to transition from legacy CPE to IP-based call handling systems. Location validation

[20] As Wikipedia describes it, "[a] **thin client** is a lightweight computer that is purpose-built for remote access to a server (typically cloud or desktop virtualization environments). It depends heavily on another computer (its *server*) to fulfill its computational roles. The specific roles assumed by the server may vary, from hosting a shared set of virtualized applications, a shared desktop stack or virtual desktop, to data processing and file storage on the client's or user's behalf. This is different from the desktop PC (fat client), which is a computer designed to take on these roles by itself." *See* https://en.wikipedia.org/wiki/Thin_client.

[21] *See* the Next Generation 911 NOW Coalition at: http://www.ng911now.org/about-ng911.

will transition from MSAG-based validation to geospatial validation. Delivery of the location information will shift from the use of dedicated ALI circuits to use of IP-based circuits and ultimately to delivery by PIDF-LO in the SIP header.[22] Event logging functions will transition from using proprietary data in separate systems to the use of end-to-end integrated logging. These are just examples of the types of changes that will need to occur as the transition is made to full end-state NG9-1-1 systems.

4.2.3.3 PSAP & 9-1-1 Authority Equipment

4.2.3.3.1 PSAP Infrastructure Elements:

In the typical legacy environment, PSAP equipment and software are predominantly located within the boundary of each PSAP (though remote positions associated with a particular PSAP may be present). Figure 4-1, provided earlier, illustrates how this PSAP equipment fits into the overall NG9-1-1 framework.

4.2.3.3.2 PSAP Telephone System/Customer Premise Equipment (CPE)

Equipment used for handling emergency 9-1-1 and non-emergency calls for service manages all communication from 9-1-1 callers, and includes the interfaces, devices and applications utilized by telecommunicators to handle 9-1-1 calls. This can also include administrative telephone systems used within an agency that are not integrated into the 9-1-1 equipment.[23] The CPE enables the reception of both emergency 9-1-1 calls and the vital incident information that is delivered in conjunction with those calls, e.g., ANI/ALI. Thus, it is the starting/entry point for the incident management workflow in the Dispatch Center/PSAP.

As legacy call handling solutions migrate to NG9-1-1, the solutions will evolve through the Foundational, Transitional, and Intermediate stages to the NG9-1-1 End-State of the Maturity Model by moving from supporting analog voice calls to supporting IP-based calls of various media types, e.g. voice, text, video, telematics, sensors, etc. The solutions will migrate from analog telephone equipment to IP-based call handling technology that consists of soft switches, databases, routers, and other equipment to support the new IP capabilities. The migration from analog technology to IP-based technology and the impact of that migration will vary based on the specific call handling architecture used, which is often vendor dependent. Typically, the event that has the most significant impact on cost is the initial transition from analog to IP-based technology. This usually results in a "fork lift" change of the back room equipment, and requires a significant upgrade of the client platform software. Once this platform technology migration occurs, the addition of new next generation capabilities is expected to be incremental in nature and facilitated mostly by software upgrades.

4.2.3.3.3 Recording/Logging:

The recording and logging functions in a PSAP is generally understood to include two solutions: (a) Instant Recall Recording (IRR); and (b) Long Term Recording (LTR). The IRR solution usually is an application that is local to the CPE workstations and it provides short term recording and playback capabilities of 9-1-1 telephony and radio dispatch audio traffic. An audio capture/replay function is used by PSAP personnel to listen, review and verify information from an incident or dispatch that is in progress or has recently taken place. The distinction between this solution and a LTR solution is that the

[22] PIDF-LO stands for "Presence Information Data Format Location Object." PIDF-LO is a standard developed by the Internet Engineering Task Force (IETF) used to represent an address/location in Extensible Markup Language (XML). SIP stands for "Session Initiation Protocol," and is a communications protocol for signaling and controlling multimedia communication sessions within Internet Protocol (IP) networks.
[23] Ibid, 75

IRR solution is used for very short periods, i.e. calls stored during a shift or day. Likewise, retention of the recording is very short usually due to hard drive space limitations on the workstations involved, and as specified by the PSAP's retention policies and procedures. A more detailed description of LTR logging solutions can be found in the appendix.

With respect to legacy logging and recording solutions and future migrations, the evolution through the various stages of the NG911 Maturity Model will progress from analog recording and logging solutions to digital IP-based solutions using the NENA i3 standard. These solutions can either be customer premise based or network based and are expected to support additional 9-1-1 media call types (*e.g.*, text, video), CAD systems, mapping and geospatial systems, i3 features, etc. Additionally, the recording and logging activities resulting from support of the new call types is expected to be included as part of the incident re-creation capabilities supported by i3 logging/recording platforms.

4.2.3.3.4 Mapping and Mapped ALI

Mapping is a critical component of the legacy PSAP equipment solutions, most notably within the call taking and incident management workflows. In these workflows, maps are typically part of the legacy 9-1-1 CPE call taking and CAD solutions. In both solutions, the map's value is manifested through the display of the 9-1-1 caller's location information and location of the incident, respectively, to which a responder is dispatched, and may include additional information such as premises notes (hazardous materials stored on-site, residence of individual known to be hostile to First Responders who possesses firearms, etc.) and prior incident flags.

Mapping became even more important with the rapid growth of wireless services in the 1990's. As wireless phone use increased, an increasing number of 9-1-1 calls to PSAPs were made using wireless devices. Coupled with the growth of wireless 9-1-1 calls was the introduction of 9-1-1 Phase I and Phase II wireless location capabilities, which were set forth by the FCC in Wireless Enhanced 9-1-1 rules established in 1996 and 2001, respectively. The rules drove the need for PSAPs to be able to identify the location of 9-1-1 callers using wireless phones.

Based on the location requirements established in Phase I and II of the FCC's E9-1-1 rules, mapped ALI solutions were developed to automatically plot 9-1-1 caller locations based on ALI when a call is answered in the PSAP. The mapped ALI solutions could be used as a stand-alone solution in conjunction with the 9-1-1 call taking and CAD solutions to assist in locating the caller and providing the appropriate dispatch response. As wireless technologies continued to evolve and new technologies such as VoIP were introduced, the sophistication of the mapping applications also increased in their ability to display the available location of the various devices. With a GIS database able to provide the locations of the variety of wireless device technologies, a robust map application could display both wireline and wireless (Phase I and II) calls, as well as VoIP calls, and even automatic vehicle location (AVL) for First Responder units of public safety field resources and CAD events for agencies using these systems.

From a mapping application and GIS perspective, as 9-1-1 systems evolve through the various stages of the NG911 Maturity Model, the significance and emphasis on both types of solutions is expected to increase. This is largely due to the NG9-1-1 requirement to provide geospatial routing of calls and additional data related to incidents. As a result, significant efforts will be required by PSAPs and 9-1-1 authorities to develop and deploy or upgrade and maintain geospatial databases for the respective areas were the NG9-1-1 services will be provided. Similarly, with the heavy reliance on GIS databases and the expected plethora of incident information that will be available and potentially provided through mapping functions, more robust mapping capabilities/solutions will be expected. One possible future scenario could be that a centralized mapping application would be available in the PSAP and used by all positions that require a map that can render the required data layers for the role of the telecommunicator at a

particular PSAP position. To support the new mapping application(s) and GIS solutions/services, funding will be required from sources such as 9-1-1 fees, grants, and/or from other sources within the PSAP's operating budgets.

4.2.3.3.5 Dispatch Solutions

PSAPs maintain the responsibility for answering incoming 9-1-1 calls from the public and making a determination of the location and nature of the call for service in order to dispatch the appropriate public safety field responders according to the business rules of the PSAP and the First Responder agencies involved. PSAPs maintain a close relationship between the inbound 9-1-1 call information and the dispatch of field responders, and 9-1-1 caller data may be integrated as part of the CAD incident tracking and resources assignment system. Traditionally, 9-1-1 PSAP equipment functioned as stand-alone workstation environments. However, many changes have occurred since the 1990s, and current systems have evolved to include improved integration, management and display of 9-1-1 and CAD information. During that time, dispatch solutions have continued to advance at a rapid pace and as the use of IP-based systems increases, public safety will experience a much closer integration, and possible consolidation of these traditionally separate technologies. The following information is intended to provide more details on the CAD functions and solutions available within a PSAP.

4.2.3.3.5.1 Voice Dispatch

Voice Dispatch is a service that allows dispatchers to efficiently and effectively manage voice communication paths on mission critical two-way radio systems, and to use these voice communication paths to interact with radio users via both voice and non-voice means. As such, Voice Dispatch manages voice and non-voice communications between dispatchers and radio users.

Voice Dispatch has been the core communications medium for public safety users since the inception of Land Mobile Radio. It enables dispatchers and radio users to instantly speak with each other, and this voice communications allows radio users and dispatchers to use their hands and eyes to execute their mission while speaking and listening. These voice communications are extremely important for:

- Dispatching field units to incidents
- Receiving updates from field units
- Enabling interoperability between radio users with incompatible radios to speak with each other when working together on an incident or event
- Providing improved situational awareness for dispatchers because they can hear the tone of the radio user's voice and any ambient sounds around the radio user

A Voice Dispatch system typically consists of dispatch positions, commonly referred to as dispatch consoles, various types of gateways and network switching equipment.

- Dispatch positions typically consist of dispatch application software, a computer, a monitor and, optionally, an audio box supporting connections for speakers, microphones, headsets, footswitches, etc. The computer can range from a full-fledged workstation computer all the way down to a tablet computer.
- Gateways are hardware devices that provide physical interfaces between the voice dispatch system and various types of external equipment commonly found in dispatch centers such as legacy conventional radio channels, intercom systems, logging recorders, alarm systems, door controls, etc.

- Network switching equipment consists of controllers, routers and switches that move audio and information between the various elements of the console system.

Legacy voice dispatch systems based on older technologies could easily last fifteen years without significant upgrades. Modern voice dispatch systems are based on computers and IP-based technology that may have much shorter lifecycles due largely to the nature of the technology. These shorter lifecycles require the hardware, operating systems and application software in the voice dispatch systems to be periodically refreshed to keep them within their respective vendors' technical support periods, and to ensure that the safety and integrity of the system can be maintained.

Voice dispatch systems can be funded via grants from the U.S. Government (typically interoperability grants) or from local funding mechanisms (e.g., bonds or taxes). Likewise, some 9-1-1 authorities allow the voice dispatch system and the components that operate within the PSAP that interface with the 9-1-1 PSAP solutions to be treated as allowable costs and to be funded by 9-1-1 fees.

As legacy voice dispatch systems migrate through the NG911 Maturity Model stages to the End State NG 9-1-1, the systems will become more integrated and modular at the platform level with support for more robust mapping and additional telephony and dispatch capabilities supported by the broadband public safety network being deployed by FirstNet.

Depending on the vendor system architecture and its platform capabilities, this migration may require upgraded or additional hardware and computing power above and beyond that required during the normal lifecycle change outs for the voice dispatch systems that support baseline functionality. Thus, additional funds from sources such as 9-1-1 fees, grants, and/or from other sources within the PSAP's operating budgets will be necessary to support the migration.

4.2.3.3.5.2 Data Dispatch - Computer Aided Dispatch (CAD)

CAD is an application, or set of applications, designed primarily to aid public safety emergency communication center personnel with the workflows and data related to managing the tasks associated with real-world events and the resources assigned to them. The First TFOPA Report defines CAD as "an integrated technology solution for management of public safety incident creation functions associated with emergency and non-emergency calls for assistance, dispatch of first responders and incident tracking."[24] Additionally, CAD systems also interact, or are directly interfaced with most other communication center systems and networks, such as radio systems, 9-1-1 telephony systems, and Local Area Networks. Likewise, the CAD also operates as a connection to other information sources and databases through various interfaces built into the system such as, but not limited to:

- National, State, Regional or local databases
- Emergency Medical Dispatch software or card system.[25]

CAD systems are the central focus of call-taker, dispatcher and supervisory workflows, and therefore the "cross-roads" for most other systems in the communication center. Radio and telephony systems are crucial elements in the overall mission-critical emergency and are interfaced with the CAD systems to provide the various roles with streamlined data management and workflows. The ability to interface to 9-1-1 telephony solutions and intake ANI and ALI provides simpler management of the call-taker workflow

[24] *First TFOPA Report*, 75.
[25] Ibid.

and more accurate and efficient dispatch workflow, contributing to greater situational awareness and improved response for first responders and the citizens they serve.

CAD systems are designed to manage the workflows and data related to both the tactical and strategic requirements of public safety incident and resource management.

Tactically, CAD applications are designed to manage the workloads and tasks of the following public safety communication center personnel roles:

- Call-takers – This role's primary responsibility is to interact with citizens (through 9-1-1 telephony solutions) and enter incoming reports of real-world events into the system. CAD Functional Areas used by this role includes Incident Management (Create, Update), Situational Awareness, External Queries, Messaging and Mapping. Their role interacts with citizens, dispatchers and supervisors.
- Dispatchers – This role's primary responsibility is to interact with and ensure the safety of field responders (police, fire and EMS) and report the information entered by call-takers to them over land mobile radio systems and mobile data computers. CAD Functional Areas primarily used by this role are Incident Management, Incident Dispatch, Resource Management, Situational Awareness, External Queries, Messaging, Mapping and others. There are PSAPs in which the dispatcher also performs the role of Call-Taker. This role interacts with citizens, call-takers, supervisors and first responders. For example, in the approximately 75 percent of PSAPs with five or fewer dispatch positions, and even medium sized PSAPs, the call-taking and dispatch roles will almost always be integrated due to these resource limitations.[26]
- Supervisors – This role's primary responsibilities are to manage the tactical workload of the Call-Taker and Dispatcher roles, manage quality control by ensuring agency standard operating procedures (SOPs) are followed, and interact with call-takers, dispatchers, citizens and supervisory personnel for the agencies for which they are contracted to dispatch. They also manage incident and resource data reports and interact with Communication Center management teams to translate the significant amounts of tactical data created during daily operations into strategic data used in the planning needs of the Communication Center and the agencies it serves. CAD Functional Areas used by this role include all of the above, plus system configuration, Service Management and Reporting. It is not unusual in smaller PSAPs for Supervisory personnel to also act as call-takers and dispatchers depending upon staffing and call loads.
- Communication Center Management – Tactically, this role primarily interacts with Communication Center Supervisors and management of the agencies they serve to ensure SOPs are followed and contractual agreements with the agencies are met.

Strategically, CAD applications are designed to aggregate, store, manage and report on the tactical data created for daily incident and resource management and to provide reports to Communication Center management and the agencies the communication center serves.

A legacy CAD system, typically consists of the following hardware and software:

[26] It is possible that in an NG9-1-1 environment, overflow calls to a PSAP generated by a significant incident will be routed to other PSAPs in which the remote PSAP personnel will assume the function of call-takers and create and transmit CAD incident files based upon the calls to the overflow PSAP. Personnel in the PSAP suffering the overflow situation will assume the dispatch function.

Hardware:

- Server(s) (Primary and Back-up)
- Client Workstations (Primary and Back-up)
- Intermediate Hardware for some interfaces (e.g.; Lantronix servers for interfaces to telephony solutions for 9-1-1, or Zetron 3030F's for TTY/TDD interfaces)
- Data back-up and tape storage solutions
- Networking systems including Firewall, Routers and other networking solutions
- GIS Management Servers

Software/Applications:

- Server operating system
- Client operating system
- Administrative applications (typically residing on the Server, but some elements of administration are sometimes incorporated into the client software)
- System management applications (interface data, system data, version control, database management, etc.)
- Client applications (may or may not include monitoring, mapping and messaging subsystems)
- Mapping (sometimes fully integrated, sometimes interfaced to a telephony-related 9-1-1 mapping solutions
- Messaging application (sometimes fully integrated, sometimes interfaced
- Back-up and system monitoring applications
- Reporting applications

Most CAD systems require GIS data. Most solutions allow the GIS administrator to manipulate raw GIS data (MapInfo, ESRI, etc.) and use some proprietary solution to manipulate the data to meet the CAD system's requirements for location services (incident location, resource location, recommendations, etc.). For further information on CAD Integration please refer to Appendix B.

4.2.3.3.5.3 Non-telephony data related CAD Mapping Use Cases

There are a number of other use cases for CAD mapping that are not related to caller location provided through 9-1-1 telephony data. They include, but are not limited to:

- **Location for Incidents not created through a 9-1-1 call** – Approximately 35-40% of the incidents created in a CAD system come from sources other than 9-1-1 calls, all of which require a location in order for CAD operators to track and manage them on a map. Further information can be found in Appendix B related to non-telephony incidents.

- **Mapping Attributes and Layers** – Mapping attributes are data built into mapping data that may or may not be displayed to the dispatcher in a graphical display for use in decision-making.

Most of the data described in this section comes from within the CAD system. In order to create a more seamless, holistic approach to addressing the workflows of the CAD dispatcher role, 9-1-1 location data

should be integrated to the CAD mapping data to provide the most complete, real-time picture of the incidents and resources for which they are responsible.

The lifecycle for most CAD systems is determined by a wide variety of factors, and will vary from agency to agency and system to system. Technology is not always the driving factor, and for most agencies, funding is the primary driver for CAD system lifecycles. Most vendors will continue to support public safety agencies beyond the industry standard maintenance agreements because of the mission critical nature of the work the application is required to perform. This holds true for hardware, operating systems and CAD application versions. Many agencies look to replace their systems in the 7-10 year range, approaching their funding bodies for a capital expenditure only once every five years or longer, as the funding cycle itself often takes multi-year requests for the funding before it is granted. Many PSAPs are subject to state limitations on borrowing money (outside of bond issues, the administrative costs of which may not be justified for the purchase of PSAP systems) or incurring payment obligations extending beyond the current fiscal year. Thus PSAPs may develop funds over multi-year periods for capital expenditures, with systems replacement cycles driven by the term required to accumulate the necessary capital.

As legacy CAD solutions evolve through the various stages of the NG911 Maturity Model to an End State NG9-1-1, CAD will be expected to enhance its capabilities from those described above. The enhanced capabilities will predominantly be in the areas of GIS and mapping applications that leverage the geospatial capabilities that NG9-1-1 will bring. Additionally, new interfaces will be required as a result of the significant ecosystem of applications and databases that are expected to be present with the deployment of ESInets and core services and broadband capabilities from FirstNet. CAD workflows and data management capabilities will evolve to be somewhat different from the legacy solutions of today as a result of initiatives such as NG PSAP, APCO Project 43, and standardization efforts such as EIDD.[27] CAD will manage a heavier workload, and will continue to be the core workflow engine for incident management.

Above and beyond the normal upgrades supported through management of a typical CAD lifecycle, and as a result of the projected new capabilities that NG9-1-1 will bring, legacy CAD solutions that migrate will be expected to require more enhanced upgrades to support the new capabilities and interfaces. The impact of these upgrades will vary based on the age and platform capabilities of the various CAD vendor solutions. It is likely that agencies will require more investment and funding options to enable these upgrades and to facilitate the migration to support the NG9-1-1 capabilities/requirements.

4.2.3.3.6 Other Services:

In addition to the core legacy PSAP equipment solutions, there are other services that support 9-1-1 emergency communications from/to citizens, are part of the call taking and incident management workflows, and may use 9-1-1 funds to procure the services. These services include relay services, language translation, and paging.

Nationwide relay services connect telephone users with people who are deaf or hard of hearing as part of the communications services created with the passage of the Americans with Disabilities Act (ADA) in

[27] APCO International Project 43 is designed to assist public safety with evolving broadband technologies impacting PSAPs. http://psc.apcointl.org/2016/02/10/apco-launches-project-43-to-tackle-broadband-implications-for-the-psap/. EIDD is a joint project between the National Emergency Number Association and the Association of Public Safety Communications Officials (NENA/APCO) on an "Emergency Incident Data Document" designed to standardize how emergency incident data will be shared between stakeholder communities. Similarly, "NG PSAP" is a joint NENA/APCO project addressing NG9-1-1 PSAP requirements.

1990. Today, 9-1-1 PSAPs interact with state specific relay services for receipt of calls for services placed through the centers.

Language translation services typically charge a specific rate, usually by the minute, for their services. Although there may be variances across 9-1-1 governing bodies on the use and cost of the language translation services, generally these services are considered allowable 9-1-1 costs.

Many PSAPs with legacy communications services and equipment have paging capabilities that have been used for many years and continue to be used today. The paging solutions typically are used for dispatching responders (e.g., police, and EMS or volunteer fire responders that need to be notified and sent to a specific incident) or special emergency notifications or reverse 9-1-1 solutions. Paging systems do not depend solely on the use of landline communications networks, which may be compromised in wide-scale disaster situations. Costs associated with the 9-1-1 paging capabilities are considered by some 9-1-1 authorities as allowable 9-1-1 costs. Thus, some PSAPs are able to use their 9-1-1 funds to cover the cost of these services.

It has been projected that with the transition to NG9-1-1, caller language preferences or disability information included in user profiles entered into user devices, could facilitate conferencing-in of translators or relay service personnel during call-setup; and further facilitating the assignment of 9-1-1 calls to translators or relay service personnel specially trained or experienced in handling 9-1-1 calls. Such specially trained or experienced personnel would likely require greater compensation than translators and relay personnel lacking such training or experience, but provide more efficient and effective 9-1-1 translation/relay service.

9-1-1 authorities should include relay services, language translation services, and necessary paging technologies as part of a NG9-1-1 strategic plan and incorporate advanced IP-based services, as appropriate, throughout the various stages of the NG911 Maturity Model.

4.2.4 Security Domain

Security considerations include a variety of physical, network, system, data, and personnel security issues that have long been an area of focus for PSAPs and state and local 9-1-1 authorities. As the transition to NG9-1-1 occurs and the potential for cyber-based attacks increases, those security considerations will become even more important. The Security Domain described here encompasses those critical security issues, and specifically focuses on the systems and applications required to develop a security posture appropriate for each stage of the NG9-1-1 Maturity Model.

4.2.4.1 Security Considerations for Legacy 9-1-1 Systems

PSAPs should, and generally do, restrict access to the PSAP to authorized personnel, and members of the public are not permitted on the dispatch floor or in other locations where confidential or protected information may be seen or heard. Access to non-public areas by visitors and contractors is controlled and may require escorts, police background checks, and other security measures.

As 9-1-1 systems, have become more sophisticated, PSAPs have incorporated various measures to enhance system and data security, including user rights with log-in and password requirements for personnel to access and use those systems. In many cases, dispatch and supervisory personnel no longer have authorized access to the processing and storage systems, as access to these systems is restricted to IT professionals assigned to support of PSAP systems.

In the legacy environment (through authorization of SSPs and selective routing of 9-1-1 calls), networks used by PSAPs for the delivery of 9-1-1 services were closed networks with access limited to the PSAP and related public safety agencies. 9-1-1 calls were terminated to the PSAP over analog CAMA trunks and dispatch radio systems also used analog technology. Access to information from NCIC, CJIS databases, CopLink, and other sources outside the PSAP were also restricted, often using virtual private networks and various security measures. Where interconnection with the Internet or other public networks is required, PSAPs generally use firewalls or other protective measures.

4.2.4.2 NG9-1-1 and Cybersecurity

The transition to NG9-1-1 will substantially increase the vulnerability of PSAPs to cyber-attacks. This increased vulnerability raises significant concerns that must be addressed through effective cybersecurity measures, and these protective measures will result in new capital, operational and maintenance expenses in an NG9-1-1 environment. TFOPA believes that there is not a broad understanding among PSAPs and 9-1-1 authorities of the potential risks and costs associated with cyber-based threats and cybersecurity. For this reason, TFOPA considers cybersecurity as one of the two great hidden costs of NG9-1-1, along with the upgraded GIS requirements of full NG9-1-1 implementation.

TFOPA addressed these important cybersecurity issues in great detail in the First TFOPA Report.[28] In that report, TFOPA proposed a cooperative and synergistic approach to cybersecurity for emergency communications, including core cybersecurity services, interconnected monitoring and mitigation, and near real-time information sharing amongst multiple levels of public safety agencies and entities. Those recommendations were based on and aligned with the National Institute of Standards and Technology (NIST) Cybersecurity Framework (NCF), and other foundational resources that include the related activities of the FCC's Communications Security, Reliability, and Interoperability Council (CSRIC), DHS, related standards bodies such as NENA, APCO, and Alliance for Telecommunications Industry Solutions (ATIS), and commercial industry best practices.[29]

Principle among TFOPA's recommendations was the proposal to introduce an additional layer, identified as the Emergency Communications Cybersecurity Center (EC3), into the recommended future architecture. As outlined in the *First TFOPA Report*, the EC3 would take on the role of providing Intrusion Detection and Prevention Systems (IDPS) to PSAPs, as well as any other emergency communications services that would benefit from centralized, core cybersecurity capabilities. The EC3 would assume the responsibility for monitoring and collecting information through a network of IDS sensors resident at each PSAP (and elsewhere), though individual PSAPs would be responsible for deploying these sensors. A description of the cost considerations associated with the EC3 was provided in Section 4.6.3.2 of the *First TFOPA Report*.[30] Importantly, one of the benefits of the EC3 is that it would be shared among multiple PSAPs, which would reduce the overall costs incurred by PSAPs in the provision of NG9-1-1 services.

There are, of course, other costs associated with implementing effective cybersecurity protections. These include local workforce issues such as hiring cybersecurity experts and training PSAP staff on appropriate security practices, costs associated with performing risk assessments and developing cybersecurity plans, costs associated with information sharing systems and processes, costs associated with network security and monitoring, cost associated with cyber-attack recovery and remediation activities, and costs associated with Identity Credentialing Access Management (ICAM). It is important to understand all the potential elements within cybersecurity infrastructure and plan for all costs that could be directly

[28] *First TFOPA Report* at Section 4 on "Optimal Approach to Cybersecurity for PSAPs."
[29] Ibid, 29.
[30] Ibid, 65-67.

impacting 9-1-1 budges, or those that will fall under other domains. PSAPs which have already migrated to IP-based systems may have already implemented some of these solutions, such that these will not represent new costs associated with the migration to NG9-1-1.

4.2.5 Operational/Performance Domain

The Operations/Performance Domain is used to describe the policies, procedures, and programs that are needed to effectively operate NG9-1-1 systems, and includes PSAP personnel and training, operational procedures, systems testing, managed services, and contingency plans.

4.2.5.1 PSAP & 9-1-1 Authority Operational / Staffing

For most enterprises, operating expenses are generally expenditures that the enterprise incurs for activities that are ". . . not directly associated with the production of goods or services." Examples include compensation for non-production employees, benefits and other personnel costs, depreciation, legal fees, office supplies, utility costs, equipment maintenance, and so on. In some cases, that definition is expanded to cover the cost of the goods or services provided, in which case direct labor is also included. Essentially, operating costs (OPEX) are the ongoing costs of running the enterprise, while capital costs (CAPEX) relate to the direct cost associated with the purchase of the capital assets and facilities involved.

For 9-1-1 services, operational expenses exist for both governmental 9-1-1 authorities and public safety answering points (PSAPs) which includes the staffing and personnel cost associated with 9-1-1 planning, call delivery and processing, training, public education, management and support costs, security, fixed assets depreciation, maintenance and network services, continuity of operations, and other administrative costs.

For 9-1-1 Authorities that provide 9-1-1 system planning and supportive services, and are not directly involved in PSAP call-taking, all their operations expenses are often funded through 9-1-1 fees and associated revenues. Operational expenses cover 9-1-1 system functions and services like:

- Operating fund account
- Consultant services
- Emergency Medical Dispatch (EMD) support
- GIS and other database services
- Telecommunication circuit charges
- Logging systems
- Emergency Notification Services (ENS)
- Telephone systems for 9-1-1
- General IT support and repairs
- Network services and connectivity
- Public education
- Training
- Security
- Translation services
- Facility maintenance

- Capital asset depreciation
- Utilities
- Continuity of services (e.g., Uninterruptable Power and Backup, Generators, Failover capacities, systems and supplies)
- CAD Systems
- HVAC and other environmental systems necessary to support the PSAP IT environment.

For PSAPs, however, their operational and personnel recruitment expenses may be funded through a variety of revenue streams depending upon their operational environments and priorities. For example, the personnel cost associated with the operation of the PSAP itself (as contrasted with a 9-1-1 authority that is providing system support) is often funded by the host governmental agency through general revenue and involved as a local expense. 9-1-1 service-fee revenue may also be used to cover other capital and operating costs, subject to other priorities, though that is often addressed through a 9-1-1 authority. Sometimes, the funding decisions are based on the functions or services involved; e.g., PSAP call taking and processing costs are covered by 9-1-1 service-fee revenue, but the cost of dispatch is funded locally as part of emergency services.

With that in mind, activities generally fall into four categories:

- PSAP Call taking and processing (including personnel and PSAP facility)
- Dispatching of emergency response services (may include trunked radio systems and computer aided dispatch or CAD)
- Administrative support
- Ancillary activities and duties, including security and continuity of services

4.2.5.2 Training Facility/Back-Up PSAP

Given the mission critical nature of 9-1-1, key operational requirements for PSAPs that must be funded include having appropriate back-up communications capabilities and training solutions. Back-up PSAPs provide a form of geographic redundancy of a primary PSAP's 9-1-1 communications capability. This becomes especially important for both planned and unplanned events where flexibility is required to shift the 9-1-1 call taking operations from the primary site to the back-up site to ensure continuity of operations.

Training solutions are equally important within the PSAP/Dispatch Center, as the need to continuously train personnel is paramount. Typically, the training involves either new hires that must be trained within the PSAP operational environment, or existing personnel that must be trained on new features/technology that are part of upgrades of the 9-1-1 CPE or CAD functionality.

Regarding legacy equipment for back-up sites and 9-1-1 training, these items are typically funded through the use of 9-1-1 PSAP funds. However, in some cases, there may be specific requirements or limitations placed on the training for it to be considered an allowable expense. Like all other PSAP equipment or services that can be procured through the use of 9-1-1 funds, the back-up equipment and training must be planned and approved within annual PSAP budgets.

As discussed in the preceding sections regarding future migrations of the PSAP equipment through the various stages of the NG911 Maturity Model, replacement of the equipment that provides more

computing power and/or software upgrades, as well as investment in GIS and mapping applications, will be required through the migration process. The same equipment/solutions/GIS/mapping applications used in the primary PSAP will be required in the back-up PSAP as well. Thus, funding to procure and maintain these capabilities and solutions must be planned for and made available to the PSAPs to support the migration.

5 Funding Mechanisms and Revenue Sources

5.1 Overview and Foundation of Further TFOPA Analysis

TFOPA's effort to develop a useful *Funding Sustainment Model* requires attention to both the costs associated with 9-1-1 and NG9-1-1 deployment and operations and the funds necessary to cover those costs. From a funding perspective, TFOPA's further analyses begin with a reexamination of existing 9-1-1 funding policies and practices employed by state and local authorities.

TFOPA previously reviewed and evaluated various studies related to 9-1-1 funding, and concluded that current mechanisms for funding 9-1-1 systems suffer from several significant challenges.[31] Among these challenges is the fact that there is little uniformity with regard to the manner in which different jurisdictions recover the costs of 9-1-1 systems. This makes it difficult to plan, design, and implement 9-1-1 systems that will increasingly impact multiple jurisdictions. Another significant challenge is the sustainability of existing fee collection mechanisms. These mechanisms, which are largely based on 9-1-1 fees applied to communications services, are becoming increasingly outmoded as communications technologies and services change. As a result, continued reliance on these mechanisms will make it difficult to provide sufficient funding for future 9-1-1 systems.

Finally, according to the FCC's latest 9-1-1 funding report, some funds collected for 9-1-1 systems continue to be diverted for other purposes.[32] Any diversion of funds creates challenges for state and local 9-1-1 authorities, but these challenges are extremely problematic when they occur on a regular basis. For example, according to a media report earlier this month, the State of New Jersey has diverted nearly $1.4 billion in 9-1-1 funds since 2004.[33] This level of fund diversion creates significant obstacles to NG9-1-1 implementation and undermines public trust in the 9-1-1 funding process.

These factors are each challenging enough in their own right, when considered in the context of providing the necessary funding to continue support for legacy 9-1-1 systems. However, taken together, they represent significant obstacles to transitioning those systems to the advanced NG9-1-1 technologies that are required for the future. These obstacles must be removed in order to realize the full benefits of NG9-1-1 and to ensure that the nation has the most effective emergency response systems possible.

In the *First TFOPA Report*, TFOPA made various recommendations designed to address these challenges.[34] Those recommendations were extensive, covering a wide diversity of initiatives designed to promote more effective funding policies and practices. Those recommendations include, among other

[31] *See First TFOPA Report* at Appendix 7.
[32] *See* "Seventh Annual Report to Congress on State Collection and Distribution of 911 and Enhanced 911 Fees and Charges," ("*7th FCC Report*"), Federal Communications Commission, Public Safety and Homeland Security Bureau, December 31, 2015, at 62. See: https://transition.fcc.gov/pshs/911/Net%20911/NET911_Act_7th report_to_Congress_123115.pdf .
[33] http://www.nj.com/news/index.ssf/2016/10/rescue_911_how_nj_used_11b_of_your_money_on_everyt.html.
[34] *See First TFOPA Report*, 24.

things: (a) the establishment of effective statewide 9-1-1 planning and coordination mechanisms; (b) efforts to enhance the quality and reporting of 9-1-1 funding data; (c) efforts to improve cooperation among federal, state, and local jurisdictions in a manner that recognizes their shared responsibilities; (d) initiatives to enhance education and outreach; and (e) the establishment of a Local State Government Advisory (LSAG) committee to focus on NG9-1-1 issues.

Principal among TFOPA's recommendations is the need to review, revise, and potentially create new funding mechanisms that would help to ensure the sufficiency of available 9-1-1 funds in the future.[35] TFOPA's earlier analyses examined five potential funding options for state and local governments with a bias towards approaches that are technologically neutral and sustainable. These options, which are summarized below, were reviewed and presented in the *First TFOPA Report* as a menu of options for state or local government agencies to consider when creating a longer-term approach for funding NG9-1-1 systems:

> **Funding Option A:** *Continue reliance on the current funding model supplemented by a new network connection fee on users of broadband services.*
>
> **Funding Option B:** *Continue reliance on the current model including efforts to secure funding from pre-paid wireless services on a competitively neutral basis in all states.*
>
> **Funding Option C:** *Migrate funding towards state universal service fee assessments.*
>
> **Funding Option D:** *Integrate NG9-1-1 funding into state sales and use taxes.*
>
> **Funding Option E:** *Consider incorporation of 9-1-1 funding into state insurance fees.*

TFOPA believes that each of these approaches continues to be a potentially viable option, and many of them were previously identified by the National Association of State 9-1-1 Administrators (NASNA) as part of their extensive review of 9-1-1 funding issues.[36] However, TFOPA believes that any changes to current 9-1-1 funding methodologies would be premature until there is a better understanding of future 9-1-1 and NG9-1-1 costs and the manner in which 9-1-1 funds are collected, remitted, and used. There is broad agreement among stakeholders that further analysis is required in these areas. Earlier this year, NASNA conducted a further review of funding issues to address the challenges faced by states in ensuring that all authorized 9-1-1 fees are properly collected, remitted, and used.[37] Building on its previous analysis, the current study examines what authority and resources are available to state officials to allow them to take appropriate actions when 9-1-1 fees are not collected, remitted, or used properly. It also recommends various best practices that would help to ensure proper use of 9-1-1 funds.

TFOPA fully supports the efforts of NASNA to better understand the current 9-1-1 funding framework, and we agree with NASNA that efforts should be made to maximize funding from those 9-1-1 funding mechanisms already authorized by law before considering new sources of revenue. Consequently, any recommendations in this report related to potential new sources of 9-1-1 funds are made as a supplement to existing 9-1-1 funding sources where such funds are not sufficient, and is presented here as an aid to states regarding the practical implications of different options and how any new funding sources might fit into the *Funding Sustainment Model* we recommend in this report.

TFOPA has not performed any further analyses of options C, D, and E noted above. These options may present potential opportunities for additional 9-1-1 funding for some states and local 9-1-1 authorities, but

[35] Ibid, 27.
[36] "Four Potential Sustainable Funding Models for NG911," National Association of State 9-1-1 Administrators (NASNA), August 2015.
[37] "911 Funding – Companion Paper," NASNA, October 2016.

such options are outside the scope of the analyses presented here. TFOPA has included an "Other Sources" category in its proposed Funding Sustainment Model for use by those authorities should they decide to pursue any of those approaches.

Option A (Network Connection Fee) is addressed in section 5.4.3 as a potential new funding mechanism. While TFOPA does not make any specific recommendations regarding the use of a Network Connection Fee (NCF), we do examine the impacts of various potential NCF options on consumers, competition, and available 9-1-1 funding.

With regard to Option B (Pre-paid Wireless Fees), TFOPA previously reviewed the use of such fees and believes they are an important source of 9-1-1 funding and are consistent with principles of technology and competitive neutrality. We previously recommended their extension to states where they are not currently authorized, and we reiterate that recommendation here. Moreover, as states consider the imposition of 9-1-1 fees on prepaid wireless services, we believe efforts should be made to achieve parity with 9-1-1 fees applicable to postpaid wireless services. In any event, we have included such fees as a component in our proposed *Funding Sustainment Model*.

TFOPA also considered an additional funding option not previously considered in the *First TFOPA Report*. Recognizing the multi-jurisdictional nature of NG9-1-1 systems and services, and the shared responsibility of entities in the federal, state, and local jurisdictions, TFOPA believes that the availability of additional federal and state funds to supplement current 9-1-1 funding sources would act as a catalyst to spur NG9-1-1 deployment and provide the additional capital funds required for new NG9-1-1 system components including those that may be shared among multiple state and local jurisdictions. Consequently, TFOPA recommends the authorization and allocation of additional federal and state funds to support NG9-1-1 implementation, and includes such funding sources in its recommended *Funding Sustainment Model*. Section 5.4.1 presents a strong case for why federal funding is appropriate and includes recommendations for how such a grant program might be administered to promote both the efficient use of available NG9-1-1 funds and the effective implementation and operation of NG9-1-1 systems.

5.2 Guiding Policy Principles for 9-1-1 Funding

The availability of effective and reliable emergency services continues to be critically important to the safety and security of our nation, and the ability to effectively transition to new and advanced NG9-1-1 services is equally important. However, those goals cannot be satisfied unless sufficient funds are available and used appropriately. In the *First TFOPA Report*, TFOPA recognized the nation's 9-1-1 systems as a "public good" that provide broad value for all citizens, and it laid out a set of policy principles that should guide all 9-1-1 funding efforts.[38] These guiding principles were described in greater detail in the earlier report, and helped to form the basis of TFOPA's earlier recommendations. However, they are worth repeating here as they provide the fundamental framework that has guided TFOPA's recommendations. As a matter of principle, TFOPA believes that 9-1-1 funding mechanisms should be:

- Predictable and stable;
- Based on a consumer's ability to request emergency services;
- Reasonable, equitable and non-discriminatory;
- Assessed on all services that can access NG9-1-1 systems;

[38] *See First TFOPA Report*, 153-156.

- Technologically and competitively neutral;
- Designed to assure fees can only be used to support 9-1-1 systems;
- Designed to assure fair and equitable allocation of funds collected to provide service to those that pay the fees;
- Designed to assure the revenues collected are sufficient to address transitional, provisioning and ongoing operational costs;
- Clearly identified and accountable; and
- Clear enough to avoid complicating the intergovernmental and sharing environment they support.

As policymakers at all levels of government review both existing and potential new 9-1-1 funding mechanisms, TFOPA believes it is important that such funding mechanisms align with these principles. We believe that doing so will ensure both the long-term sustainability of the 9-1-1 system as well as the accountability and transparency of the overall funding process.

5.3A Review of the Current 9-1-1 Funding System

5.3.1 Current funding mechanisms used today

There is no uniform manner in which states and local municipalities fund the nation's 9-1-1 systems. Generally speaking, 9-1-1 funding sources fall into one or more of four distinct categories: (a) fees on communications services (assessed by state or local authorities); (b) general funds from city, county and/or state tax revenues; (c) targeted grant funds (federal or state); and/or (d) other sources.[39] While the majority of states get most of their 9-1-1 funding through fees on communications services, some states rely on other sources for a significant percentage of their 9-1-1 funding. For example, according to the FCC's most recent report on 9-1-1 funding, Kansas, Maryland, and Wisconsin each get more than half of their funds from general tax funds at the county level.[40] Iowa gets 41% of its 9-1-1 funding through federal grants.

Even where 9-1-1 fees are assessed on communications services, the amount of such fees and the services on which those fees are assessed varies widely from one jurisdiction to another. Appendix C provides greater detail on the types and amounts of 9-1-1 fees that are assessed on communications services across the fifty states and the District of Columbia. These fees can be summarized as follows:

> **Wireline Services:** Utilized by all states except Vermont; most utilize a flat rate fee per access line, ranging from a low of $0.16 (parts of Wisconsin) to a high of $6.40 (parts of West Virginia).
>
> **Post-Paid Wireless Services:** Utilized by all states except Missouri, Vermont and Wisconsin;[41] most assess fees that are comparable to wireline services.
>
> **Pre-Paid Wireless Services:** Adopted by thirty-nine states, the District of Columbia, and Puerto Rico, and collected at the point-of-sale; variability on fee structure with 23 states assessing a flat

[39] The State of Vermont, for example, utilizes a Universal Service Fund (USF) mechanism to fund 9-1-1 systems. Georgia, Missouri, and Washington State have each authorized the use of a sale tax to support 9-1-1 services. Other states, including Arizona, California, Colorado, Illinois, Kansas, Nebraska, and Oklahoma have authorized the use of sales taxes for public safety programs but not explicitly for 9-1-1.

[40] Kansas, Maryland, and Wisconsin receive 72%, 51%, and 85%, respectively, of their 9-1-1 funds through local taxes. *See 7th FCC Report* at 59-62.

[41] Vermont assesses USF on post-paid wireless. As previously noted, most money collected through the USF by Vermont is used to fund 9-1-1 systems.

fee and 16 states assessing a fee based on percentage of sale; fees generally set to achieve parity with comparable wireless services.

VoIP Services: Forty-three states and the District of Columbia assess fees on VoIP services, and where these are applied, they are generally comparable to wireline.

TFOPA conducted a thorough examination of these funding mechanisms as part of its earlier analyses, and we do not undertake any further analyses here. With regard to prepaid services, however, TFOPA received some additional research data from Joseph Barrows that supplements information provided by him in 2015.[42] That research, which analyzes information on 9-1-1 fees from prepaid wireless services in thirty-one states and the District of Columbia, concludes that states are under-recovering 9-1-1 fees through prepaid wireless services because such fees are not commensurate with those applicable to postpaid wireless services. TFOPA was not able to fully consider the results of Mr. Barrows' research because the data was not received until late in September, and thus, TFOPA was not afforded the opportunity to review either the underlying data or study methodology, nor was it able to seek independent assessments from other industry experts. While TFOPA cannot reach any conclusions about Mr. Barrow's recent research, it does appreciate the considerable effort that was made to collect and analyze this data. While TFOPA has not independently validated the study's data and conclusions, TFOPA believes the alleged under-recovery underscores the importance of establishing parity, to the greatest extent possible, between competing services that allow end users to access 9-1-1 services. TFOPA recommends that any further evaluation of 9-1-1 fees on pre-paid wireless services be undertaken by an entity which can access potentially confidential and proprietary information related to 9-1-1 fee receipts and prepaid service sales and use data, and possesses the expertise to evaluate the data.

TFOPA makes no representations about the appropriateness of specific fee amounts applicable to prepaid wireless services or any other funding sources, as we recognize that those determinations are made based on a variety of factors specific to each jurisdiction (including the costs of eligible 9-1-1 system components), and in any event, are beyond the scope of this analysis. However, TFOPA believes it is important to ensure that any 9-1-1 fees are consistent with the guiding principles already articulated. Such fees should be "technologically and competitively neutral," should be "reasonable, equitable, and non-discriminatory," should be "based on a consumer's ability to request emergency services," and should be "assessed on all services that can access NG9-1-1- systems." These important principles argue in favor of fees that are applied consistently to comparable services regardless of whether they are based on wireline, wireless, or VoIP technologies. Many states have achieved these important goals with their current funding policies. However, some have not, and those states should consider changes to their 9-1-1 funding policies especially as additional funding is required for NG9-1-1.

5.3.2 Challenges to the existing funding system

Much of TFOPA's initial work on 9-1-1 funding focused on the challenges of the existing funding system, which has become increasingly outdated and is inconsistently applied across the country. In the *First TFOPA Report*, the Task Force observed that:

> *[e]xisting fee collection systems unquestionably are under increasing strains. At the same time, many policy makers at both the federal, state and local levels are aggressively pressing to deploy NG9-1-1 systems. Some argue that current funding mechanisms are too complex and inconsistently applied across both (i) jurisdictions and (ii) the services capable of connecting callers to the 9-1-1 system. States continue to face challenges in fitting emerging services into existing funding mechanisms . . . Such gaps in fee collection*

[42] *See First TFOPA Report* at footnote 91.

> *have forced some members of the 9-1-1 community to engage in extensive legislative battles and litigation with those non-contributing carriers whose customers still rely on the 9-1-1 system. With the advent of these new technologies, current approaches that simply assess fees on end-use device or access lines, administered largely by traditional carriers, may no longer be sufficient. Today, revenues from 9-1-1 fees imposed on wireline services continue to decrease as more households, approximately 47%, cut the cord and shift to wireless-only voice service.*[43]

The report concludes that "[i]n short, the nation's system of 9-1-1 fee collection and expenditures is at risk."[44] For the most part, this risk stems from the significant dependency of current 9-1-1 funding mechanisms on communications services, and the challenges associated with trying to keep pace with changing technology in the telecommunications industry and the changing market structure of the industry. Limited initially to wireline services, these funding mechanisms have evolved to include post-paid wireless services, pre-paid wireless services, and VoIP-based services. However, these changes have not occurred consistently across the country, and the rapid emergence of broadband services and new modes of accessing 9-1-1 beyond voice will make it increasingly difficult for state and local 9-1-1 authorities to keep pace with market changes. These funding challenges are exacerbated by the fact that many state and local statutes limit the manner in which 9-1-1 authorities can implement new technologies, ultimately restricting these systems to the legacy technologies that are becoming rapidly outdated. These current and future challenges have fueled a growing concern about the future state of emergency communications systems and the adequacy of the current funding scheme.

The nation's 9-1-1 systems provide public access to emergency services, and they use communications technologies to do that. For the most part, those services, which speak to the welfare and protection of the general public, are the responsibility of state and local government. Likewise, funding that access has been largely a state and local responsibility, implemented through laws and policies that place subscriber fees on communications services. A telecommunications service provider collects those fees and remits them to state and local governments to help support 9-1-1 service. For example, in Texas, statutes exist that impose an "emergency service fee" on a "local exchange access line" or "its equivalent."[45] By rule, "[t]he terms 'local exchange access line' or 'equivalent local exchange access line' mean the physical voice grade telecommunications connection or the cable or broadband transport facilities, or any combination of these facilities, owned, controlled, or relied upon by a service provider, between an end user customer's premises and a service provider's network that, when the digits 9-1-1 are dialed, provides the end user customer access to a public safety answering point through a permissible interconnection to the dedicated 9-1-1 network."[46]

As a technology-based service, evolution in that technology potentially impacts any process that depends upon it. For example, the process works relatively well when the communications service involved provides access to emergency services through a stationary landline phone at a place of primary use. Consumer access is fixed geographically, and service fee revenue is logically remitted to the 9-1-1

---

[43] Ibid, 153.
[44] Ibid.
[45] *See* Texas Health and Safety Code, Chapter 771, Section 771.063(e).
[46] *See:* http://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=1&pt=12&ch=255&rl=4. Not all of Texas is funded through a set fee on an access line. For example, that part of the state served by "emergency communication districts" operating either within the authority of a home rule municipality, or organized under Chapter 772 of the Texas Health and Safety code, slight variations to this process exist, though the basis for such fees are access lines.

authority that serves the area involved. However, with the arrival of mobile phone service in the middle 1980s, the process became more complicated.[47] Since the service is now mobile, some other method had to be selected to allocate the 9-1-1 service fee revenue to a serving 9-1-1 authority. Effectively, the process connection between a consumer's access to mobile service and the 9-1-1 authorities that may serve the location of that consumer has been weakened.[48]

Communications technologies continue to evolve. In the early 21st century, mass-market services using VoIP technologies arrived on the scene. VoIP is a group of technologies to deliver voice communications over Internet Protocol (IP) networks (such as the public Internet). This heralded a general migration away from the traditional circuit based public switched telephone network – a migration that continues today.[49] The challenge for 9-1-1 is that in IP telephony, there is not necessarily a direct link between a location and communication end points.[50] Such communication technology by nature can enable device mobility, and that again potentially generates a funding allocation issue. If the VoIP service is relatively static, then a 9-1-1 service fee can be jurisdictionally assigned, and the revenue involved appropriately allocated. On the other hand, if the service is nomadic or mobile, then funding emergency communication services in a fair and logical way becomes more problematic.[51]

IP is simply a method (or protocol) for delivering data from one end-point to another over a network. The underlying network for transmitting the data may be a wired one, a wireless one, or alternate between both. The data involved can represent anything, from voice to multimedia communications. In the Internet Protocol suite, while there is an underlying network, it is the protocol that essentially provides the communications functionality, and generically supports a variety of application environments that define the services involved.

---

[47] 9-1-1 fees were not the only such issue. Similar issues existed with state sales and use taxes also. Congress responded with the federal Mobile Telecommunications Sourcing Act (P.L. 106-252), effective August 1, 2002. That Act provides that a customer's home service provider will be subject to the state's sales and use tax regardless of where transmissions originate or terminate within the home service provider's licensed service area. The Law determined that mobile communications services are taxable at the location of the customer's "primary place of use". This is the residential or business address of the customer, which must be located in the service provider's licensed service area. Forty-nine of the fifty states, including the District of Columbia, have enacted legislation that complies with the MTSA. Montana was the only state that chose not to conform. With regard to wireless 9-1-1 fees, for example, the Texas Legislature in 2001 enacted an amendment (now Section 771.0735 of the Texas Health and Safety Code) to incorporate the 2000 federal Mobile Telecommunications Sourcing Act for the purpose of sourcing charges for mobile telecommunications services. Section 771.0735(3) provides that the wireless 9-1-1 fees shall be administered in accordance with Section 151.061 of the Tax Code. Section 151.061, entitled "Sourcing of Charges for Mobile Telecommunications Services."

[48] 9-1-1 authorities across the country continue to see a decline in landline based, 9-1-1 calls, while wireless calls grow exponentially. In Texas, for example, over 80 percent of annual 9-1-1 call volume is generated by wireless devices.

[49] *See* Tracy Watson, Business 2 Community, "2015: The Year of VoIP," http://www.business2community.com/tech-gadgets/2015-year-voip-01122398#d2zSd1j35iahjBR6.97

[50] *See* https://en.wikipedia.org/wiki/Voice_over_IP

[51] The FCC had to address this type of issue in the context of the Federal Universal Service Fund contribution methodology, noting the reasonableness of using the consumer's 9-1-1 location as a proxy when the Interconnected VoIP provider could not determine the consumer's place of primary use. *See* In the Matter of Universal Service Contribution Methodology, WC Docket 06-122 (rel. Nov. 5, 2010) at footnote 58: "We note that to the extent an interconnected VoIP provider cannot determine a customer's primary place of use, it would be reasonable if a state allowed the provider to use a proxy for the primary place of use, such as the customer's registered location for 911 purposes."

Those IP application environments may involve communication services that can potentially access 9-1-1 more and more today and can do so more commonly in the future. One example is "Wi-Fi Calling," which allows smartphone users to place their calls on Wi-Fi networks instead of their carrier's commercial networks.[52] A recent blog on wi-fi360.com observes that:

> *Wi-Fi now carries more mobile traffic than cellular does, according to Cisco's Visual Networking Index Global Mobile Data Traffic Forecast (2015 to 2020), which cites Maravedis' research. The vast majority of that is data and video, but voice is a growing amount as mobile operators and end users realize the financial benefits of using Wi-Fi for telephony, too.*[53]

Wi-Fi, of course, is used for many things in today's data-rich world. If some part of that is the ability to access 9-1-1, then associating some kind of 9-1-1 funding mechanism with that ability is problematic. The bottom line is that communications technology continues to evolve and grow more complex. The historical method of funding 9-1-1 services through a fee relating to a device used to place a 9-1-1 call, and allocating fee revenue based on the location of that device will have to continue to evolve as well.[54]

Finally, it is important to note that challenges to 9-1-1 funding noted above are complicated by current funding mechanisms that are not fully realized, and/or diverted for other purposes. Section 6.4 of the *First TFOPA Report* addressed "Diversion of [9-1-1] Funding" and described seven states that funded non-9-1-1 public access activities in 2013, and/or have simply transferred unappropriated fund balances into the state's general fund.[55] The continued problem of 9-1-1 fund diversion was confirmed in the FCC's most recent legislatively required Report to Congress on 9-1-1 funding.[56] In that report, the FCC noted " . . . 40 states and other jurisdictions – indicate that during calendar year 2014, or fiscal year 2014, they collected 911/E911 funds only for 911/E911 purposes."[57] But, they also noted " . . . [e]ight states – California, Illinois, New Hampshire, New Jersey, New York, Rhode Island, Virginia, and West Virginia – report that they used collected funds, at least in part, to support programs other than 911 and E911 service in calendar year 2014."[58] Some of that diversion supported other public safety activities, while several simply diverted funds for other expenditures or to their state general revenue fund.[59]

TFOPA believes that this fund diversion problem may be even more significant than represented by the FCC's report, because we believe that some states that reported "no diversion of fund" have actually used those funds for other purposes but reported "no diversion" because they were statutorily authorized to do so. The issue of 9-1-1 fund diversion is a significant problem even for those states that use those funds

---

[52] Because mobile handsets have a built in 9-1-1 call preference for handoff to an available mobile network, VoWiFi 9-1-1 calling is fairly rare today, but has started to occur.
[53] *See* Wi-fi360.com, "As WiFi Calling Goes Mainstream, Challenges and Opportunities Emerge," http://www.wi-fi360.com/wi-fi-calling-goes-mainstream-challenges-opportunities-emerge/ .
[54] Section 6.2 of the *First TFOPA Report* set out "Guiding Policy Principles for any State Funding Mechanism." Included are ten principles providing structure around any 9-1-1 funding mechanism; e.g., that such mechanisms should be predictable and stable, based on a consumer's ability to request emergency services, be reasonable, equitable and non-discriminatory, assessed on all services that can access NG9-1-1 systems, be technologically and competitively neutral, and so on. Part of the challenge of developing a sustainable funding model for the evolving telecommunications world will be staying true to that vision.
[55] Ibid, Section 6.4 Diversion of Funding, at 158.
[56] *See 7th FCC Report*, 62.
[57] Ibid.
[58] Ibid.
[59] The State of New Jersey, for example, diverted 89% of its total 9-1-1 funds collected to purposes other than 9-1-1 ($106,728,000 diverted). Ibid.

for other public safety and emergency response activities. After all, a traditional 9-1-1 fee relates specifically to the public's "access" to emergency services, not the services themselves that are traditionally funded as a cost of general government. As long as this practice continues, it will be difficult to develop and adopt any new 9-1-1 funding mechanism that could potentially be used for other purposes.

5.3.3 Current and future market trends and impact on 911 funding

As already noted, the telecommunications marketplace has changed radically in both the Consumer and Enterprise sectors over the past ten years. The Public Safety sector has lagged other sectors of the market in transitioning to new telecommunications technologies, but now must address this transition due to the increasing obsolescence of the legacy technologies and increasing expectations from citizens in how they want or expect to communicate with 9-1-1 call centers. In recent months, the importance of transitioning the nation's 9-1-1 systems to new more advanced technologies has received increased attention. In February 2016, the National Emergency Number Association (NENA), NASNA, and the Industry Council for Emergency Response Technologies (iCERT) established the NG911 NOW Coalition to promote the implementation of NG9-1-1 capabilities by the end of 2020.[60] This goal, while aggressive, demonstrates the critical importance of aligning the nation's 9-1-1 systems with communications technologies and services that are already widely used by U.S. consumers.

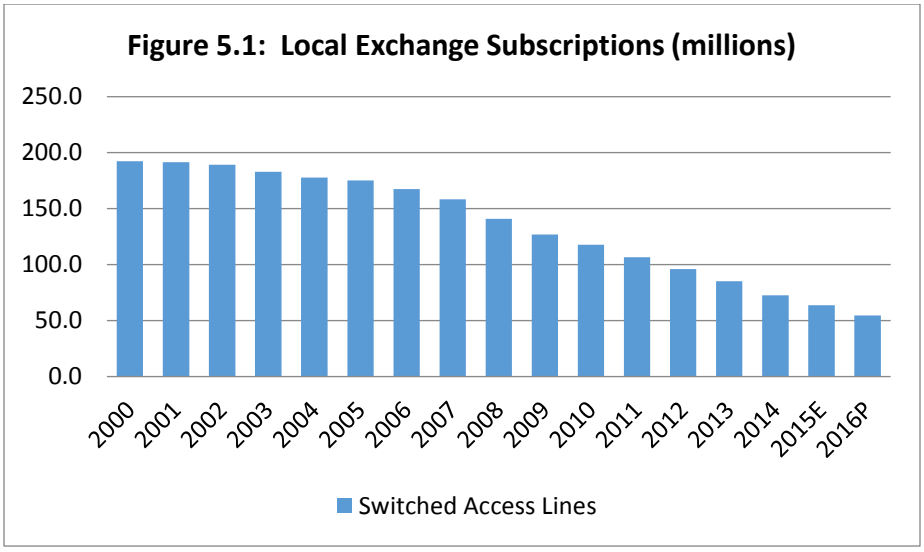
From a consumer perspective, these marketplace changes have been characterized by several clear market trends including a shift from traditional TDM-based wireline local exchange services to IP-based telephony (including over-the-top voice services). These trends include the rapid adoption and growth of mobile services, an exponential rise in data usage, and the introduction of new device-based applications that enable consumers to communicate to 9-1-1 call centers in different ways and with enhanced location accuracy that may be network-based or device-based. More recently, we have begun to see the emergence of new machine-to-machine (M2M) data connections that are moving us to a future dominated by the Internet of Things (IoT).

These market trends are not surprising, and they illustrate both the rapid advancement in technologies and the revolutionary changes in the ways consumers choose to communicate. However, as already noted, these trends present significant challenges for 9-1-1 system administrators because they have direct impacts on the funds available for 9-1-1 services. State and local 9-1-1 officials have attempted to keep pace with these marketplace changes, e.g., by instituting 9-1-1 fees for VoIP-based services. However, that task has become increasingly difficult as commercial services change in response to shifts in consumer preferences. These changing market conditions make it increasingly difficult for state and local 9-1-1 administrators to implement funding practices that are either "technologically and competitively neutral" or "predictable and stable" – principles that TFOPA wholeheartedly endorses.

While there is little that states, or others for that matter, can do to improve the predictability of the commercial communications marketplace, TFOPA believes that increased access to market data can assist states in evaluating how changes to such commercial services might impact their 9-1-1 funding requirements. Consequently, we review such data in this section and make recommendations regarding how such information might be included in a *Funding Sustainment Model*.

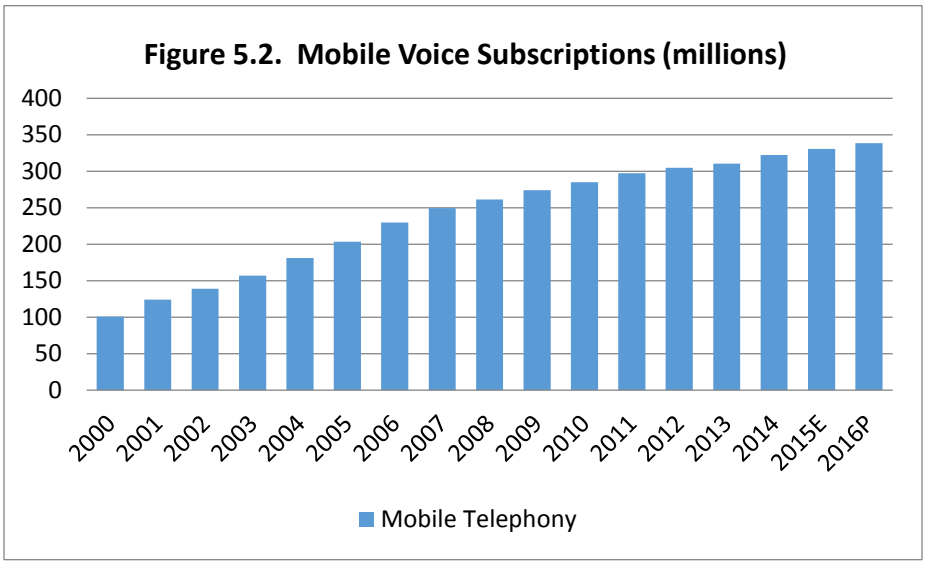
[60] "9-1-1 Organizations Launch Next Generation Accelerated Deployment Effort," News Release of the NG911 NOW Coalition, Feb. 23, 2016, available at http://www.ng911now.org/blog/2016/2/23/press-release-9-1-1-organizations-launch-next-generation-accelerated-deployment-effort.

Wireline Services. The market for traditional TDM-based local exchange services has changed significantly over the past fifteen years. Between 2000 and 2015, subscriptions for these services decreased from 192.4 million to 63.6 million; an overall decline of approximately 67% and a compound annual growth rate (CAGR) of -7.1%. This decline has been more significant in recent years as CAGR has exceeded -13%. The decline in local exchange services is shown in Figure 5.1.[61]

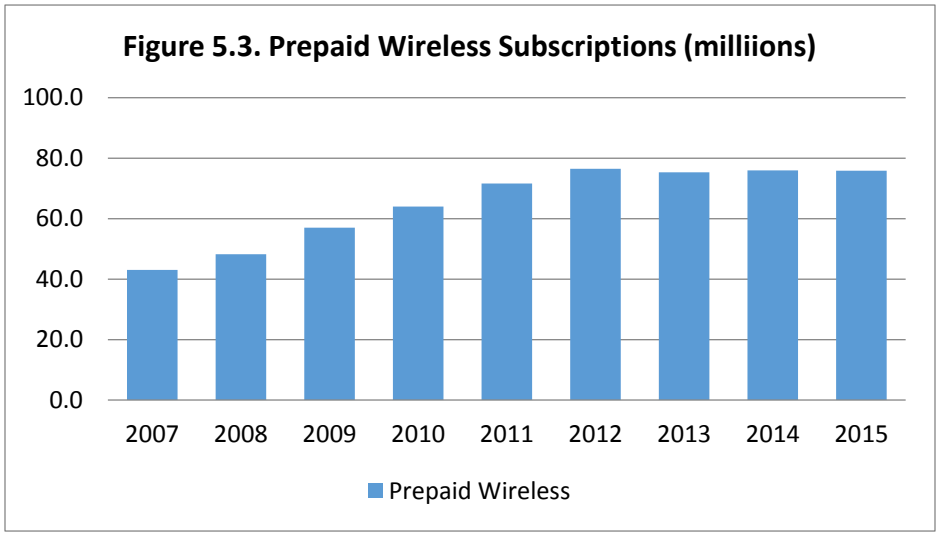


Post-Paid Wireless Services. During this same period of time, mobile telephony services grew by more than 227%, from 101 million subscriptions in 2000 to more than 330 million in 2015. This represents a CAGR of more than 8% over that period. Mobile telephony growth has slowed, however, in recent years to a CAGR of approximately 3%. The increase in mobile voice services is shown in Figure 5.2.[62]

[61] Information displayed in Figures 5.1 through 5.5 is based on the *7th FCC Report* and was compiled by the United States Telecom Association (US Telecom).
[62] Ibid.



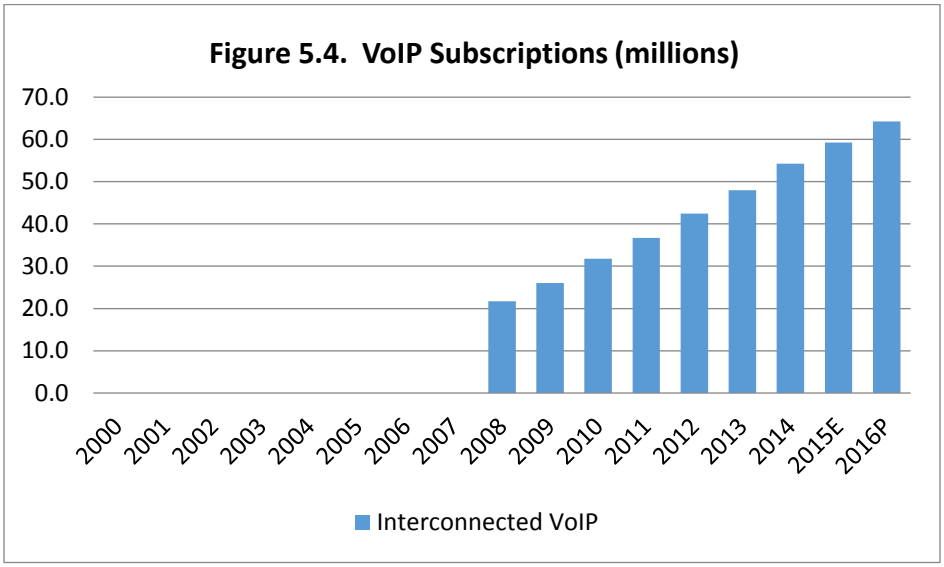
Pre-Paid Wireless Services. Pre-paid wireless services represent a significant segment of the wireless market. Based on data provided by CTIA The Wireless Association, subscriptions for such services has grown by 76% since 2007, from 43 million subscriptions to about 76 million. As shown in Figure 5.3, this growth has leveled off in recent years.[63]



VoIP Services. VoIP-based services also experienced significant growth during this period. Between 2008 and 2015, the number of interconnected VoIP subscriptions increased by 173%, from 21.7 million

[63] Ibid.

to 59.3 million, and that number is expected to exceed 65 million by the end of 2016. This data is shown in Figure 5.4.[64] While interconnected VoIP services have significantly displaced traditional voice services, and can be expected to continue to do so, we are also in the midst of a second phase of VoIP innovation as OTT and other competing voice services like FaceTime and Skype have emerged and have the potential to substantially disrupt the market.[65] While TFOPA did not have access to historical OTT VoIP data, market analysts predict that OTT VoIP services will grow at a compounded annual rate of 20% and will have a significant impact on both traditional landline and mobile telephony.[66]

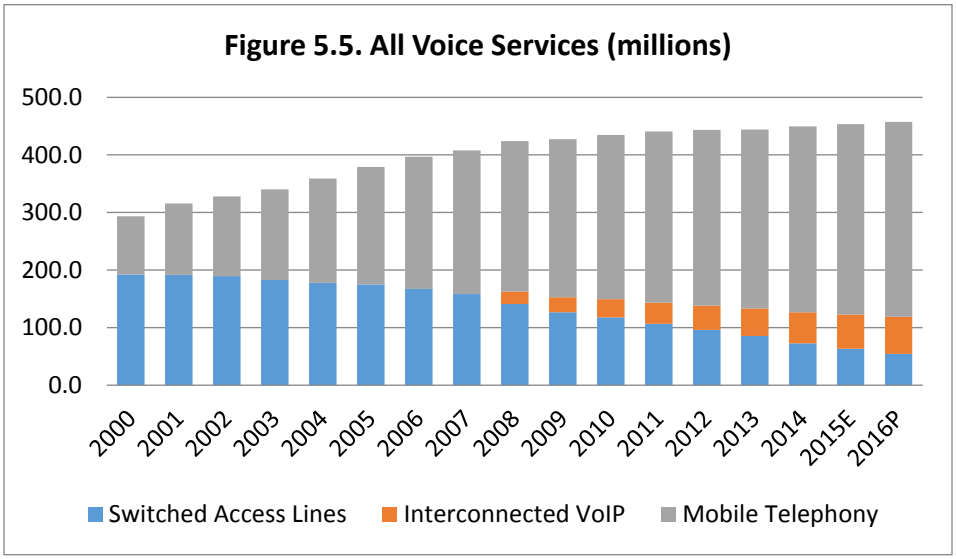


These changes in telephony services are likely attributable to several market trends. First, the increasing appeal of mobility and the growing competition amongst mobile services have caused many consumers to replace their traditional local exchange service with wireless service. According to the latest National Health Interview Survey (NHIS) conducted by the U.S. Department of Health and Human Services, approximately half of American homes have only wireless phones.[67] The NHIS report also shows that wireless substitution is more prevalent among certain demographics, including younger adults (72.6% for adults aged 25-29 versus 41.2% for those aged 45-64), adults living in rented homes (68.8% versus 37.3% for those that own their own homes), adults living in poverty (64.3% versus 45.7% of higher income adults), and Hispanic adults (60.5% versus 44.0% for non-Hispanic white adults). Consequently, the

[64] Ibid.
[65] "Disruptive Threat or Innovative Opportunity? Scenarios for Mobile Voice OTT," Arthur D. Little, available at http://www.adlittle.com/downloads/tx_adlreports/ADL_OTT_Disruptive_threat_or_innovative_opportunity_v2_01.pdf.
[66] "Telecom companies count $386 billion in lost revenue to Skype, WhatsApp, others." www.Fortune.com. See also "Over-The-Top (OTT) Services a Potential Threat to Mobile Operators' Call Revenues." Market Research Insights & Business Intelligence. Paul Budde Communications Pty Ltd. www.marketresearch.com.
[67] "Wireless Substitution: Early Release of Estimates From the National Health Interview Survey, July-December 2015." National Health Interview Survey Early Release Program. U.S. Department of Health and Human Services. Released 5/2016.

trend towards wireless substitution is not only affected by technological factors, but also by a variety of socio-economic factors as well.

Second, the continued convergence of IT and telecommunications and the rapid growth of more robust, scalable, cost effective IP-based technologies have fueled the rapid growth of VoIP services and a shift away from traditional voice telephony. Today, interconnected VoIP services represent more than half of all landline voice subscriptions. As this shift to VoIP and mobile voice services has occurred, traditional landline telephony has moved from a dominant position to a relatively minor force in the voice market. Importantly, the overall telephony market has been relatively flat over the past five years. While traditional landline voice services have been replaced by mobile and VoIP alternatives, the overall market for voice services has grown by less than 1% annually. This is reflected in Figure 5.5.[68]



An examination of both past and expected future market trends can provide important information to 9-1-1 administrators about available 9-1-1 funding. A significant dependency on 9-1-1 surcharges from local exchange services, for example, would have a detrimental effect on 9-1-1 funding since those services have declined significantly and can be expected to continue to decline. Including such market data in a *Funding Sustainment Model*, therefore, is an important tool for helping state and local 9-1-1 officials plan for the future.

While TFOPA reviewed a variety of data regarding historical communications trends, it did not conduct exhaustive research on future market expectations, and has not identified a source of market data that it believes could be reliably used by 9-1-1 administrators to accurately forecast the growth of communications services and their impact on available 9-1-1 funding.

Should current trends continue, however, the overall voice services market may continue to grow, but at a relatively modest rate as compared to historical trends, and inconsistently across different platforms. This yields two important conclusions for 9-1-1 administrators. First, such services should not be viewed as a

[68] *See 7th FCC Report*.

source of significant 9-1-1 revenue growth to the extent that higher levels of 9-1-1 funding support are needed in the future to support NG9-1-1 and future 9-1-1 services. This underscores the importance of identifying new sources of 9-1-1 revenue, as discussed in Section 5.4. Second, consistent with the guiding principles recommended by TFOPA, it is important for policymakers and 9-1-1 officials to establish parity among competing commercial services that are used to access 9-1-1. This would help to prevent funding shortfalls when changing consumer preferences shift market interest from one set of services to another (as has been the case for local exchange services).

5.4Potential New Mechanisms

5.4.1 Federal Grants

The responsibility for managing the nation's 9-1-1 systems largely falls to state and local authorities, and the responsibilities assigned to these jurisdictions will likely continue as future NG9-1-1 systems are implemented. However, the United States Government has a vested interest in the success of the nation's 9-1-1 systems, and various federal agencies have played important roles in supporting 9-1-1 services since their inception. Moreover, 9-1-1 systems are important components in the evolving emergency communications landscape and the National Emergency Communications Plan developed by the U.S. Department of Homeland Security (DHS).[69] In conjunction with the development of a nationwide public safety broadband network to be constructed by FirstNet[70] and emergency notification systems, such as EAS and WEA,[71] the nation's 9-1-1 systems help to facilitate timely and effective communications between public safety officials and the public during times of emergency.

Federal funding support for 9-1-1 services dates to the 1970's. At that time, the Law Enforcement Assistance Administration (LEAA), a federal agency within the U.S. Department of Justice, administered federal funding to state and local law enforcement agencies and funded educational programs, research, state planning agencies, and local crime prevention initiatives. Over the next several decades, various other 9-1-1 grant programs were established and each provided valuable assistance to local public safety agencies.

In 2004, Congress enacted the *Ensuring Needed Help Arrives Near Callers Employing 911 Act of 2004 (ENHANCE 911 Act)*, which created the E-911 Implementation and Coordination Office (National 911 Program), a federal entity housed within the National Highway Traffic Safety Administration at the U.S. Department of Transportation and jointly managed by the National Telecommunications and Information Administration at the U.S. Department of Commerce.[72] The mission of the National 911 Program is to provide federal leadership and coordination in supporting and promoting optimal 9-1-1 services, and its functions include administering a grant program for NG9-1-1 implementation. In 2009, the National 911 Program made more than $40 million in grants available to 30 states and territories to help 911 call centers across the nation upgrade equipment and operations. These grants have provided invaluable assistance to states in helping them to implement newer technologies, and some examples of how those grants have been used are summarized in Appendix F. In 2012, Congress appropriated an additional $115

[69] *See* https://www.dhs.gov/sites/default/files/publications/2014-11-07%20NECP%20Brochure_0.pdf.
[70] The First Responder Network Authority (FirstNet) was established by Congress in 2012 and tasked with the responsibility to oversee the construction and operation of a nationwide public safety broadband network for use by the nation's first responders. *See* Middle Class Tax Relief and Job Creation Act of 2012. Public Law 112-96.
[71] EAS ("Emergency Alert System") and WEA ("Wireless Emergency Alerts") are two public warning systems that are used to notify the public about major weather events and other emergencies.
[72] Ensuring Needed Help Arrives Near Callers Employing 911 Act of 2004 (ENHANCE 911 Act). Public Law 108-494.

million of funds to be made available for NG9-1-1 implementation, but as of this date these funds have not yet been made available. TFOPA encourages the National 911 Program and any other federal agencies involved in the grant authorization process to work diligently to make these funds available for NG9-1-1 implementation as soon as possible. While these federal grant programs have provided important funding to assist states and localities in improving their 9-1-1 systems, significant additional funding is needed in order for states to fully implement NG9-1-1.

5.4.1.1 Factors that support increased federal funding

The critical role that 9-1-1 systems increasingly play in the nation's emergency response efforts, and the manner in which NG9-1-1 systems are expected to be planned, built, and operated in the future, suggests both an increased responsibility for funding such systems at the national level and an increased opportunity to advance national 9-1-1 objectives through that increased federal funding. There are various factors that argue in favor of increased federal funding for 9-1-1 and NG9-1-1.

Criticality of 9-1-1 Services to National Security & Emergency Preparedness Efforts: Protecting our nation against a myriad of threats has become an increasing focus of the federal government in recent years. In 2011, President Barack Obama issued Presidential Policy Directive 8: National Preparedness (PPD-8) "to strengthen the security and resilience of the United States through systematic preparation for the threats that pose the greatest risk to the security of the Nation, including acts of terrorism, cyber attacks, pandemics, and catastrophic natural disasters."[73] In response to that directive, DHS developed a *National Preparedness Goal* that is designed to prevent, protect against, mitigate, respond to, and recover from those threats and hazards and which includes thirty one core capabilities for addressing these five mission areas.[74] DHS subsequently developed a detailed plan for each of these areas that outlines how the Federal Government, local, state, tribal, and territorial governments, the private sector, and nongovernmental organizations can work together to better prepare and protect the nation. Recognizing that "national preparedness is the shared responsibility of our whole community," these plans include citizens and communities as important contributors and participants in this *National Preparedness Framework*.

The role of the nation's public alert and warning systems during times of national emergency is clear, as they provide important mechanisms for providing the public with critical information about what is happening and what actions to take. However, recent events have clearly demonstrated that information from the public may be just as crucial during times of emergency, and, thus, the nation's 9-1-1 systems are an integral part of our national security and emergency preparedness efforts. This fact will become increasingly apparent as 9-1-1 systems transition to NG9-1-1 technologies and as state and local authorities gain access to a plethora of data that will enable them to respond more efficiently and more effectively to emergencies of all types.

NG9-1-1 will certainly enable local 9-1-1 authorities and first responders to more quickly provide assistance to a citizen in distress. However, the capabilities afforded by NG9-1-1 technologies will also enable the nation to better prepare for and respond to emergencies of a much greater scale. With NG9-1-1 technology, the emergency communications centers of the future will be at the center of a robust communications system that will support vital two-way communications between the public and first responders. This system will enable the country and its citizens to be better prepared for emergencies and to respond to them more effectively when they occur. If the data and information received by 9-1-1

[73] *See* https://www.dhs.gov/presidential-policy-directive-8-national-preparedness.
[74] *See* https://www.fema.gov/pdf/prepared/npg.pdf.

Public Safety Answering Points were leveraged, then 9-1-1 call centers could serve as sensors, in identifying incidents and trends that directly affect national security.

Interstate Coordination of 9-1-1 Networks and Services: Emergency response efforts do not stop at state or other jurisdictional boundaries. The numerous examples of emergency 9-1-1 calls that extend across such boundaries already demonstrate the need to coordinate the planning and operations of such systems. However, the need for interstate coordination and interoperability increases as both the nature of emergencies changes and the manner in which 9-1-1 systems are designed changes. As states transition from legacy 9-1-1 systems to advanced NG9-1-1 systems, the need for interoperability and the development and use of standardized data interfaces will be even more important, even when interconnecting network components and users within a single state.

In April 2016, the National Governors Association (NGA) Center for Best Practices, in partnership with the DHS Office of Emergency Communications (OEC), awarded five states the opportunity to participate in an NGA Policy Academy on Enhancing Emergency Communications Interoperability.[75] The five states invited to participate are Alaska, Hawaii, Illinois, Utah, and West Virginia. They will each develop specific strategies designed to strengthen current statewide interoperability plans, including assessing governance structures and standard operating procedures. In coordination with NGA and OEC, states will identify lessons learned and share best practices nationwide.

The NGA initiative demonstrates both the need for interoperability among states and the strong interest among states in advancing such national goals. However, these coordination and interoperability requirements add to the financial burdens of states that already have a daunting task in funding future 9-1-1 systems. Federal grant support will help to ensure that such coordination and interoperability is achieved.

Sharing of NG9-1-1 Network Components: In the *First TFOPA Report*, TFOPA noted that the implementation of NG9-1-1 systems provides a significant opportunity to share various network components, databases, and infrastructure among multiple PSAPs.[76] This might include assets that are national in scope, e.g., a National Forest Guide. As the report notes, "such sharing offers the potential for optimization in many areas such as cost, operations, interoperability, shared services and survivability."[77] The availability of federal funds to support such sharing would be both appropriate and, in some cases, necessary to facilitate a more efficient and cost effective system.

Securing the Nation's 9-1-1 Systems Against Cyber Threats: NG9-1-1 presents an incredible opportunity to improve emergency response efforts by incorporating advanced IP-based technologies and broader access to data not afforded by today's 911 systems. However, these same IP-based technologies and the myriad of public and private networks with which they interconnect present new levels of exposure to cyber threats. State and local 9-1-1 authorities must understand these threats and actively manage associated cyber risks as part of a comprehensive risk management program.

In the *First TFOPA Report*, TFOPA proposed a cooperative and synergistic approach to cybersecurity for emergency communications, including core cybersecurity services, interconnected monitoring and mitigation, and near real-time information sharing amongst multiple levels of public safety agencies and

[75] *See* https://www.dhs.gov/safecom/blog/2016/04/07/five-states-awarded-opportunity-participate-national-governors-association.
[76] *See First TFOPA Report* at 21-22.
[77] Ibid.

entities.[78] TFOPA's recommendations are based on the National Institute of Standards and Technology (NIST) Cybersecurity Framework,[79] the National Initiative for Cybersecurity Education (NICE),[80] and the ongoing work of the FCC's Communications, Security, Reliability, and Interoperability Council (CSRIC),[81] and each help to enhance the significant work being done in this area by DHS, APCO, NENA, and others.

The implementation of effective measures to ensure proper cybersecurity, however, should not be left to state and local 9-1-1 authorities alone. The criticality of the nation's 9-1-1 systems to the overall security and preparedness of the country and the significant potential for cyber-based threats to undermine those systems argue strongly in favor of both national-level coordination and federal funding support to promote effective and secure NG9-1-1 systems.

5.4.1.2 Options for increased federal funding

Until recently, local and state jurisdictions have had no single source of information regarding federal funding for emergency communications. To address these and other issues, and following recommendations from the 9/11 Commission Report,[82] Congress authorized the establishment of the Emergency Communications Preparedness Center (ECPC) – a federal interagency focal point for interoperable and operable communications coordination. Its fourteen federal members represent departments and agencies which roles include regulation, policy, operations, grants, and technical assistance for emergency communications.[83]

The structure of the ECPC includes an Executive Committee, a Steering Committee, and Focus Groups, which function much like committees in doing the work of the ECPC. An annual product of the Grants Focus Group is a document entitled, "The ECPC Federal Financial Assistance Reference Guide."[84] While the primary purpose of the *ECPC Reference Guide* is to provide common guidance for federal program managers, the document also provides a comprehensive list of all federal programs that fund emergency communications.

Some of these federal programs explicitly include 9-1-1 and NG9-1-1 as an eligible use of grant funds or eligibility for low-interest loans. Other programs don't explicitly mention 9-1-1 or NG9-1-1, but they do have eligibility criteria that could include some components applicable to 9-1-1 or NG9-1-1. Appendix D includes a list of federal grant programs that might offer opportunities to support various 9-1-1 or NG9-1-1 activities.

TFOPA recommends that states consider how existing federal grant programs focused on emergency communications might help to address their 9-1-1 and NG9-1-1 funding needs. We encourage 9-1-1 administrators to establish an ongoing relationship with the designated point-of-contact in their state that is generally responsible for submitting applications for these federal funds. Additional information is available at www.grants.gov. Interested parties can access ECPC documents by registering on the ECPC

[78] *See generally First TFOPA Report* at Section 4.
[79] *See* https://www.nist.gov/cyberframework.
[80] *See* http://csrc.nist.gov/nice/.
[81] *See* https://www.fcc.gov/about-fcc/advisory-committees/communications-security-reliability-and-interoperability.
[82] *See* https://9-11commission.gov/report/.
[83] Emergency Communications Preparedness Center, https://www.dhs.gov/emergency-communications-preparedness-center, last accessed September 17, 2016.
[84] "Emergency Communications Preparedness Center: Federal Financial Assistance Reference Guide ("*ECPC Reference Guide*")," Recommendations and Resources for Federal Program Managers of Emergency Communications Funding, 2016.

Clearinghouse, which resides on the MAX website (https://max.omb.gov) and allows staff of federal agencies and their partners to share emergency communications information.

5.4.1.3 Recommended federal grant guidelines

All federal grant programs include guidelines that are designed to promote national policies consistent with Administration policy and the direction of Congress. Some of these guidelines are broad (e.g., use of competitively neutral acquisition procedures), while others are related to specific statutes designed to promote particular objectives (e.g., conditions tied to specific 9-1-1 grant programs). TFOPA reviewed various guidelines that it believes are relevant to 9-1-1 services, and considered how these principles might help to advance NG9-1-1 implementation and the principles and objectives that TFOPA has identified as being important.

ECPC Reference Guide. The *ECPC Reference Guide* provides common guidance for federal program managers to use when developing notices of funding opportunities, award agreements, performance and financial reports, and other program materials, and includes common grant guidelines for applicants of emergency communications funds. Consequently, it is a useful starting point for information about guidelines applicable to federal grants that might be used for 9-1-1 and NG9-1-1. Besides offering general guidance on the development of appropriate federal grant guidelines, TFOPA believes that the *ECPC Reference Guide* provides important guidance on several specific issues relevant to 9-1-1 and NG9-1-1 systems and services. Section 2.1.2 of the *ECPC Reference Guide* discusses the cybersecurity risks associated with evolving to an IP-based network, and recommends a multifaceted approach to ensure the confidentiality, integrity, and availability of sensitive information. The guide states that "…assessments of cyber risks, strategies to mitigate vulnerabilities, and responses to security breaches must be conducted before the deployment of IP-based networks occurs to ensure that mission requirements can be met securely and reliably from the outset."[85] Section 3.1 references the *SAFECOM Guidance on Emergency Communications Grants* (*SAFECOM Guidance*), which provides general guidance for entities applying for federal financial assistance for emergency communications projects, and Section 3.2 references various project-specific recommendations. These requirements include: (a) statewide coordination; (b) alignment of specific project objectives with broader state emergency communications objectives; (c) adherence to technical standards; (d) effective security provisions; and (e) effective training practices.

Ensuring Needed Help Arrives Near Callers Employing 911 Act of 2004 (ENHANCE 911 Act). Enacted in 2004, the *ENHANCE 911 Act* is the federal law that created the National 911 Program.[86] It also required the establishment of a federal grant program to support the implementation of enhanced 9-1-1 (E9-1-1) services, and required certain conditions associated with those grants including: (a) state and local funds to match federal grants; (b) coordination among PSAPs within the state; (c) a designated single point-of-contact in the state for coordination with the federal government; (d) the existence of a state plan for E9-1-1; and (e) a certification that other 9-1-1 funds are not being diverted to non-911 purposes. The National 911 Program issued 9-1-1 grants totaling more than $41 million.

New and Emerging Technologies 911 Improvement Act of 2008. The *NET 911 Improvement Act* required the National 911 Program to develop a national plan for migrating to IP-enabled 9-1-1 systems, which provides useful guidance to state and local officials in their efforts to implement NG9-1-1 systems and services.[87] The *NG911 Migration Plan*, released in 2009, addresses a variety of issues including: (a) identification of implementation barriers and funding mechanisms to address those barriers; (b) specific

[85] Ibid, 5.
[86] *ENHANCE 911 Act*. Public Law 108-494.
[87] *NET 911 Improvement Act*. Public Law 110-283.

mechanisms for ensuring NG9-1-1 is available in every community and coordinated statewide; (c) requirements for engagement with PSAPs and other public safety officials within the state; (d) identification of statutory recommendations necessary to implement NG9-1-1; and (e) equal access for those citizens with disabilities.

Next Generation 9-1-1 Advancement Act of 2012. Subtitle E of the *Middle Class Tax Relief and Job Creation Act of 2012* (the legislation that established FirstNet) includes grant provisions applicable to NG9-1-1 implementation.[88] These provisions amend the current statute applicable to the National 911 Program, and extend the same grant conditions applicable to E9-1-1 to NG9-1-1. (*See ENHANCE 911 Act* above).

State and Local Implementation Grant Program (SLIGP). Subtitle C of the Middle Class Tax Relief and Job Creation Act of 2012 includes the establishment of a State and Local Implementation Fund to support the development of a nationwide public safety broadband network by FirstNet. The National Telecommunications and Information Administration (NTIA) established SLIGP to comply with that statutory requirement.[89] While SLIGP is not designed to support 9-1-1 and NG9-1-1 services, TFOPA believes that the conditions applicable to SLIGP grants might offer useful insights into the types of grant conditions that might be effective to such services. SLIGP includes the following requirements: (a) a governance structure to consult with FirstNet; (b) procedures to ensure state coordination and local representation; (c) a process for public education; and (d) a comprehensive plan that ensures interoperability.

SAFECOM Grant Guidance. SAFECOM was formed to improve public safety interoperability, allowing emergency responders to communicate effectively before, during, and after emergencies and disasters. SAFECOM's mission is to improve designated emergency response providers' inter-jurisdictional and inter-disciplinary emergency communications interoperability through collaboration with emergency responders across Federal, State, local, tribal, and territorial governments, and international borders. To further these ideas, SAFECOM annually publishes "Emergency Communications Grant Guidance," and compliance requirements for DHS Grants include conforming to NG911 standards, as published in the document entitled "NG911 Standards Identification and Review," a compendium of all NG911 standards published annually by the National 911 Program.

TFOPA believes that it is important that federal funds be used in a manner that advances important national, state and local emergency service goals and promotes the timely and effective deployment of NG9-1-1 systems and services. Having reviewed the various statutes noted above, and in consideration of various issues already identified as important to NG9-1-1 deployment, TFOPA recommends that the following conditions be considered for any new federal grants to support NG9-1-1:

1) Conformance to open, non-proprietary and commercially available standards;
2) Interoperability with other PSAPs, States, and FirstNet;
3) Open, transparent and competitive acquisition process;
4) Access to NG9-1-1 for all communities and citizens;
5) Development of a Statewide Plan and coordination with local authorities;

[88] The *Next Generation 9-1-1 Advancement Act of 2012* was enacted as Subtitle E of the *Middle Class Tax Relief and Job Creation Act of 2012*. Public Law 112-96.
[89] For more information on SLIGP, see https://www.ntia.doc.gov/category/state-and-local-implementation-grant-program.

6) Plan provisions that protect the NG9-1-1 network against cyber attacks;
7) Public education and outreach plan;
8) Matching state and/or local grants;
9) Designated officer in each state as single point-of-contact; and
10) Certification that no 9-1-1 fees are being diverted for non-911 purposes.

5.4.1.4 TFOPA recommendation for additional federal funding

TFOPA believes that NG9-1-1 is an integral part of the nation's emergency communications and response system, and should be viewed as a national security imperative. For those reasons, and other reasons outlined in this report, TFOPA recommends that a substantial amount of federal funding be made available to support the implementation of NG9-1-1 nationwide. Moreover, we recommend that such federal funds be made available to state and local authorities subject to the conditions outlined in Section 5.4.1.3 above.

5.4.2 State Grants

While TFOPA supports the availability of additional 9-1-1 funding through federal grant programs, it also recognizes that there are numerous state grant programs that may offer an additional source of funding for 9-1-1 administrators. While we did not undertake an extensive review of such programs, several examples are identified below. TFOPA strongly supports the continued funding of these critical programs.

> **Virginia:** Virginia's 9-1-1 Services Board administers a multi-million dollar PSAP Grant Program to "financially assist primary Virginia PSAPs with the purchase of equipment and services that support the continuity and enhancement of wireless E-911."[90]
>
> **Florida:** Florida's E911 Board provides three separate grant programs including a Rural Grant Program, an E911 State Grant Program, and an E911 Emergency Grant Program.[91]
>
> **Massachusetts:** Massachusetts Office of Public Safety and Security administers several grant programs including the Support and Incentive Grant Program, the Training Grant and Emergency Medical Dispatch Grant Program, the Regional and Regional Secondary PSAP and Regional Emergency Communications Center Development Grant Program, and the Wireless State Police Grant Program.[92]

5.4.3 Network Connection Fee

5.4.3.1 Overview of TFOPA's January 29, 2016 report

The *First TFOPA Report* recommended consideration of a Network Connection Fee (NCF) as an option for 9-1-1 funding that could potentially provide a more equitable means of collecting and remitting 9-1-1 fees in lieu of current mechanisms. This approach, as outlined in the report, would "assess 9-1-1 fees on end user connections to the facilities-based communications providers over whose facilities voice telephony and other communications with a PSAP can be initiated."[93] Thus, instead of assessing 9-1-1 fees on end users of certain communications services, a NCF would be assessed on the end users of

[90] For more information, see http://www.vita.virginia.gov/isp/default.aspx?id=8578.
[91] For more information, see http://www.dms.myflorida.com/business_operations/telecommunications/enhanced_911/e911_grant_information.
[92] *See* http://www.mass.gov/eopss/agencies/state-911/grant-applications.html.
[93] *See First TFOPA Report*, 167.

network connections provided by facilities-based providers of communications services over which 9-1-1 access is possible. The report notes that the intent of such a fee is to "treat equally all facilities-based network connection providers on whom 9-1-1 fee collection and remittance can be practically enforced," while also treating "equally providers of non-facilities-based communications capabilities provided over those network connections (including capabilities provided by the facilities-based providers) on which no fee would be assessed."[94]

The *First TFOPA Report* notes that there may be certain advantages to application of a NCF in lieu of the current system. This includes making the collection and remittance process easier and more practically enforceable by only requiring that fees be paid by facilities-based providers that are readily identifiable. The report also posits that a NCF approach would help to promote more effective competition among comparable services by eliminating the "free rider" problem, a problem created by the failure of independent VoIP providers and Independent Retailers to collect and remit 9-1-1 fees.[95]

Today, broadband service providers often offer their customers voice services that use the underlying broadband connection, and they typically assess a 9-1-1 fee on such voice services. Broadband consumers, however, may also purchase voice services from competing service providers that use the underlying broadband connection, including those that provide over-the-top services. These non-facilities-based competitors typically do not assess a 9-1-1 fee on the voice services they provide. This disparity in the way in which 9-1-1 fees are collected and remitted for competing voice services is what creates the "free rider" problem, as it allows some end users of communications services to avoid paying the 9-1-1 fee. It may also yield a price advantage to independent VoIP providers as compared to their facilities-based competitors. The NCF concept, posited by TFOPA in its earlier report, is to replace the current 9-1-1 fee structure, which relies on collection and remittance of fees by providers of voice services, with a mechanism that applies the fee to the underlying broadband connection that may be used by multiple voice service providers. The theory is that such an approach, if implemented effectively, might help to ensure that all end users pay their fair share of 9-1-1 costs, that there be no duplicative 9-1-1 fees paid by any end user, and that there be no harmful effect on competition for voice, broadband, and other communications services. The *First TFOPA Report* recommended that further study be undertaken regarding how a NCF might be established and how it might be applied to broadband services in a manner that ensures these requirements are satisfied.

The *First TFOPA Report* noted that there is some question about the legality of using a NCF framework, but it did not take a formal position on that issue. TFOPA continues to believe that it is inappropriate for it to make any judgments about the legality of a NCF. However, in this report, we do consider potential options for applying a NCF, to the extent it is considered lawful to do so, and consider what impacts those options might have both on consumers and on the state of competition.

---

[94] Ibid.

[95] A "free rider" problem occurs when some beneficiaries of a common service or improvement are able to avoid paying their share of the costs of the service or improvement. This may occur by simply refusing to pay until other users deem the value of the service or improvement sufficient to pay the hold-out's share, or through a "loophole" that permits the user to avoid paying their share of the cost. The consequences of either can be that other users will be incentivized to take similar action. This results in a declining number of users to pay an increasingly larger share of the cost of the service or improvement until the fees become unsustainable. In the case of 9-1-1 fees, if VoIP users, for example, find that they can avoid paying the fee by purchasing broadband services that don't carry it and obtaining VoIP, text, video and other such services from over-the-top providers which do not collect and remit 9-1-1 fees, they will do so. This problem adversely impacts the facilities-based providers which reliably collect and remit 9-1-1 fees, as well as the amount of funds available to support 9-1-1 services.

It is also important to note that TFOPA's analysis presented here is limited to wireline services provided to residential consumers and does not include either wireless services or wired broadband services provided to businesses. With respect to wireless services, TFOPA's earlier report noted that "under a connection-based fee program, a single surcharge per account-user device would continue to apply" as it does in many states today.[96] This recommendation was based on the current manner in which consumers are charged for wireless services, and recognizes the fact that the current 9-1-1 surcharge regime for wireless is consistent with the principles outlined by TFOPA. If the manner in which wireless service providers charge their customers were to change significantly, then a review of this surcharge regime may be warranted.

With respect to broadband services offered to businesses, TFOPA did not include that analysis because it was unable to obtain access to the existing 9-1-1 fee data used in each state for these services. Traditionally, business customers that purchase trunk lines into a Private Branch Exchange (PBX), for example, would pay a 9-1-1 fee for each line derived from the trunk (e.g., 24 per typical trunk). Though some regulations may cap the fee at a particular number of trunks, TFOPA believes that this fee structure, which assesses 9-1-1 fees based on the number of derived channels, is generally consistent with its recommended funding principles. As business customers shift to IP-based broadband services, however, this fee structure may no longer apply and may not be standardized even within a given jurisdiction. Unfortunately, since TFOPA was not able to obtain specific 9-1-1 fee data for such services, it was unable to include any detailed analysis in this report. TFOPA believes that further study of this issue is warranted and should be completed before reaching any final conclusions about the applicability of a NCF approach on broadband services provided to businesses. The Local State Advisory Committee, which TFOPA recommended be established in its *First TFOPA Report*, may be an appropriate body for completing such an analysis.

5.4.3.2 Options for applying a NCF on residential broadband services

The *First TFOPA Report* did not explicitly recommend any particular options for applying a NCF to broadband connections that support voice telephony and other communications services. It did note, however, that broadband services provide consumers with significantly greater capacity. As a result, such services would facilitate access to 9-1-1 services in multiple ways (e.g., voice, text, video) and could support many more voice channels as compared to a traditional telephone access line.[97] As an example, a broadband service that supports a data rate of 10 Mbps might support more than a hundred voice-grade equivalent services, depending on how the network connection was configured. The *First TFOPA Report* stressed, however, that any capacity-based fee (should one be used in the future) should be designed to be equitable to both consumers of broadband services and competing providers of such services on a technology and competitively neutral basis.

TFOPA addresses here potential options for applying a NCF on the underlying broadband connection that supports voice telephony and other communications services provided to residential consumers, as a means to consider the potential effects on consumers and competition. While there may be any number of permutations that could be considered, TFOPA focuses its attention on four general options:

> *Single Flat-Rate 911 Charge:* This option would apply a single flat-rate 911 fee on any underlying network connection that would support any means to access 911 (e.g., voice, text, video, etc.).

[96] *See First TFPA Report*, 170.
[97] *See First TFOPA Report*, 170.

Mode-Dependent 911 Charges: This option would apply a separate 911 fee for each mode of 911 access supported, e.g., an underlying network connection that supports both voice and video access to 911 would be assessed two fees.

Capacity-Based 911 Charge (Per Voice Equivalent): This option would apply a separate 911 fee for each voice equivalent channel that could be supported on the underlying network connection.

Revenue-Based 911 Charge: This option would apply a 911 fee based on the total revenue derived by the underlying network provider, e.g., 2% of monthly price.

5.4.3.3 Analysis of the potential effects on consumers and competition

TFOPA evaluated each of the general options identified above to assess the impact of the changing communications market on the 9-1-1 revenues derived for use by state and local authorities, on consumers, and on competition. In performing our analyses, we limited our assessment to wireline services and made certain assumptions about both the nature of those services and the 9-1-1 fees assessed on those services. A description of those assumptions is provided below:

Assumption #1: Impacts on consumers and available 9-1-1 funds are evaluated on a per-consumer basis.

Assumption #2: All options are compared to an existing 9-1-1 funding framework where a $1 per month 9-1-1 fee is assessed uniformly on local exchange service and integrated VoIP services; no 9-1-1 fees applied to other service arrangements.

Assumption #3: For non-revenue-based options, a base 9-1-1 fee of $1 per month is used, e.g., $1 per POTS line, $1 per mode of access, and $1 per equivalent voice channel.

Assumption #4: For the revenue-based option, a base 9-1-1 fee of 2% of revenue is used, and market pricing estimates of $40, $50, and $60 per month, respectively, are assumed for 25 Mbps, 50 Mbps, and 100 Mbps Internet access services.

Assumption #5: For the capacity-based option, it is assumed that the 9-1-1 fee would be based on the capacity of the "upstream" communications channel, i.e., communications from the end user to the network, and that each 1 Mbps data rate would support 8 equivalent voice channels.[98]

Assumption #6: For the mode-dependent option, it is assumed that a broadband data connection would support two modes of 9-1-1 access, i.e., voice and non-voice.

Based on the assumptions and other considerations noted above, TFOPA developed a quantitative model that compares the various options and assesses the impacts on consumers and on available 9-1-1 revenues. Table 5.1 summarizes the quantitative results of that analysis.

[98] Traditionally, broadband services offered to residential consumers have been asymmetrical, with downstream data speeds being significantly higher than upstream speeds. In recent years, broadband services have begun to shift to symmetrical arrangements, where the downstream and upstream capacity is equal. Both types of arrangements are evaluated in TFOPA's analysis presented here.

Table 5.1. Impact of NCF Options on 9-1-1 Revenues and Consumers

Option	Connection	Baseline	NCF	Impact on 911 Revenue	Impact on Consumers
Single Charge	POTS Line	$1.00	$1.00	$0.00	$0.00
	25 Mbps (data only)	$0.00	$1.00	$1.00	-$1.00
	25 Mbps (w/ voice)	$1.00	$1.00	$0.00	$0.00
	50 Mbps (data only)	$0.00	$1.00	$1.00	-$1.00
	50 Mbps (w/ voice)	$1.00	$1.00	$0.00	$0.00
	100 Mbps (data only)	$0.00	$1.00	$1.00	-$1.00
	100 Mbps (w/ voice)	$1.00	$1.00	$0.00	$0.00
Mode-Dependent	POTS Line	$1.00	$1.00	$0.00	$0.00
	25 Mbps (data only)	$0.00	$2.00	$2.00	-$2.00
	25 Mbps (w/ voice)	$1.00	$2.00	$1.00	-$1.00
	50 Mbps (data only)	$0.00	$2.00	$2.00	-$2.00
	50 Mbps (w/ voice)	$1.00	$2.00	$1.00	-$1.00
	100 Mbps (data only)	$0.00	$2.00	$2.00	-$2.00
	100 Mbps (w/ voice)	$1.00	$2.00	$1.00	-$1.00
Capacity-Based	POTS Line	$1.00	$1.00	$0.00	$0.00
	25 Mbps/25 Mbps (data only)	$0.00	$200.00	$200.00	-$200.00

Option	Connection	Baseline	NCF	Impact on 911 Revenue	Impact on Consumers
	25 Mbps/4 Mbps (data only)	$0.00	$32.00	$32.00	-$32.00
	25 Mbps/25 Mbps (w/ voice)	$1.00	$200.00	$199.00	-$199.00
	25 Mbps/4 Mbps (w/ voice)	$1.00	$32.00	$31.00	-$31.00
	50 Mbps/50 Mbps (data only)	$0.00	$400.00	$400.00	-$400.00
	50 Mbps/8 Mbps (data only)	$0.00	$64.00	$64.00	-$64.00
	50 Mbps/50 Mbps (w/ voice)	$1.00	$400.00	$399.00	-$399.00
	50 Mbps/8 Mbps (w/ voice)	$1.00	$64.00	$63.00	-$63.00
	100 Mbps/100 Mbps(data only)	$0.00	$800.00	$800.00	-$800.00
	100 Mbps/16 Mbps (data only)	$0.00	$128.00	$128.00	-$128.00
	100 Mbps/100 Mbps (w/ voice)	$1.00	$800.00	$799.00	-$799.00
	100 Mbps/16 Mbps (w/ voice)	$1.00	$128.00	$127.00	-$127.00

Option	Connection	Baseline	NCF	Impact on 911 Revenue	Impact on Consumers
Revenue-Based (2%)	POTS Line	$1.00	$0.20	-$0.80	$0.80
	25 Mbps (data only)	$0.00	$0.80	$0.80	-$0.80
	25 Mbps (w/ voice)	$1.00	$0.80	-$0.20	$0.20
	50 Mbps (data only)	$0.00	$1.00	$1.00	-$1.00
	50 Mbps (w/ voice)	$1.00	$1.00	$0.00	$0.00
	100 Mbps (data only)	$0.00	$1.20	$1.20	-$1.20
	100 Mbps (w/ voice)	$1.00	$1.20	$0.20	-$0.20

TFOPA believes that several general conclusions can be reached through this simple analysis, especially as each identified NCF option might compare to the others. The Capacity-Based Option would result in 9-1-1 fees that are significantly higher for broadband consumers, potentially exceeding hundreds of dollars each month, without a commensurate increase in 9-1-1 access. Such an approach, as compared to other options, is inherently unreasonable and inequitable to consumers, as it would unfairly impose a significantly higher 9-1-1 funding burden on broadband consumers. Today, residential broadband connections routinely support 100 Mbps data rates, and these rates are often supported in both the downstream and upstream directions. These data rates theoretically equate to 800 (or more) equivalent voice channels, if those broadband connections were actually used for that purpose. They are typically not. Even if one were to limit the analysis to asymmetrical data services where the available upstream capacity is significantly less than downstream capacity, the disparity between broadband consumers and others that access the 9-1-1 system is still significant. Importantly, consumers purchase broadband services to support the video and high-speed data services that are widely available over the Internet and not to conduct multiple simultaneous voice calls. TFOPA believes that the use of a capacity-based approach for 9-1-1 fees would be inconsistent with the principles outlined in Section 5.2 of this report. In addition to being unreasonable and inequitable, it would not be based on a consumer's ability to request emergency services but rather on factors unrelated to 9-1-1.

The Revenue-Based Option also raises questions as to consistency with the funding principles recommended by TFOPA. Based on our assumptions and analysis, broadband consumers would pay 9-1-1 fees anywhere from four to six times that of consumers of traditional local exchange service without any corresponding benefit in their ability to access 9-1-1 services. Depending on how the percentage of revenue factor is applied, those fees may be considerably higher. This option may also introduce additional complexity into the fee collection and remittance process, and make it more difficult for state and local 9-1-1 authorities to accurately estimate available 9-1-1 funds and, thus, plan for future 9-1-1 expenditures.

The Single Charge and Mode-Dependent Options are more equitable from a consumer perspective. They would assess 9-1-1 fees in a manner that is more commensurate with a consumer's ability to access 9-1-1 services including on services for which 9-1-1 fees do not apply today, e.g., a data-only service.

Admittedly, any assessment of the equitability of the Mode-Dependent Option hinges to a large degree on the number of "modes" of 9-1-1 access that are assumed available to consumers for 9-1-1 fee assessment purposes and how many such modes are actually utilized by those consumers. If our assumption about two supported modes (i.e., voice and non-voice) were increased to three or four (e.g., voice, video, data and/or text), the impact on consumers would be significantly greater, and such an approach may be deemed less equitable if consumers generally don't leverage such modes to access 9-1-1 services. The use of a Mode-Dependent Option may be difficult to implement and enforce, as the format of data transmitted may not be discernable. It may also act as a disincentive to facilitating new modes of accessing 9-1-1, as consumers may not want to pay the additional charges they would incur. And, such an approach may unfairly assess higher fees on some segments of the community that rely on these different modes of communications to access 9-1-1 (e.g., the hearing and speech impaired). On the other hand, 9-1-1 authorities could view such an approach positively, as it might discourage consumers from using some modes of 9-1-1 access that might significantly strain PSAP resources without any corresponding benefit to the caller or the public at large. 9-1-1 administrators should carefully consider all each of these effects on consumers before implementing a Mode-Dependent Option. Importantly, TFOPA believes that any consideration of 9-1-1 fees based on different modes of 9-1-1 access should also be predicated on whether PSAPs have incorporated changes to their 9-1-1 systems that allow those modes to be used.

The Single Charge Option (evaluated here for wireline services) is arguably comparable to the manner in which 9-1-1 fees are currently assessed to wireless services. As described in the *First TFOPA Report*, wireless service providers assess 9-1-1 fees on a per-device basis and not separately for voice and data services that might be supported on that device. TFOPA recommended continuation of that approach even under a potential NCF-based approach, arguing that assessing charges on both a per-device basis and on a NCF basis for wireless services would be duplicative. Admittedly, wireline services are different than wireless services in that the latter are generally purchased with the inclusion of voice services while the former are often not. In any event, of the four options considered, TFOPA believes that the Single Charge Option may be the most consistent with its recommended funding principles. It would assess 9-1-1 fees on services that enable access to 9-1-1 and would include broadband services that don't currently carry such a fee today, while eliminating the fee from voice services that use those broadband connections. It would also be technology neutral (e.g., as compared to wireless services) and more reasonable and equitable to consumers by avoiding excessive and duplicative charges.

Before making any specific conclusions about these NCF options, however, TFOPA believes it is important to undertake a thorough competitive analysis. Competitive neutrality is an important principle that TFOPA believes should be supported in any 9-1-1 funding mechanism. Assessing 9-1-1 fees disparately on different service providers (or their customers) would be unfair to those service providers (and their customers) and would have a detrimental effect on competition and, consequently, ultimately harm all consumers. While TFOPA was not able to conduct a thorough competitive analysis, it does believe that certain general conclusions can be reached regarding the impact on competition of the four identified NCF options.

As noted earlier, a "free-rider" problem results when 9-1-1 fees are not collected from end users on a competitively neutral basis by all service providers. This is an important 9-1-1 funding challenge that should not be trivialized, and demonstrates the importance of enforcing statutes that require service providers to collect and remit fees (or alternatively, finding sources of 9-1-1 funds that don't depend on

communications services). The implementation of a NCF approach may address that problem by ensuring that all end users with access to the underlying broadband connection pay an appropriate 9-1-1 fee. However, a shift to a NCF approach will not necessarily resolve any competitive disparities between services provided by facilities-based providers and those provided by their non-facilities-based counterparts. Rather, it may simply serve to institutionalize, as accepted practice, the disparate treatment of competing services that each facilitates access to 9-1-1. By applying an obligation to collect and remit 9-1-1 fees only on broadband network operators, a NCF could provide an unfair advantage to Independent VoIP providers that would have no such obligation. While this may be deemed to be equitable to some consumers, because duplicative charges are avoided, it may not eliminate the competitive disparity that may exist between service providers unless there is a mechanism for facilities-based providers to pass on a portion of those 9-1-1 fees to independent VoIP providers that use their facilities to provide VoIP services. It is not clear to TFOPA whether and how this problem might be addressed given that facilities-based providers may have little if any visibility into the third party VoIP applications their customers use.

TFOPA was not able to undertake a more thorough examination of this problem including what means may be available to "level the playing field" between facilities-based providers and their non-facilities-based competitors. Before further consideration is given to implementing a NCF-based approach, TFOPA believes that a more rigorous examination of these competitive issues should be undertaken. We do note, however, that there is a clear disparity in the competitive effects that may result from different NCF options. The Capacity-Based and Revenue-Based Options would clearly have a greater competitive impact because the amount of 9-1-1 fees assessed on broadband connections would be considerably higher, and thus, would create a significant competitive disadvantage should there be no mechanism available to share those costs with non-facilities-based competitors that use the broadband facilities. By comparison, the Single Charge Option would have the least competitive impact since it would result in the lowest 9-1-1 fee and a fee more comparable to 9-1-1 fees assessed on wireless and traditional local exchange services (based on stated assumptions).

6 Development of a Funding Sustainment Model

The availability of a *Funding Sustainment Model* will enable 9-1-1 authorities to make more informed judgments about the sufficiency of available 9-1-1 funds. The development of such a model requires that both the costs associated with 9-1-1 and NG9-1-1 deployment and operations and the funds necessary to cover those costs be evaluated in order to assess whether sufficient funds are available. TFOPA developed such a model that considers both the 9-1-1 and NG9-1-1 cost categories identified in Section 4 and the available funding sources to support 9-1-1 and NG9-1-1 services identified in Section 5.

Section 4 identified the common costs of 9-1-1 and NG9-1-1 systems based on the NG9-1-1 Maturity Model used by the National 911 Program for its ongoing NG9-1-1 cost study. By applying the *Funding Sustainment Model* to those cost components applicable to each domain and maturity stage of the Maturity Model, state and local 9-1-1 administrators can estimate the costs associated with each domain category and whether or not sufficient funds can be expected to be available at each stage of deployment as it transitions from legacy 9-1-1 systems to an end state NG9-1-1 system.

Section 5 identifies 9-1-1 funding mechanisms commonly employed today by state and local authorities (e.g., surcharges on communications services) and potential new 9-1-1 funding mechanisms (e.g., new federal grants or a network connection fee). Each of these mechanisms is included in the *Funding Sustainment Model*, though individual states and localities may or may not choose to employ one or more of these mechanisms. As previously noted, estimates of the 9-1-1 funds available through communications service fees would have to take into account the impact of changing market conditions across the various stages of NG9-1-1 deployment (to the extent such effects can be estimated). Given the

dependency of current funding on these fees, it is important that 9-1-1 authorities perform regular market analyses to understand the impact that changing market conditions will have on available funds.

This *Funding Sustainment Model* is shown Table 6.1. TFOPA acknowledges that each of the component cost categories identified in the model can, and should, be broken down into greater levels of detail, subject to the needs of each individual 9-1-1 authority. Only the more general categories of costs are shown here for illustrative purposes.

Table 6.1. *Funding Sustainment Model*

9-1-1 / NG9-1-1 Costs	
Cost Category	**Cost Amount**
Business Domain:	
Planning	
Governance	
Policy	
Procurement	
Implementation	
Data Domain:	
MSAG & ALI	
GIS	
Additional Data	
Applications/Systems & Infrastructure Domains:	
Physical Facilities	
Network Infrastructure	
Call Routing	
Call Handling	
Recording and Logging	
Dispatch Solutions	
CAD Systems	
Mapping	
Other PSAP Equipment	
Security Domain:	
Physical Security	
Systems Security	
Data Security	

Operational/Performance Domain:	
Training	
Contingency Plans	
Other Services	
Personnel	
Total Costs =	
9-1-1 / NG9-1-1 Funds	
Funding Source	**Funding Amount**
General Revenue Tax Funds:	
City & County Taxes	
State Taxes	
Fees on Communications Services:	
Wireline Service Fees	
Post-paid Wireless Service Fees	
Pre-paid Wireless Service Fees	
VoIP Service Fees	
Broadband Service Fees (if applicable)	
Grant Funds:	
Federal Grants	
State Grants	
Other Sources: (list; e.g., dedicated tax funds)	
Total Available Funds =	
Total Costs =	
Funding Surplus or Shortfall =	

APPENDIX A

Statewide Procurement of 9-1-1 and NG9-1-1 Services and Systems

State 9-1-1 Administrators of three states (New Hampshire, Texas and Massachusetts) shared with TFOPA their experiences in establishing statewide procurement contracts to build and operate components of their 9-1-1 and NG9-1-1 systems.

New Hampshire Statewide Procurement

New Hampshire is one of two states with one, statewide 9-1-1 system. For more than two decades, all purchases have been procured at the state level. All 9-1-1 calls are accepted at the statewide level and are forwarded to local dispatch centers. Mr. Bruce Cheney (ENP), Director of Emergency Services and Communications for the State of New Hampshire, has overseen the procurement processes and rollout of the statewide 9-1-1 systems since 1995. Mr. Cheney highlighted the following ideas for states in considering statewide system procurement and operation:

- Statewide procurement is cost effective. Not only is it cost effective in purchasing and consolidating software and equipment, but also it is extremely cost effective when personnel and employee training is taken into consideration. It is expensive to train telecommunicators, but because New Hampshire can do it on a larger scale, the cost is more efficient. Mr. Cheney describes this using the following example, "If you have two- to-five telecommunicators working at one time, and you need to retrain them, are you in a position to take them off the phones and put them in training? When you have 70-80 operators, it's easy to do. When you're doing it on a larger scale, you can accommodate situations like sick personnel and taking them off the phones is much more manageable."
- Local stakeholder input is critical. Mr. Cheney and the New Hampshire Emergency Services and Communications office traveled to every city in the state to engage local city councils, boards, and dispatch centers in the statewide procurement process. During these engagements, Mr. Cheney was able to determine specific requirements of these local dispatch operations, including GIS mapping and adjusting to the specific needs of unique calls from people with disabilities and aging populations. In this effort, New Hampshire utilized the supplemental automatic location information (ALI) system to address the needs of callers who required special care.
- Procurement planning is integral. New Hampshire is currently in the procurement process for an NG9-1-1 upgrade. This would be the third iteration of software since their statewide office opened in 1995. The State of New Hampshire advises to take special consideration in selecting vendors to ensure the technology can fully address the operational needs of NG9-1-1. Understanding that NG9-1-1 is a new system technology, it's important to take the necessary steps in procurement planning to ensure the components result in the desired fully operational system.

Texas Statewide Procurement

During the past two to three years, Texas has begun the procurement process for major statewide technology acquisitions. Heading up this venture is Ms. Kelli Merriweather, Program Director for the Texas Commission on State Emergency Communications (CSEC). Ms. Merriweather indicates there are distinct advantages of procuring NG9-1-1, and specifically ESInets, at a statewide or multiregional level. The benefits include cost savings and statewide information sharing. As Texas continues the rollout of its procurement process, Ms. Merriweather shares the experiences of CSEC procurement.

The CSEC established an enterprise management office to manage statewide contracts in a systematic way. Ms. Merriweather notes the following three factors that have been prominent for procurement and transition: 1) the complexity of a procurement process; 2) the innovation of technology and the unknown; 3) the limited yet, emerging pool of vendors.

To further elaborate on these factors, Ms. Merriweather encourages others to take the following actions:

- Identify a standardized GIS data match rate. Under their NG9-1-1 project plan, the state of Texas developed the Enterprise Geospatial Database Management Service (EGDMS). This was a critical component to standardize data across 22 regions and 200 counties, each with their own unique GIS datasets. Having adopted the National Emergency Number Association (NENA) GIS match rate, CSEC standardizes data collection by creating goals and timelines across the state.
- Engage with stakeholders and develop a governance structure. CSEC conducts workshops and trainings for PSAPs and localities. In addition to engaging these technical stakeholders, CSEC maintains communication to keep executive-level stakeholders informed. Through a series of newsletters, CSEC specifically communicates with the non-technical, non-9-1-1 executives and elected officials. They have also developed and adopted a statewide ESInet governance structure that delineates how the stakeholders own and operate their ESInet to facilitate collaboration at all levels.
- Adopt project management principles in procurement planning. To procure large contracts in the State of Texas, a very extensive planning process is required. To address these requirements, CSEC developed a project delivery framework based on project management principles. This includes the development of a business case, acquisition plan, vendor solicitation planning, and more. Before drafting a scope of work or RFP, CSEC spend time doing "due diligence" or "sourcing" potential vendors. This allows CSEC to identify the fielding of capabilities and the availability of innovative technology.

Massachusetts Statewide Procurement

In August of 2016, the Commonwealth of Massachusetts initiated actions to establish its first NG9-1-1 pilot system. Their goal is to connect its 247 primary PSAPs and approximately 60 secondary PSAPs to a statewide NG9-1-1 system. The pilot program is being conducted through the fall of 2016 to allow for a complete deployment by the fall of 2017.

Mr. Frank Pozniak, Executive Director of the Massachusetts State 911 Department, describes the benefits of a statewide system as cost effective and efficient. A single network system allows for a consistent response and consistent data reporting. With a centralized system, municipalities no longer have to worry about the cost because the system operates on a single state surcharge.

Based on procurement experiences by Mr. Pozniak and the State 911 Department, the following advice is shared on the concept of statewide procurement:

- Maintain stakeholder engagement. In regionalizing 9-1-1 systems, it is critical to communicate with local charters. All parties need to be on the same page including the fire chiefs, police chiefs, city councils, board members, etc. The Massachusetts State 911 Department coordinated services and resources, including connecting vendors directly with PSAPs to understand at all levels what the centralization would entail.
- Apply project management principles: Through an RFP process, the Massachusetts State 911 Department applied a strong provision to allow for effective project management with its contractor. This was critical as the department was in the process of transitioning service

providers. By applying project management principles to its procurement process, the department is able to coordinate system rollout timelines, in conjunction with personnel training and technology requirements, in a tight and efficient manner.

- Plan for testing and security: The Massachusetts State 911 Department conducted three phases of testing including scenario-based testing. With a project of this magnitude, the department recognized the importance of testing prior to system deployment. As a component of these tests, the department brought in a third party to assess security issues and identify vulnerabilities. In keeping a tight operational understanding of every system component, the department is looking to prevent and address system issues before they occur.

Statewide Procurement is cost effective and technologically efficient. By adopting practices such as those outlined in the three case studies provided, others can realize significant benefits in employing a statewide procurement process. As technology advances and shared data become standardized, collective procurement will help 9-1-1 authorities realize the true potential of NG9-1-1 and effectively improve 9-1-1 services.

APPENDIX B

PSAP & 9-1-1 Authority Equipment

PSAP Phone System / Customer Premise Equipment

In general, legacy Customer Premise Equipment solutions include the call-handling equipment that resides at the PSAP premise to support 9-1-1 voice calls. The solutions consist of several major components, 1) Network connectivity to the CPE to enable call delivery, 2) Site back–up power equipment, e.g., Uninterruptible Power Supplies (UPS), 3) Back room equipment, which includes Call Processing Equipment in a rack, i.e., servers, databases, telephony switch, power supplies, etc. (See Figure 1.0), 4) Call handling client equipment which is comprised of computer work stations, monitors with keyboards and mouse, headset, etc. which is on the PSAP floor and is connected to the backroom equipment (See Figure 1.0), 5) Management Information System (MIS) that gathers the data and generates reports on the call detail record, 6) Map application that displays the location of the 9-1-1 call, and 7) Applications/Services such as GIS, MSAG, ANI/ALI, dispatch applications, e.g., emergency medical dispatch (EMD Protocols) and supplemental incident information in support of the call processing of the incident that is delivered through interfaces to the clients. For a CPE solution, "backroom equipment, such as equipment racks and line cards, with their respective controller cards plugged into a backplane, can be expected to last at least 10 years. Backroom servers may last up to seven years with proper care and environmental controls, e.g., keeping the area that it resides in clean and keeping the temperature and humidity at the manufacturer-recommended levels. Workstations may last up to five years before hard drives begin to fail. Operating temperatures at the location of the workstation can also reduce lifespan."[99]

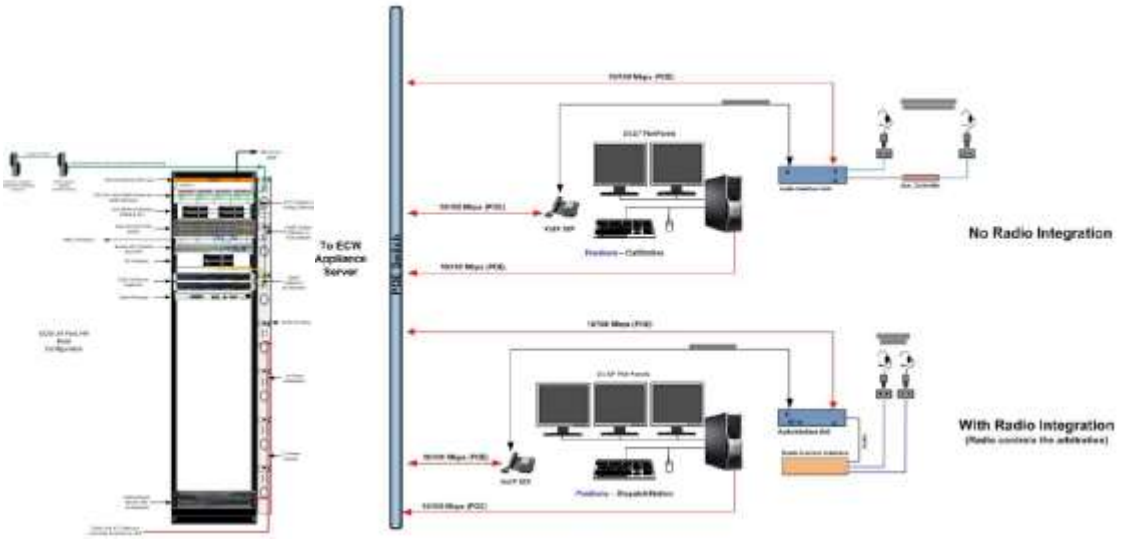


Figure 1[100]

[99] L. Robert Kimball & Associates Inc. PSAP Equipment Gap Analysis Executive Summary for the Statewide Network Modernization Project – the State of Minnesota Department of Public Safety, 3, March 2008
[100] Source: "High Level Workstation Overview and Design" Next Generation E9-1-1 Communication, Mapping, and Dispatch System Emergency CallWorks Products and Approach 3.1, 17

With respect to the procurement of CPE solutions, the major components and the ongoing service and maintenance of the solution are the main cost drivers from an equipment and services perspective. Within PSAP accounting/budget reports, typically, the CPE solution costs are broken down into a series of line items which include the lease/purchase of hardware, software/upgrades, install costs and ongoing maintenance, network connectivity, power equipment such as uninterruptible power supplies, ALI database management, GIS/MSAG mapping equipment and database and maintenance including software upgrades, annual maintenance, and technical support, and 9-1-1 specific training. Although there may be variability across the 9-1-1 governing bodies (e.g. 9-1-1 state Director, Public Utility Commission, Treasury Office, State boards) across the states and tribes that collect, approve and distribute the funds to each PSAP in terms of the allowable items to fund and magnitude of funds, CPE solution costs are typically paid for by the 9-1-1 fees that are collected and used to support a PSAP's operation

To this point, "as part of a 2006 Government Accounting Office (GAO) survey, the state E9-1-1 contacts were asked if their states had established written criteria on the allowable uses of funds collected for the purposes of wireless E911 implementation. Of the 38 state contacts that responded to this question, 35 reported that their state have established written criteria, while the other 3 indicated that written criteria had not been established. Examples of allowable uses of funding include the purchase of equipment upgrades or software, personnel costs directly attributable to the delivery of 9-1-1 services.

Recording & Logging Equipment

A dispatch supervisor or other assigned personnel are typically responsible for accessing recordings required to meet incoming requests from District Attorney's, etc. "Aside from Legal mandates, there are three key reasons for the PSAP to record 9-1-1 calls. First is that the recordings could offer evidence in a prosecution case. Second, the recordings can validate that the PSAP followed procedure and responded properly and professionally (an insurance/liability suit). Recordings also can be utilized as part of a Quality Assurance program designed to improve performance of the Dispatchers and/or Call Takers (and some States offer cost-reductions on insurance premiums if a Quality Assurance program is in place)." Accessing the recorded call information can be done either through the primary/centralized recording system, or at the 9-1-1 Call Takers console, depending on the technology deployed. One example of a QA program that was established was in the Commonwealth of Pennsylvania. "a) Chapter 120d implements section 3(a)(8) of the act (35 P. S. § 7013(a)(8)) which was added by section 3(a)(8) of the act of February 12, 1998, (P. L. 64, No. 17) to establish standards for performance review and quality assurance programs for 9-1-1 emergency communications systems operating in this Commonwealth.

The quality assurance standards in this report are designed to:

- *Promote Statewide adherence to established 9-1-1 communications center goals and procedures*
- *Facilitate the learning process for 9-1-1 communications center personnel*
- *Provide a framework for the continuous improvement of the overall operation of 9-1-1 communications centers in this Commonwealth*

  These procedures also will provide the operational standards that are needed to ensure that 911 communications centers consistently provide the best possible emergency communications service to the citizens of this Commonwealth."[101]

[101] "The Pennsylvania Code", Chapter 120d 911 Performance Review and Quality Assurance Standards, August 11, 2000, 30 Pa.B. 4238; http://www.pacode.com/secure/data/004/chapter120d/chap120dtoc.html

The Long-Term Recording /Logging solution is, as its name implies, a solution that captures/stores/ replays 9-1-1 emergency communications telephony and radio dispatch audio traffic for long term evidentiary purposes, as required by the PSAP's/Dispatch Center's retention policies and procedures. The legacy LTR Recording/Logging solutions traditionally, include the digital capture and storage of emergency communications audio and meta data associated with VoIP, analog, digital telephony, or dispatch-radio call sources. This audio coming into the PSAP, and meta data are captured on the logging recorder where they are stored, managed, and made available for replay. A replay application accesses the recordings on the logging recorder.

The legacy Recording/Logging equipment is on-premise of the PSAP/Dispatch Center, and its use is required due to the state specific open records laws mandating the recording of 9-1-1 audio traffic.

LTR Recording solutions typically consist of recording servers (either proprietary or Commercial Off the Shelf - COTS hardware), replay clients (COTS hardware), and application software used for recording, reconstruction, and replay of recorded media (audio, text, screens, etc. – See Figure 2.0). A variety of interfaces are used to record incoming telephony traffic such as drivers for ANI/ALI information, D-Channel capture, VoIP and SIP recording. "Recording solutions can be sold as software only, or as turnkey solutions with hardware included. The best solutions offer a single application Graphical User Interface (GUI), to perform all tasks/features available within a solution. For example, a single application GUI to display all recordings across all media-types (radio, telephone, text, screens, mapping) – and all functionality within that same GUI (search, replay, quality monitoring, analytics, etc.)"[102]

Figure 2[103]

The life cycle of a recording solution is tied to both the hardware and the software (logging applications and Operating System -OS). These life cycles can vary. For example, if a manufacturer normally ships a server platform for 2 to 4 years, then, after that period, the product is cancelled and enters a 5-year support window. Operating systems can have similar cadence. The OS ships for a certain period of time and then enters a support period. Finally, the logging software also has a standard shipment period followed by a support period. Application life cycles may range from 1-2 years for new product sales plus an additional 5 years for support after cancellation. Further, there may be other hardware components unrelated to the server or workstation that have different life cycles that can impact the logging solution. An example could be DAT drives that are no longer supported in the 2012 OS. This example demonstrates a dependency that can exist between hardware and an O/S

Generally, platform hardware changes for the recording/logging solutions are handled as part of a normal lifecycle management process. At various intervals of the lifecycle, required hardware change-outs and

[102] NICE Inputs, July 25,2016
[103] Source -NICE

movement to the latest computing platform supporting next generation processor(s) and corresponding memory are required to address "Commercial Off the Shelf" (COTS) equipment planned obsolescence issues. With respect to the logging/recording solutions, depending on the age and specifications (processing and memory) of the legacy hardware platform, migration to the i3 End State NG9-1-1 may require hardware changes specifically to support new media call types, and i3 requirements. Assuming a user of legacy logging/recording solutions has a relatively current version of a hardware platform, the migration scenario could require only software upgrades to obtain the newest features and support of additional media call types. In both the hardware and software upgrade scenarios, funding provided by sources such as 9-1-1 fees, grants, and/or from other sources within the PSAP's operating budgets will be required to facilitate the migration. 9-1-1 Authorities are encouraged to fully understand all elements within a PSAP environment that require recording services and incorporate those needs throughout the various NG9-1-1 maturity transitions.

GIS

In 2002 the National Emergency Number Association published a whitepaper for public safety agencies on how to deal with wireless location data utilizing a Geographic Information System (GIS).[104] The following information is primarily extracted from that educational guide. When discussing mapping, it's imperative that one first understand the difference between GIS and a map.

> *A geographic information system (GIS) allows for the display of database information on a visual map. A GIS does not contain any maps or graphics, it creates maps and graphics from the information contained in the databases. GIS is not a mapping program, it is a complex mix of database management, display technology, and analysis tools that can be used to create maps. All the information in a GIS is referenced to a location. A GIS can contain images of aerial photography, photographs of homes, and floor plans of buildings, and large amounts of text and attribute information, but they are all tied into the databases by their location on the earth's surface.*
>
> *GIS technology combines a powerful database with the unique ability to display the database information on a map. This ability to visualize information on a map allows quick analysis of information, which makes GIS invaluable to public safety. By referencing all the data in a GIS to a location on the earth's surface, maps can be generated and displayed, information can be visualized, and decisions can be quickly made.*
>
> *GIS allows every feature on a map to be represented by points, lines, or polygons. Lines can be streets, pipelines, creeks, and railroads. Points could be fire hydrants, cell tower locations, building structures, or mileposts. Polygons represent areas in a GIS. Polygons could be city boundaries, county boundaries, Emergency Services Zones (ESZ areas), lakes, and others.*
>
> *GIS store information about each feature in a database. Each street line has a directional, street name, type, address range, Master Street Address Guide (MSAG) community, and other information associated with it. Every point, line, or polygon on the*

[104] "A Public Safety Answering Point Managers Guide to Geographic Information Technology - A National Emergency Number Association White Paper," October 2002. *See* https://c.ymcdn.com/sites/www.nena.org/resource/collection/9958052B-4063-4AE1-A1D6-E00D3F4F15E9/nenagiswhitepaper-final.pdf

map is associated with a record in the geographical database. For example, each street on the map is a record in a table in the database.

- *Where is the caller located*
- *What police units are available in the area*
- *In which Emergency Service Zone is the caller located*
- *Who is the responding EMS agency*
- *Where is the nearest trauma center*
- *Which residents are in a flood zone*

All can be answered with GIS. Integrating the GIS into the PSAP is a powerful tool for improving response time, and locating wireless callers.

GIS can be defined as a collection of computer hardware, software, geographic data, trained personnel, and procedures designed to store, analyze, and display geographically referenced information. The five GIS components are data, hardware, software, personnel, and procedures. Each component is dependent upon the others to allow the GIS to be effective. Each component is dependent upon the others to allow the GIS to be effective." As noted above in the Customer Premise Equipment section of this report, GIS and map applications equipment, and services are generally approved as allowable use of 9-1-1 funds, and thus their costs can be covered by the 9-1-1 fees that are collected and used by PSAP's to support their operations.

Data is an important part of GIS; it is the information on what the road is named, where an address is located, how far is the nearest fire station, or the fire response agency for that area. GIS stores all the data in different tables. These tables can be considered a layer of information. The streets, creeks, hydrants, city boundaries, and cell tower locations are each a different layer of data.

Each layer of information can be displayed on a map, and turned on or off as needed. The GIS stores all information as a reference to the geographic location on the earth. Being able to retrieve the data based on a location, and turning on and off layers as needed, is one of the benefits of GIS over paper maps. Being able to plot the wireless call location on a map— which shows streets, addresses, ESZ areas, and city boundaries — is a PSAPs asset.

The computer hardware stores the geographic data. Hardware provides a platform that allows for the accessibility of the data. It provides the video display, memory, and input /output connections to the computer. The computer hardware used in a GIS must be dependable, quick, and affordable. The increase in computer processing speed and the decrease in computing cost has allowed GIS technology to be available on every desktop.

While computer hardware is an important part of a GIS, it is not the most important component. Many people become too involved with computer hardware, and overlook the much more important aspects of GIS.

GIS software allows the user to store, display, analyze, maintain, and create the data. The software resides on the computer hardware. GIS software is specifically designed to allow the user to easily acquire, display, correct, and maintain the data. Software

selection plays an important part of being able to use and share information for other sources. Software, designed to be integrated with your existing PSAP telephony systems, leads to fewer problems, and lower cost.

The most important components of a GIS are people who ensure timely accurate data. Trained people, who understand GIS, as well as E9-1-1, play a vital role in a successful GIS. People, who create and maintain the data as well as those who use the GIS are key to a successful E9-1-1 implementation. The procedures, processes, and techniques these people use in developing and using a GIS are critical to reaching an informed decision

CAD Integration/Interfaces

With the CAD system being the incident management workflow engine, it requires connections to many information sources that it will share information with while handling incidents (See Figure 3.0 for Mapping Application Example). Following is a list of interfaces that a CAD system may support

- Telephony (9-1-1)
- External Databases (Local, State and Federal Law Enforcement)
- TTY/TDD
- Radio system console or PTT
- Mapping solutions (especially for 9-1-1 or solutions that do not have an integrated mapping solution), See Figure 3.0.
- Aerial photography and Pictometry (oblique aerial photography to show faces of buildings)
- Records Management Solutions (this may be a simple data feed or a more complex interface
- Toning and station alerting (Primarily a Fire dispatch function, but may also communicate data to Mobile Data for Law and EMS installations
- CAD-to-CAD interfaces provide data sharing between disparate CAD systems, typically CAD systems installed in communication centers/PSAPs in nearby jurisdictions
- Mobile data systems, including CAD data, Messaging and Location (AVL) solutions
- Resource management solutions (roll call, staffing, and other personnel management software)

Figure 3[105]

[105] Source – PremierOne CAD, Motorola Solutions Inc

Non-Telephony Data Related to CAD

Not all incidents created in the CAD system are generated through 9-1-1 or a public safety ten-digit telephone number, but all require location information. The following are examples of non-telephone related incidents:

- Walk-in Reports – Citizens report at a kiosk or "front desk"
- Field Initiated Incidents – Field Personnel report incidents to dispatchers directly over the air or through a mobile data application
- Monitored Alarm Activations – Some communication centers monitor multiple types of alarms, and all take reports from alarm monitoring companies
- Other – There are any number of other ways for incidents to get generated in a CAD system, such as admin tasks related to emergency calls, calls to utilities, etc. that all require location data and to be displayed on a map

Resource Location data

There are a number of CAD Mapping use cases related to resource location data, including but not limited to:

- AVL Tracking – Used to increase officer safety and situational awareness for dispatchers through the CAD Map display and for field personnel through Multi-Unit Display (MUD) on a mobile mapping client. Dispatchers also use this capability to track units that are moving on the map, especially while enroute to an incident or during a pursuit.
- AVL Recommendations – Used by CAD systems to determine closest unit to respond to dispatched incidents; dispatchers often use the mapping display to visually location the closest units to the incident location for the call they are about to dispatch. Some CAD systems recommend units to dispatch or automatically dispatch units based on location and ability to reach the location of the incident the soonest, taking into consideration general traffic levels on the routes the First Responders will actually take to the incident location, effective speed limits,[106] road closures, scheduled at-grade rail crossings, and even real time traffic volumes and speeds where Department of Transportation traffic sensors are deployed (as well as on First Responder training, equipment on the unit, or other factors which the PSAP and First Responder agency may use to develop business rules for automated/recommended unit dispatch).
- Drive Directions (and ETA) – Uses resource last known location, incident location (may or may not be provided by 9-1-1 telephony data) and routing data (see below) to find the shortest or fastest route to the incident
- Resources "in the area" – Dispatchers use the graphical display of incident and resource

Mapping Attributes and Layers

Mapping attributes are data built into mapping data that may or may not be displayed to the dispatcher in a graphical display for use in decision-making. The following are examples of attributes and layer data:

- Street Center Line / Address Point data – CAD dispatchers can use this data to determine actual locations, especially in those situations in which no telephony location data is available.

[106] For example, the effective speed limit for heavy fire units on curving mountain roads may be less than the posted speed limit, while the effective speed for First Responders on a flat rural road with limited traffic may be above the posted speed limit.

- Landmarks – CAD dispatchers use landmarks to help "hone in" on locations, especially in situations in which no other location data is available, and direct first responders around items like fences, railroads, and bodies of water, especially during a pursuit.
- Satellite / Ortho images – Can be useful to direct first responders on the ground especially regarding obstacles or other potentially dangerous situations that might not be apparent from the ground, especially during foot pursuits.
- Premise /Hazard Data – Dispatchers can alert first responders of potential hazards or access information to first responders.
- Preplan Data – Especially for the Fire discipline, Pre-Plan data is used to provide floor plans, Key holder and information about SOP's for the location.
- Routing Data (and impedance) – Routing information contains information about direction of travel, average speed, clearance (for underpasses) and impedance data (obstacles that affect the normal routing data, such a road closure) to find the closest unit when determining recommendations and drive directions. While this data is not always displayed for dispatch use, it is an option, and many agencies do display this data to at least supervisors.
- Jurisdictional Data – This information is often displayed as an overlay, and is used by dispatchers to determine which agency should respond to an incident, especially in intersections and areas where multiple jurisdictional boundaries coincide.
- Common Place Names – For example, in one jurisdiction commonly known and referred to by residents as "the old green bridge," even though the bridge has been painted a color other than green for decades and is also known by the route number of the road it is on and by reference to the road it overpasses. All three of these names are entered into the CAD system as aliases for the bridge.

Paging Solutions

Following are some examples of the State of Montana Paging equipment and capabilities that are allowed to be funded by 9-1-1 fees.

> ***PSAP Operation****: The budgetary item relates to the operation of the PSAP and may include:*
>
> - *Radio frequency coordination / licensing fees /dispatch paging*
> - *Paging Encoders / paging systems*
> - *Special emergency notification paging systems / "reverse 9-1-1" systems*[107]
>
> ***Dispatch of emergency service responders:*** *The budgetary item supports the direct dispatch, relay or transfer of calls for emergency service and may include:*
>
> - *Paging encoders and emergency paging systems in the PSAP*
> - *Pagers for law enforcement, fire or emergency medical service (EMS) responders*[108]

[107] "Appendix C State of Montana Basic and Enhanced 9-1-1 Funding Guidelines," Enhanced 9-1-1 State of Montana E9-1-1 Coordinator's Handbook, 62
[108] Ibid, 62

APPENDIX C

9-1-1 Fees on Communication Services (by State)[109]

State	Wireline	Post-Paid Wireless	Pre-Paid Wireless	VoIP
Alabama	$1.75	$1.75	$1.75	$1.75
Alaska	$0.00 - $2.00	$0.00 - $2.00	N/A	N/A
Arizona	$0.20	$0.20	0.8% of Sale	$0.20
Arkansas	5% - 12% of tariff rates	$0.65	$0.65	$0.65
California	0.75% of intrastate long distance toll	0.75%	N/A	0.75%
Colorado	$0.43 - $1.75	$0.43 - $1.75	1.4% of Sale	$0.43 - $1.75
Connecticut	$0.47 (adjusted annually but can't exceed $0.75)	$0.47 (adjusted annually but can't exceed $0.75).	$0.47 (adjusted annually but can't exceed $0.75)	$0.47 (adjusted annually but can't exceed $0.75)
Delaware	$0.60	$0.60	$0.60	$0.60
District of Columbia	$0.76	$0.76	2% of Sale	$0.76
Florida	$0.40	$0.40	$0.40	$0.40
Georgia	$1.50	$1.00 - $1.50	$0.75	$1.50
Hawaii	$0.27	$0.66	N/A	$0.66
Idaho	$1.00 or $1.25	$1.00 or $1.25	2.5% of Sale	$1.00 or $1.25
Illinois	$0.87	$0.87 $3.90 – Chicago	3% of Sale 9% of Sale - Chicago	$0.87
Indiana	$1.00	$1.00	$1.00	$1.00
Iowa	$1.00	$1.00	$0.51	$1.00

[109] This table summarizes the 9-1-1 "fees" applicable to various communications services throughout the fifty states and the District of Columbia. Such fees are characterized in different ways statutorily from state to state. For example, in some states these are defined as "service fees" or "surcharges," while in other states they are "taxes." Generally, a tax has the primary purpose of raising revenue, while a fee recoups the cost of providing a service from a beneficiary. For more discussion of that distinction, see http://taxfoundation.org/article/understanding-difference-between-taxes-and-fees. Source: National Association of State 9-1-1 Administrators (NASNA).

State	Wireline	Post-Paid Wireless	Pre-Paid Wireless	VoIP
Kansas	$0.53	$0.53	1.06% of Sale	$0.53
Kentucky	$0.36 - $4.50 (Local govt option; no limit; varies by county; range is $0 - $4.28)	$0.70	$0.93	$0.36 - $4.50 (Local govt collects wireline fee on VoIP; no state fee on VoIP)
Louisiana	$0.62 - $1.25 Res $1.30 - $2.75 Bus	$0.85 - $1.25	4% of Sale	$1.00
Maine	$0.45	$0.45	$0.45	$0.45
Maryland	$1.00	$1.00	$0.60	$1.00
Massachusetts	$1.00	$1.00	$1.00	$1.00
Michigan	$0.19 State $0.00 - $3.00 County	$0.19 State $0.00 - $3.00 County	1.92% of Sale	$0.19 State $0.00 - $3.00 County
Minnesota	$0.95	$0.95	$0.95	$0.95
Mississippi	$1.05 Res $2.05 Bus	$1.00	$1.00	$1.00
Missouri	2% - 15% of Base Rate (45 counties) 1/8% - 1% of Sales Tax (51 counties) None (19 counties)	N/A	N/A	N/A
Montana	$1.00	$1.00	$1.00	$1.00
Nebraska	$0.50 - $1.00	$0.45 - $0.70	1.1% of Sale	$0.50-$1.00
Nevada	Varies; property tax and/or surcharge	Same as wireline	??	N/A
New Hampshire	$0.75	$0.75	N/A	$0.75
New Jersey	$0.90	$0.90	N/A	$0.90
New Mexico	$0.51	$0.51	N/A	N/A
New York	$0.35 - $1.00	$1.20	N/A	$0.35
North Carolina	$0.60	$0.60	$0.60	$0.60
North Dakota	$1.00 - $1.50	$1.00 - $1.50	2% of Sale	$1.00 - $1.50

State	Wireline	Post-Paid Wireless	Pre-Paid Wireless	VoIP
Ohio	$0.50 (max) (A few counties)	$0.25	0.5% of Sale	N/A
Oklahoma	3-15% of Base Rate	$0.50 (42 counties)	$0.50	$0.50
Oregon	$0.75	$0.75	$0.75	$0.75
Pennsylvania	$1.65	$1.65	$1.65	$1.65
Rhode Island	$1.00	$1.26	N/A	$1.26
South Carolina	$0.45 - $1.00	$0.62	$0.62	$0.45 - $1.00
South Dakota	$1.25	$1.25	2% of Sale	$1.25
Tennessee	$1.16	$1.16	$1.16	$1.16
Texas	$0.50 State Fees vary by district	$0.50	2% of Sale	$0.50 State Fees vary by district
Utah	$0.61 Local plus $0.15 State	$0.61 Local plus $0.15 State	1.9% of Sale	$0.61 Local plus $0.15 State
Vermont	N/A	N/A	N/A	N/A
Virginia	$0.75	$0.75	$0.50	$0.75
Washington	$0.25 state $0.70 local	$0.25 state $0.70 local	$0.25 state $0.70 local	$0.25 statewide $0.70 local
West Virginia	$0.98 - $6.40 by county	$3.00	6% of Sale	$0.98 - $6.40 by county
Wisconsin	$0.16 - $1.00 (gen. capped at $0.40)	N/A	N/A	N/A
Wyoming	$0.25 - $0.75	$0.25 - $0.75	1.5% of Sale	$0.25 - $0.75

APPENDIX D

Federal Financial Assistance Programs Funding for emergency Communications[110]

Department/Agency	Office	Program	Program Amount	Website	911 Eligibility
Department of Justice (DOJ)	National Highway Traffic Safety Administration (NHTSA)	911 Grant Program	N/A	www.911.gov	Targeted 911 grants
Department of Justice (DOJ)	Office of Community Oriented Policing Services (COPS)	Community Oriented Policy Services Coordinated Tribal Assistance Solicitation (COPS/CTAS)	Tribes with 1-9 officers eligible for $300,000; 10-20 eligible for $600,000; 20+ officers eligible for $1,000,000.	http://www.cops.usdoj.gov/Default.asp?Item=2489	NG911 not specifically mentioned. Grantees may integrate NG911 into victim assistance services. Funds may be applied to phone equip and emergency response systems, incl. phone hotline services and rotating on-call cell phones for victims support.
Department of Justice (DOJ)	Office of Community Oriented Policing Services (COPS)	Community Oriented Policy Services Community Policing Development (COPS/CPD)	Awards scaled between $100,000 and $1,000,000	http://www.cops.usdoj.gov/default.asp?Item=2450	NG911 not specifically mentioned. Grantees may integrate NG911 into planning related to community policing through partnerships, organizational mgt, and problem solving techniques.
Department of Justice (DOJ)	Office of Justice Programs (OJP)	Edward Byrne Memorial Justice Assistance Grant Program (JAG)	Awards of at least $25,000 are 4 yrs in length; awards less than $25,000 are 2 yrs in length	https://www.bja.gov/ProgramDetails.asp?Program_ID=59	NG911 not specifically mentioned. Grantees should consider integrating NG911 emergency response efforts when coordinating with local SWICs in the state.
Department of Justice (DOJ)	Office of Justice Programs (OJP) / National Institute of Justice (NIJ)	National Institute of Justice Research Grants (Law Enforcement, Geospatial, Criminal Justice IT)	Varies	http://www.nij.gov/funding/current.htm	Research/academic grants that may or may not have an emergency communications component.
Department of Health and Human Services (HHS)	Office of the Assistant Secretary for Preparedness and Response (ASPR)	Hospital Preparedness Program (HPP)	$228,500,000	http://www.phe.gov/Preparedness/planning/hpp/Pages/funding.aspx	NG911 not specifically mentioned. Grantees may consider integrating NG911 implementation into emergency operations and information sharing systems. May be overlap between EMS information systems, web-enabled emergency mgt systems, and 911 call centers.

[110] Source: The National 911 Program in conjunction with the Emergency Communications Preparedness Center (ECPC).

Department/Agency	Office	Program	Program Amount	Website	911 Eligibility
Department of Health and Human Services (HHS)	Center for Disease Control (CDC)	Public Health Emergency Preparedness (PHEP)	$611,750,000	http://www.cdc.gov/phpr/coopagreement.htm	NG911 not specifically mentioned. Grantees may consider integrating NG911 into emergency operations and information sharing systems. May be overlap between EMS info systems, web-enabled emergency mgt systems, and 911 call centers.
Department of Agriculture (USDA)	Rural Utilities Service (RUS)	Community Connect	$13,000,000	http://www.rd.usda.gov/programs-services/community-connect-grants	NG911 not specifically mentioned. Grantees may integrate NG911 into planning related to public safety efforts.
Department of Agriculture (USDA)	Rural Utilities Service (RUS)	Community Facilities	Graduated Scale	http://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program	NG911 not specifically mentioned. Grantees may integrate NG911 into planning related to public safety such as fire depts., police stations, prisons, public works vehicles.
Department of Agriculture (USDA)	Rural Utilities Service (RUS)	Telecommunications Infrastructure Loan – Expansion of 911	Graduated Scale	http://www.rd.usda.gov/programs-services/telecommunications-infrastructure-loans-loan-guarantees	NG911 not specifically mentioned but incl. 911 response efforts. Recipients can integrate NG911 strategic planning with efforts to enhance 911 such as improved location in rural areas, 911 text messaging, or sending real-time photos/videos.
Department of Homeland Security (DHS)	Science & Technology (S&T)	Small Business Innovation Research (SBIR)	Phase 1: $100,000 Phase 2: $750,000	https://www.fbo.gov/?s=opportunity&mode=form&id=a591b70cee17b77ebda2c70e67b144ce&tab=core&_cview=0	NG911 not specifically mentioned. May be overlap with strategic planning efforts for NG911 because it provides funding for next gen communications systems as well as cybersecurity.
Department of Homeland Security (DHS)	Federal Emergency Management Agency (FEMA)	Assistance to Firefighters Grant (AFG)	$306,000,000	http://www.fema.gov/assistance-firefighters-grant	NG911 not specifically mentioned. May be overlap of fire, rescue, and EMS activities with NG911 planning efforts.
Department of Homeland Security (DHS)	Federal Emergency Management Agency (FEMA)	Emergency Management Performance Grant (EMPG)	$350,100,000	http://www.fema.gov/media-library-data/1427284768817-b62b93d48b12617f423c0e8fbfde562b/FY2015EMPG_NOFO.pdf	NG911 not specifically mentioned. Grantees can incorporate NG911 strategies incl. GIS data and cybersecurity enhancement equipment.
Department of Homeland Security (DHS)	Federal Emergency Management Agency (FEMA)	Homeland Security Grant Program State Homeland Security Program (HSGP/SHSP)	$402,000,000	http://www.fema.gov/media-library-data/1427915404889-93f7e18b135ef16f5e682ccc0a6fd345/FY2015HSGP_NOFO.pdf	NG911 not specifically mentioned. Grantees may integrate NG911 into activities that focus on responding to mass casualty or catastrophic events. May be overlap with GIS, cybersecurity, and mobile countermeasure systems. Must be aligned with SCIP and be coordinated with SWIC.

Department/Agency	Office	Program	Program Amount	Website	911 Eligibility
Department of Homeland Security (DHS)	Federal Emergency Management Agency (FEMA)	Homeland Security Grant Program Urban Area Security Initiative (HSGP/UASI)	$580,000,000	http://www.fema.gov/media-library-data/1427915404889-93f7e18b135ef16f5e682ccc0a6fd345/FY2015HSGP_NOFO.pdf	NG911 not specifically mentioned. Grantees may integrate NG911 into activities that focus on responding to mass casualty or catastrophic events. May be overlap with GIS, cybersecurity, and mobile countermeasure systems. Must be aligned with SCIP and be coordinated with SWIC.
Department of Homeland Security (DHS)	Federal Emergency Management Agency (FEMA)	Homeland Security Grant Program Operation Stonegarden (HSGP/OPSG)	$55,000,000	http://www.fema.gov/media-library-data/1427915404889-93f7e18b135ef16f5e682ccc0a6fd345/FY2015HSGP_NOFO.pdf	NG911 not specifically mentioned. May be overlap with activities related to operational, material, and technological readiness of state, local and Tribal agencies.
Department of Homeland Security (DHS)	Federal Emergency Management Agency (FEMA)	Tribal Homeland Security Grant Program (THSGP)	$10,000,000	http://www.fema.gov/media-library-data/1427918389101-4d2f4a92e9132ed8b065802101655a51/FY2015THSGP_NOFO.pdf	NG911 not specifically mentioned. Can be applied to mobile and portable electronic countermeasure systems, specialized devices, GIS data gathering, and cybersecurity activities that may support NG911 implementation.
Department of Homeland Security (DHS)	Federal Emergency Management Agency (FEMA)	Non-Profit Security Grant Program (NSGP)	$20,000,000	http://www.fema.gov/media-library-data/1427915956955-346268ab50a661fcafd12acf8f2f84f0/FY2015NSGP_NOFO.pdf	NG911 not specifically mentioned, May be overlap as program prioritizes spending on efforts to respond quickly, save lives and protect property in aftermath of a catastrophic event.
Department of Homeland Security (DHS)	Federal Emergency Management Agency (FEMA)	Port Security Grant Program (PSGP)	$100,000,000	http://www.fema.gov/media-library-data/1427917974031-7bd75b1e02f7416d814f8c1e3950294b/FY2015PSGP_NOFO.pdf	NG911 not specifically mentioned by may be eligible as program prioritizes spending on efforts to respond quickly to catastrophic events. May be overlap with GIS and cybersecurity.
Department of Homeland Security (DHS)	Federal Emergency Management Agency (FEMA)	Transit Security Grant Program (TSGP)	$87,000,000	http://www.fema.gov/media-library-data/1427939211890-e811e5884ff9e3a83d65cb95fecd0a00/FY2015TSGP_NOFO.pdf	NG911 not specifically mentioned. May overlap with activities to enhance security plans, protocols, and assessments.
Department of Homeland Security (DHS)	Federal Emergency Management Agency (FEMA)	Intercity Bus Security Grant Program (IBSGP)	$3,000,000	http://www.fema.gov/media-library-data/1427918222254-46587d84e1f0ba7770cdd6e8673d8bb5/FY2015BSGP_NOFO.pdf	NG911 not specifically mentioned. May overlap with technology projects that focus on theft prevention, real-time bus inventory, tracking and monitoring, GIS data gathering and cybersecurity.

APPENDIX E

Commercial Communications Services Market Data

This appendix provides a list of reference materials used by TFOPA in its review of the effects of changing market conditions on funding for 9-1-1 and NG9-1-1 systems and services. Some of these sources are cited explicitly on the text of the Working Group 3 report, while others were used generally to inform WG3 members.

Arthur D. Little. "Disruptive Threat or Innovative Opportunity? Scenarios for Mobile Voice OTT. http://www.adlittle.com/downloads/tx_adlreports/ADL_OTT_Disruptive_threat_or_innovative_opportunity_v2_01.pdf .

Center for Disease Control and Prevention, U.S. Department of Health and Human Services. "Wireless Substitution: Early Release of Estimates from the National Health Interview Survey, July-December 2015." May 2016. (These reports have been produced biannually since 2006; other reports included by reference). http://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201605.pdf.

Cisco. "Cisco Visual Networking Index: Global Market Data Traffic Forecast Update, 2015-2020 White Paper." Feb. 1, 2016. http://www.cisco.com/c/en/us/solutions/service-provider/visual-networking-index-vni/index.html.

CTIA-The Wireless Association. "Prepaid Wireless Service in the United States: A Special Report from CTIA based on CTIA's Wireless Industry Survey Results." Year-End 2015 Results. Updated July 2016.

CTIA-The Wireless Association. "Wireless Industry Survey: 2015." 2016.

Deloitte & Touche LLP. "2015 Global Mobile Consumer Survey: U.S. Edition: The Rise of the Always Connected Consumer." 2015.

Ericsson. "Ericsson Mobility Report on the Pulse of the Networked Society." June 2016. https://www.ericsson.com/res/docs/2016/ericsson-mobility-report-2016.pdf.

Federal Communications Commission. "Seventh Annual Report to Congress on State Collection and Distribution of 9-1-1 and Enhanced 9-1-1 Fees and Charges for the Period of January 1, 2014 through December 31, 2014." Dec. 31, 2015. https://transition.fcc.gov/pshs/911/Net%20911/NET911_Act_7thReport_to_Congress_123115.pdf. (Annual reports issued since 2010; see https://www.fcc.gov/general/9-1-1-and-e9-1-1-services for information on previous years).

Federal Communications Commission. Industry Analysis and Technology Division, Wireline Competition Bureau. "Voice Telephone Services: Status as of June 30, 2015." August 2016. https://apps.fcc.gov/edocs_public/attachmatch/DOC-340665A1.pdf.

Federal Communications Commission. Industry Analysis and Technology Division, Wireline Competition Bureau. "Voice Telephone Services: Status as of December 31, 2014." March 2016. https://apps.fcc.gov/edocs_public/attachmatch/DOC-338629A1.pdf.

Federal Communications Commission. Industry Analysis and Technology Division, Wireline Competition Bureau. "Local Telephone Competition: Status as of December 31, 2013." October 2014.

https://apps.fcc.gov/edocs_public/attachmatch/DOC-329975A1.pdf. (Annual reports issued since 1998; *see* https://www.fcc.gov/general/local-telephone-competition-reports for information on previous years).

Federal Communications Commission. Industry Analysis and Technology Division, Wireline Competition Bureau. "Internet Access Services: Status as of June 30, 2015." August 2016. http://transition.fcc.gov/Daily_Releases/Daily_Business/2016/db1013/DOC-340664A1.pdf. (Annual reports issued since 2000; see https://www.fcc.gov/reports-research/reports/internet-access-services-reports/internet-access-services-reports for information on previous years).

Federal Communications Commission. Wireless Telecommunications Bureau. "Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services: Nineteenth Report." Sep. 23, 2016. http://transition.fcc.gov/Daily_Releases/Daily_Business/2016/db0923/DA-16-1061A1.pdf. (Annual reports issued since 1995; see https://www.fcc.gov/general/mobile-wireless-competition-reports for information on previous years).

Fortune. "Telecom companies count $386 billion in lost revenue to Skype, WhatsApp, others." www.Fortune.com.

Ovum. "Telecoms, Media, and Entertainment Outlook 2015." 2015.

Paul Budde Communications Pty Ltd. Market Research Insights & Business Intelligence. "Over-The-Top (OTT) Services a Potential Threat to Mobile Operators' Call Revenues." www.marketresearch.com.

United States Telecom Association. Compilation of market data for landline and mobile services collected from the FCC's various competition reports. September 2016.

Watson, Tracy. "2015: The Year of VoIP," Business 2 Community. http://www.business2community.com/tech-gadgets/2015-year-voip-01122398#d2zSd1j35iahjBR6.97

Wi-fi360.com. "As WiFi Calling Goes Mainstream, Challenges and Opportunities Emerge," http://www.wi-fi360.com/wi-fi-calling-goes-mainstream-challenges-opportunities-emerge/

APPENDIX F

9-1-1 Grant Program
Use of Funds for 2009-2012[111]

Background

Each year more than an estimated 240 million emergency calls are made to 911 across the United States, to approximately 6,000 Public Safety Answering Points (PSAPs). The limitations of the original 911 infrastructure have become evident, with growing market penetration of both wireless telephones and Voice over Internet Protocol (VoIP) technology. Unless the basic infrastructure of the 911 network is updated, callers will not be able to send digital data (e.g., photos, video) to PSAPs, and PSAPs will continue to be unable to transfer 911 calls among themselves. The 911 community has acknowledged the need to transition to Next Generation 911 (NG911) infrastructure.

Put simply, NG911 is an Internet Protocol (IP)-based system that allows digital information (e.g., voice, photos, videos, text messages) to flow seamlessly from the public, through the 911 network, and on to emergency responders. It also allows PSAPs to transfer calls and data among themselves, increasing their resilience (e.g., responding to call overload, transferring calls from nonoperational to operational PSAPs, establishing "virtual" PSAPs by connecting to an NG911 network).

In their attempt to make the transition from current 911 systems to NG911 infrastructure, many PSAPs do not have the funds necessary to cover the necessary capital expenses. At the state level, 911 taxes and surcharges may not provide adequate funding for this transition, and many states are looking to Federal grant programs to help fund "the leap" from the current 911 infrastructure to NG911.

The E911 Grant Program was authorized under the Ensuring Needed Help Arrives Near Callers.

Employing 911 Act of 2004 (ENHANCE 911 Act) to assist PSAPs to implement NG911 technologies; and was funded from the proceeds of an analog spectrum auction, conducted by the Federal Communications Commission. The total appropriation for the E911 Grant Program during this grant period was $43.5 million. In September of 2009, the E911 Grant Program awarded funds to 30 states and territories. These awards ranged from $200,000, in American Samoa, to $5.4 million, awarded to Texas.

[111] This information was provided by the National 911 Program office, which administers the E911 Grant Program and other programs related to 9-1-1 services. For more information on the E911 Grant Program, see "Enhanced 911 (E911) Grant Program Final Report," E911 Implementation Coordination Office, National Highway Traffic Safety Administration, National Telecommunications and Information Administration, Washington, DC, released March 2013.

The following is a sample of how grantees used their 911 funding.

Arkansas: $550,396.10

The 911 Grant Program provided funding for 11 of Arkansas's 911 Public Safety Answering Points (PSAPs) to upgrade their equipment, allowing them to receive and process more accurate location information for 911 callers. This information is critical for 1) routing 911 calls to the right PSAP, and 2) to pass the caller's location information on to emergency responders, so callers can be found as quickly as possible.

California: $4,113,231.26

California used grant funding to construct an Internet-based network, for use by 13 counties in the northeastern part of the state. Putting this infrastructure in place is the first technical step in a process that will ultimately allow 911 callers to transmit digital data (e.g. photographic, video) to the PSAP, and will allow this digital information to be transmitted to emergency responders. It will also allow PSAPs to transfer calls from one PSAP to another, creating a much more resilient network. In the case of large incidents, call overload can be transferred to another PSAP. In the case of natural or manmade destruction of the PSAP, it allows calls to be transferred to an operational PSAP, or the establishment of a "virtual" PSAP, with connection from a mobile unit. This network will be designed and constructed to interconnect with a future, statewide Next Generation (NG) 911 network.

Colorado: $487,312.56

Colorado used 911 grant funds to award grants to multiple local jurisdictions, for multiple purposes:

- Geographic Information System (GIS) data was collected, to enable accurate 911 call routing, and enable emergency responders to have accurate data to find 911 callers,
- Equipment was upgraded, to receive and process more accurate location information for 911 callers. This information is critical for 1) routing 911 calls to the right PSAP, and 2) to pass the caller's location information on to emergency responders, so callers can be found as quickly as possible.

Connecticut: $792,125.65

Grant funds were used by the state of Connecticut to support the construction of the Public Safety Data Network (PSDN) – a fiber optic network connecting all 106 of Connecticut's PSAPs. It delivers 10 gigabit connectivity to every PSAP and was designed and constructed to provide the first technical step toward NG911 services for all 106 PSAPs.

Iowa: $1,333,456.30

The state of Iowa used 911 grant funds to build a Next Generation IP-based 911 network as the first technical step on migrating towards NG911. All 117 PSAPs in Iowa were migrated to the Next Gen IP network.

Indiana: $1,563,140.03

The Indiana Wireless E911 Board used grant fund to award multiple sub-grants to county PSAPs across the state. These sub-grants were used by county PSAPs to migrate to an IP-enabled 911 network, as a first step in the process of transitioning to NG911 capabilities. The Indiana Wireless Board also used part of the funds to modernize the technology used to process and route all wireless 911 calls to PSAPs.

Kansas: $292,728.71

Kansas used its grant fund to conduct a pilot, connecting three PSAPs to a digital, Internet-model network. Overall the knowledge gained and lessons learned from the pilot project combined with the statewide transition blueprint will be valuable assets as the state prepares to move toward the deployment of next generation technologies. The costs of deploying a statewide next generation compatible network can also be accurately projected.

Massachusetts: $1,051,135.47

Massachusetts purchased the required hardware and constructed a fiber optic network that can serve as the backbone for an NG911 network, for the 50 PSAPs that were connected to this infrastructure – the first technical step towards establishing an NG911 network in the state.

Minnesota: $865,283.22

Minnesota used its grant funds to construct an Internet-based network and at the end of the grant period, twenty Minnesota PSAPs were using this network. Many PSAPs have reported automatic location information is being delivered with 911 calls more quickly. An improvement in voice quality on 911 calls has additionally been reported.

Pennsylvania: $2,478,093.81

Pennsylvania used its grant funding to construct a Internet-Protocol enabled, NG911 network, to connect three PSAPs, and serve as the foundation for a statewide network and connection of the state's remaining 66 PSAPs.

Puerto Rico: $500,000.00

The grant funds enabled the migration and Upgrade of Puerto Rico's 911 Services to an IP-Enable Infrastructure, as the first technical step toward full NG911 implementation.

Texas: $5,317,058.00

Texas used its grant funding to construct an NG911 network infrastructure, and connected 47 of its PSAPs to this network, providing the first technical step toward NG911 services for all of its PSAPs.