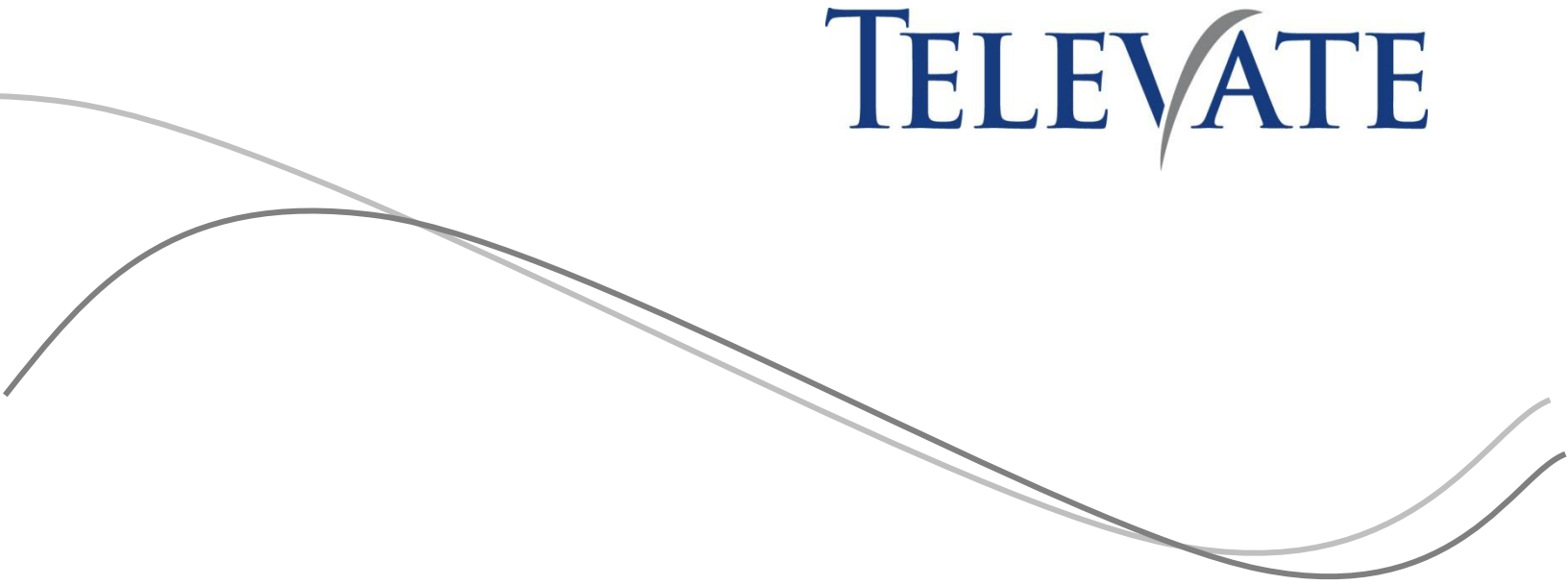

The Business Modeling of the Nationwide Public Safety Broadband Network

A Capital and Operational Expenditure Financial Model Analysis

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Executive Summary

The First Responder Network Authority (FirstNet) has a tremendous opportunity to revolutionize public safety communications through the successful implementation of the nationwide public safety broadband network (NPSBN). To achieve this monumental challenge, FirstNet has at its disposal 20 MHz of spectrum, up to $7 billion in Federal funding, and the national support of public safety. While $7 billion is a large investment, it is only a fraction of what commercial wireless carriers spend in a single year to enhance and operate their networks. Yet, commercial networks do not today meet the mission critical communications requirements of public safety: commercial sites are not constructed to public safety grade, and carriers do not deliver service to geographic areas where there is insufficient return on investment. Public safety requires highly reliable, "hardened" [1] facilities, and must provide coverage within geographies unattractive to commercial investment. For the NPSBN to succeed, investments must benefit both public safety and the private partners involved.

The available FirstNet funding and the radio spectrum are a tremendous catalyst for creating a robust, public safety grade network, but is it sufficient to support the objective? How should the available funds be used? What are the best strategies to drive the NPSBN business plan? Construction of the NPSBN could be achieved in a near infinite number of ways. A variety of options also exist for structuring business partnerships and approaches for generating the funds and revenue needed to sustain the network. Across the country, public safety's operational requirements could vary substantially. The willingness of potential private partners to meet public safety's requirements and the structure of the partnerships that emerge also will vary. Given this complexity, the modeling of potential business scenarios can provide valuable information to decision makers who must choose among the various NPSBN component options and evaluate their financial viability. To help make these decisions, Televate has constructed a robust NPSBN modeling tool that integrates Long Term Evolution (LTE) network design, public safety and commercial assets, public private partnership considerations, and overall deployment cost and revenue projections using relevant network deployment and subscriber access scenarios. The model is based on extensive industry research and Televate's industry leading experience with supporting public safety broadband over the last decade.

For this white paper, Televate assessed seven possible scenarios to illustrate the economics of the nationwide network. While a nearly unlimited number of options could be modeled, we have selected those that represent a mix of current industry thinking, and alternative scenarios based on independent and hybrid commercial and public safety partnership. The modeling tool that Televate has developed is useful for analyzing various combinations of key indicators and attributes of network development and implementation of interest to federal, state, and local governments, commercial entities and FirstNet. An overview of the seven-modeled scenarios is as follows:

[1] The term "hardened" describes a physical wireless facility containing backup uninterruptable power supplies (UPS), generators and backhaul transport to enhance the reliability of the facility to "public safety grade".

1. An "Initial Suburban Phase, Public Safety Leverage" scenario focused on serving the metro areas by covering the 226 most densely populated counties[2] in the United States and leveraging public safety's infrastructure to the greatest extent possible.

2. A "Commercial Footprint, Multi-Carrier Partners" scenario whereby FirstNet would partner with all necessary commercial cellular carriers to deliver coverage equal to the aggregate cellular carrier coverage (74 percent of the land area), fully leveraging the carrier infrastructure, and hardening all the cell sites.

3. A "Commercial Footprint Public Safety Leverage" is similar to that of scenario #2 in that FirstNet would build out coverage to the same footprint as the net commercial cellular carriers without partnering with the carriers, prioritize the use of public safety sites first, and harden all the cell sites.

4. An "Extended Footprint Multi- Carrier Leverage, Outdoor Coverage Hardening" scenario whereby FirstNet would partner with all commercial carriers, extend coverage beyond the cellular footprint to 80 percent of the country while prioritizing commercial infrastructure use, and harden a sufficient quantity of cell sites to ensure reliable outdoor coverage.

5. An "Extended Footprint Public Safety Leverage, Outdoor Coverage Hardening" scenario similar to option #4, achieving 80 nationwide percent, with the exception that FirstNet does not partner with commercial carriers and prioritizes the use of public safety sites.

6. A "Commercial Footprint, Single Large Commercial Partner" scenario whereby FirstNet partners with a single commercial carrier that has a large nationwide footprint. The net footprint would be extended to that of the aggregate total commercial cellular service in the United States; those new service areas would prioritize the use of public safety sites, and all cell sites would be hardened.

7. A "Commercial Footprint, Single Small Commercial Partner" scenario similar to option #5, with the exception that FirstNet partners with a single commercial carrier that currently has a substantially smaller nationwide footprint.

Table 1 provides a high-level financial summary of the cost to build the network under each of the seven scenarios, the cost to operate the network, and the projected revenue from public safety and government usage on the network. A detailed analysis of each scenario and the underlying assumptions and model attributes are presented throughout the study.

[2] The 226 counties with the greatest population density were modeled to illustrate a potential strategy for expending the $7 billion of planned Federal funding.

No.	Scenario	Area Coverage	CapEx (millions)	Network OpEx (millions)	Revenues (millions)	Public Safety "Credit" (millions)
1.	Initial Suburban Phase, Public Safety Leverage	3.5 %	$7,000	$1,490	$670	$370
2.	Commercial Footprint, Multi-Carrier Partners	74%	$13,500	$3,290	$1,400	$0
3.	Commercial Footprint Public Safety Leverage	74%	$16,390	$3,370	$1,400	$850
4.	Extended Footprint Multi-Carrier Leverage, Outdoor Coverage Hardening	80%	$12,450	$3,050	$1,400	$20
5.	Extended Footprint Public Safety Leverage, Outdoor Coverage Hardening	80%	$12,980	$2,870	$1,400	$870
6.	Commercial Footprint, Single Large Commercial Partner	74%	$13,550	$3,280	$1,400	$10
7.	Commercial Footprint, Single Small Commercial Partner	74%	$14,430	$3,220	$1,400	$270

Table 1: NPSBN Financial Modeling Results

The model assumes that public safety is compensated for the use of their assets over the NPSBN with a network service credit. This approach of compensating the government for use of their assets increases both the public safety and taxpayer benefit nationwide. The table depicts the "value" of these assets for each scenario as a respective service credit.

The financial results for these scenarios illustrate a number of critical factors including:

- $7.0 billion is insufficient to fund the construction of a nationwide network, only 3.5 percent of the land area including 50% of the expected user population can be served with this funding level
- Nationwide service will cost $5.5 to $9.4 billion more to build than the existing funding supports
- Public safety user fees are insufficient to fully cover the costs to operate the network, these fees cover a rage of 40 to 50% of the operational costs depending on the scenario modeled
- Private participation is needed whereby a partner will derive sufficient value to invest some $5.5 to $9.4 billion in capital to build the network, and secure more than $ 1.5 - $2.0 billion in additional revenue annually to cover network operations costs. The private partner must be able to capture sufficient value to make such investments

- Leverage of commercial and public safety assets saves substantial capital expenses, however, leverage of commercial assets shifts the costs to operating expenses

- Use of the public safety asset value as credits can increase public safety participation in the network as much as 50 percent, enabling more first responders to have access to broadband wireless communications

- Especially in areas where commercial carriers do not provide service, the public safety assets will become important factors in reducing capital costs

- It is unclear the extent to which the existing assets can be leveraged, and therefore, it is critical that the State and Local Implementation Grant Program collect this information as quickly as possible such that vendors can in integrate the assets into their planning

- Smaller commercial operators could derive substantial benefit from the integration of public safety assets into the network, further supporting the collection of public safety assets over the course of the State and Local Implementation Grant Program

- This analysis was performed strictly on economic terms, the commercial carriers and other partners may balk at public safety's requirements. It is important that public safety know how its requirements may become poison pills for private partners.

- Public safety must also fully understand the cost implications of its decisions as well as tradeoffs in how the network is constructed.

- The user fees associated with the model are based on existing government spending nationwide, however, in order to capture this revenue, FirstNet will need to meet or exceed the requirements of public safety agencies. FirstNet must provide a compelling solution to realize these revenues.

If the NPSBN is deployed and public safety does not subscribe in sufficient numbers, the network becomes unsustainable and this opportunity for public safety will be squandered. Loss of public safety subscription is equally problematic to constructing an unsustainable network, and neither of these results are acceptable. Public safety must be an educated partner in making these and all other key decisions for implementing the NPSBN. The financial model supporting this study can be modified to address various alternatives, particular State requirements and circumstances, or specific approaches. Televate looks forward to continuing to work with the public safety community to advance and capitalize on this opportunity for public safety offered by the NPSBN.

Introduction

For more than a decade public safety has diligently worked to conceive and deliver essential wireless broadband communications improvements nationally. The recently passed Middle Class Tax Relieve and Job Creation Act of 2012 ("The Act") is the much heralded initiative that will deliver on this critical public safety communications requirement. The Act provides public safety 10 MHz of additional radio spectrum, increasing available broadband spectrum to 20 MHz, and designates funding and a governance body, the First Responder Network Authority (FirstNet). The Act also allows non-public safety use on a secondary basis, which may entice private partnership interests in helping achieve public safety's nationwide coverage objectives.

Deploying and operating a nationwide broadband network is an enormously expensive investment. The major cellular carriers already spend billions of dollars annually to sustain the pace needed to meet America's demand for wireless communications. They regularly invest in expanding their network coverage footprint, upgrading to the newest technology, and providing consumers with innovative devices. Because public safety's broadband communications needs are fundamentally different from commercial consumers, however, Congress created the Act to address the fundamental requirement of public safety for robust and reliable communications. These unique needs are not being satisfied with today's commercial offerings and doing so will involve additional expenditures and decisions about how best to use these investments.

Delivering a national interoperable public safety broadband network is more complex than many have imagined. These complexities go beyond wireless infrastructure technology challenges, or the logistics of implementing the network under well-established technical requirements. The greatest challenges are rather those involved in the business modeling and analysis required to properly complete the effort, and within a reasonably tight budget. It involves not only prioritizing objectives and rigorous budgeting, but needs to answer "What are the real goals of the network?" and "How much will it cost to achieve them?" Without thoughtful answers to these questions, it is difficult, and perhaps impossible, to make acceptable tradeoffs or understand the impact of working within a limited resource constrained budget

There is no simple solution to addressing the rigorous communications demands of public safety. The failure to attract a viable private partner in the D Block Auction illustrates in part the tremendous economic challenge of delivering a broadband network that meets public safety's data communications needs. Moving forward, in order to design a successful broadband network implementation strategy, public safety must analyze the various tradeoffs at national, state, and local levels that could affect the quality and cost of service and outright network adoption. This study describes a range of options that public safety could undertake in its quest to deploy and operate the nationwide broadband network and examines the economic impact of each option. This analysis is intended for the public safety community as a whole, but specifically for decision makers to help them understand the cost of various NPSBN

partnership, deployment and operational decisions. FirstNet, the individual states, and other public safety stakeholders will face difficult decisions in setting priorities for the nationwide public safety broadband network (NPSBN). This white paper is intended to help decision makers understand how their choices affect the feasibility of building and sustaining the broadband service. This study can serve as a reference document for states as they articulate their requirements to FirstNet. It also may highlight prospective business models not considered viable by public safety officials and FirstNet.

Televate constructed the underlying financial models described in this study using our extensive experience in the construction and operations of both public safety and commercial wireless networks. With respect to the fundamental methods of delivering broadband service, a near infinite number of methods could be conceived. The optimal approach could be different for each state, and even within a state, the private-public partnership options available could lead to considering substantially different delivery models on a state-by-state basis. The Televate NPSBN business model is capable of customization on a state or local level, but for simplicity's sake, it applies service delivery approaches to the entire United States. The model leverages public safety and commercial assets where available in urban, suburban, and rural areas and calculates the costs to build new facilities where needed and to harden other physical assets. All engineering, construction and required technical resources to deploy the NPSBN in each scenario are also modeled.

Proper business modeling is therefore essential. However, this task cannot be conducted on a comprehensive basis without considering the costs and benefits of several likely scenarios or without critical inputs from all stakeholders. The Federal Government has established the State and Local Implementation Grant Program (SLIGP) to help define and collect the various modeling inputs. The SLIGP affords the states and FirstNet the opportunity to define coverage, performance, application and governance requirements, to document possible assets to integrate into the NPSBN, and to document all potential government subscribers and state partners that could play a role in the final solution. All of these components, which should result from a properly executed SLIGP, need to be considered within a comprehensive model to determine the proper course for the NPSBN. There are, however, few organizations that have a complete understanding of the costs and challenges associated with modeling the various scenarios.

Televate, having pioneered some of the critical concepts that have shaped NPSBN over more than a decade, in addition to our extensive commercial wireless experience, has developed a complex model that incorporates a wide variety of inputs and will allow FirstNet and the states to solve this complex problem in a manner that incorporates the goals of the network and the special interests and objectives of the various stakeholders.

Televate has been engaged in the public safety broadband mission since it began in 2002. Televate championed the construction and operations of the first two citywide 700 MHz broadband networks

designed to "public safety grade". Televate has also supported customers engaged in the construction of commercial broadband networks as well as numerous land mobile radio networks. Televate fully understands the engineering and implementation of "public safety grade" service while having a thorough grasp on commercial networks, including their operations and the business case. Televate professionals have designed, deployed and operated both commercial and public safety networks; we understand the differences in how they are constructed and operated, and the resulting differences in cost. As a result of our dual public safety and commercial experience, we have tremendous insight into the network infrastructure of these operators, respective asset ownership issues, and the factors that affect the likelihood of shared access. Televate has integrated this experience into this modeling.

Business Models and Scope

The Act calls for FirstNet to assess and collect fees that are "sufficient and shall not exceed the amount necessary, to recoup the total expenses of the First Responder Network Authority in carrying out its duties and responsibilities."[3] This requirement is described within a section entitled "Establishment of Fee Amounts – Permanent Self-Funding", implying that FirstNet has a responsibility to recoup its expenses, and to sustain the network over the entire lifecycle. FirstNet is an independent authority within the National Telecommunications and Information Administration (NTIA), located within the Department of Commerce. While a quasi-governmental entity, FirstNet must function as a business in which operational expenses must be offset by revenue-generating income. And like any business, FirstNet must be engaged in winning, retaining, servicing, and collecting fees from its customers and partners where appropriate. The net cost of administering the business of the NPPSBN, must be equal to the fees it generates.

The primary elements of the business model include:

- **The service delivery model:** How FirstNet will offer its service and what services will be offered? Will service be provided nationwide via terrestrial cell sites, or augmented by satellite service?

- **The business arrangement model:** Will FirstNet seek a fixed cost operating agreement with its vendor(s), or will it seek a variable, per user operating agreement?

- **Partnerships:** What types of partners are included in the delivery of the service? Will FirstNet in-source or outsource certain operational elements of the business?

- **Revenue model:** How will FirstNet structure its fees? What will it charge for services? What will it charge for other allowable fees? What will FirstNet's uptake be for its services?

[3] Section 6208 (b) of Public Law 112-96, February 22, 2012

Service Delivery Models

FirstNet could choose to deliver service using a variety of methods. It can use public safety's broadband spectrum at 700 MHz. It can use existing commercial services, or can augment the commercial networks with government assets. Satellite services can likewise be integrated into the service delivery model. Alternatively, FirstNet can facilitate service over a variety of these options, and the delivery options can differ in distinct parts of the country. For example, FirstNet might choose to use one approach in urban areas, a different approach in suburban areas, and a third approach in rural areas. In addition, FirstNet, or its partners, can choose to use both public safety and commercial assets (as the law specifies) in differing scenarios. One approach could be to prioritize the use of public safety's assets, and another approach may be to prioritize the use of commercial assets where both parties have assets. The network can also be built to different standards for coverage, hardening, and other factors. Importantly, the cost to build and operate the nationwide network varies significantly depending on the approach.

The variation in business models can shift deployment and operations costs to future dates. For example, the capital expense (CapEx) to build the network can be reduced by leasing existing assets. However, this will increase the operational cost due to the annual site lease. While asset owners could "donate" the asset for public safety's use (and avoid the increased operational costs), commercial and public safety entities, are likely to require compensation for the asset to generate a net return on the investment. For example, commercial entities may provide no-cost access to backhaul in exchange for capacity on the nationwide network; public safety could request network access credits. Regardless of how it is accomplished, private partners require that the value for their assets is recouped.

Business Arrangement Models

There are many ways to structure the FirstNet business arrangement with private partners. Partners could provide access to assets in exchange for service on the network, or they could serve as the Mobile Network Operator (MNO) and receive excess capacity for retail wireless services. Methods of compensation also vary based on the business relationship. For example, FirstNet could hire an entity (or several regional entities) to build, operate, and maintain the nationwide network for a fixed fee. Under this arrangement, FirstNet owns the financial risk to secure sufficient revenues and funding to cover the fixed costs. Alternatively, the MNO could offer service to FirstNet based on actual usage (number of subscribers) and this cost could be passed on to NPSBN end users. However, under either approach, one entity owns the risk that there will not be sufficient users to cover the fixed operating costs. Additional financing may then be necessary until the point where revenues fully cover all operating costs.

Partnership Models

A variety of potential partners can participate in the construction and operations of the nationwide network. FirstNet could either partner with them individually, create an environment for them to partner on their own, or construct an alternate partnership model. Ultimately, the procurement model that will be employed will dictate how these partnerships are formulated. For example, FirstNet could directly engage tower company services and dictate that the MNO use the FirstNet leased assets. Or, FirstNet could leave such matters to the MNO, and have the MNO absorb those costs into the service it provides. Likewise, FirstNet could enter into partnerships with utility companies to use their assets in exchange for network service in addition to service revenues. FirstNet could then turn to an MNO requiring the use of those assets and those differentiated services to utilities. Ultimately, public safety is the primary partner, and a viable model to integrate government assets must be developed.

Revenue Models

The Act allows NTIA to borrow up to $2 billion from the Treasury to cover initial NPSBN deployment, including $100 million over a 10-year period to fund Administrative expenses[4]. The Act allows for an additional $5 billion in Federal funding allocated to the Public Safety Trust Fund in the event of sufficient revenues generated by spectrum auctions conducted by the Federal Communications Commission (FCC). These funds could be used to construct or operate the network.

In addition, the Act establishes several potential revenue sources for FirstNet. FirstNet can establish user fees for public safety agencies, collect lease fees for secondary use (users other than public safety entities), and lease excess capacity for other infrastructure. There are a variety of services that FirstNet could provide to public safety under the Act. Clearly, FirstNet is obligated to provide wireless broadband services to public safety agencies, but additional mechanisms would allow it to provide service to individual employees working in public safety. While governments may not provide all public safety employees with broadband data devices, nearly all are likely to have their own personally funded device. If a government does not currently pay for a police officer's personal smartphone service, it may be possible for that officer to contract for service directly with FirstNet. Alternatively, FirstNet could assist governments in establishing programs that enable these individuals to pay for services through their government employer, lowering FirstNet's customer acquisition costs. A substantial number of volunteer firefighters throughout the country also will have an interest in NPSBN service. FirstNet needs mechanisms to capture these users and their user fees. FirstNet could also provide hosted applications (e.g., Computer Aided Dispatch, electronic patient care records, etc.) for a fee to public safety users.

The law specifies that network use of non-public safety entities is to be enabled through "covered leasing agreements." It states the "covered leasing agreement" is a written agreement resulting from a

[4] See Section 6207 (a) and 6207 (b) (1).

public-private arrangement to construct, manage, and operate the nationwide public safety broadband network between the First Responder Network Authority and secondary users to permit (i) access to network capacity on a secondary basis for non-public safety services."[5] The Act does not specifically address the ability to lease spectrum to a private partner, and therefore does not specifically prohibit it. However, the Act does prohibit "direct offering of commercial telecommunications service directly to consumers,"[6] whereby FirstNet cannot "offer, provide, or market commercial telecommunications or information services directly to consumers." In other words, FirstNet could become a wholesaler of network capacity via a private partner who in turn offers service over the network to consumers. Alternatively, FirstNet could allow the private partner to provide services to consumers over the network in exchange for other benefits, such as reduced subscription fees to public safety users.

The revenue model must consider the feasibility of user fees coming from public safety agencies. While some suggest that a premium should be placed on the improved service, public safety agencies likely have limited abilities to increase communications spending from their current commercial subscription levels. Therefore, any increase in the cost for individual users could reduce the overall number of users with access to broadband wireless service. Some alternative forms of deployment funding and operational costs might become an option. For instance, additional Federal funding may become available, or state and local agencies could secure capital or operational funds through bonds or 911 fees. The FCC also could allow the Universal Service Fund to be applied to the NPSBN or designate an additional fee for the NPSBN. Many of these revenue sources are already designated for various projects or operating costs, however, and diverting them to the public safety network could be a challenge. Tax rates also could be raised to pay for these fees, but this option may present challenges given the current economic and political climate.

This white paper does not conjecture the likelihood of these alternate funding sources. And, because we cannot forecast available capacity for secondary use, or project the value of spectrum to future partners, it is not modeled at this time. It is expected that a hardened public safety grade network adds value for users such as utilities, however, the types of applications that they will use and the "value" they present to utilities is unclear, and therefore, these potential revenues are also not modeled. Therefore, this financial modeling study includes only those funding sources that are perceived to exist today, and that are "under the control" of FirstNet and public safety agencies or users.

Service Delivery Model Overview

The nationwide public safety broadband network can be constructed and operated using a variety of methods. Different areas of the country or different partnership situations have various service delivery

[5] See Section 6208 (a) (2) (B)
[6] See Section 6212

methods to choose from depending on their needs. The salient components of the service delivery model include:

- **Service Delivery Methods:** Using the public safety band, commercial roaming, or satellite services to deliver broadband wireless capabilities to public safety

- **System Build Variables:**
  - Coverage Extent – how much "public safety" grade service is available
  - Hardening – whether or not the public safety grade service uses hardened sites
  - Indoor or Outdoor Service – does the network support in-building or outdoor service where service is provided

- **Infrastructure Leverage Method:** Whether the system is "anchored" on public safety or commercial assets. The model assumes use of all commercial and public safety assets where available. This variable determines which type of asset receives priority. Where only one type of asset is thought to exist, only those assets are leveraged (e.g., in very remote areas, there are very few commercial towers, and therefore, public safety towers are assumed)

- **Commercial Service Method:** Which service delivery methods are employed to provide service beyond the "public safety" footprint (e.g., commercial roaming or satellite service)

Service Delivery Methods

At a high level, there are five fundamental methods for FirstNet to deliver wireless mobile data services:

1. **Via the Public Safety Broadband Spectrum (Band Class 14) and Using LTE:** FirstNet could build out coverage using public safety broadband spectrum in the 700 MHz band. This approach makes it easier for vendors to segment the capacity and offer benefits such as priority, pre-emption, and others. It also requires a cell site operating on these frequencies wherever coverage is required.

2. **Via Commercial Roaming:** FirstNet is required to establish roaming agreements with commercial carriers and to secure priority service with these carriers. While the Act calls for FirstNet to pursue this operational scenario, it cannot force the commercial carriers to provide the service. Therefore, commercial service quality may vary from today's standard carrier offerings, or public safety could receive only the standard roaming service.

3. **Via Low Earth Orbit (LEO) Satellite:** LEO satellites enable global coverage from above. Handheld devices are feasible with this model. Throughput is limited, however, and usage fees are high. Satellite services generally require line-of-sight between the subscriber antenna and the satellite. LEO Satellites, due to their orbits around the earth, provide service globally, even in Northern latitudes. This option does not provide 100% coverage. Satellite signals can be blocked by trees, buildings, and other obstructions.

4. **Via Geosynchronous Earth Orbit (GEO) Satellite To A Moving Vehicle:** GEO satellites can provide higher throughput services to a moving vehicle equipped with specialized equipment that continually points a dish at the satellite. We refer to this option as Satellite on The Move (SoTM). GEO satellites are impacted at more Northern locations (e.g., Alaska) where signals are often degraded due to blockage from the earth and from satellite antenna patterns.

5. **Via Geosynchronous Orbit Satellite to a Cell On Wheels (COW):** GEO satellites can also provide service to a specialized communications vehicle. The solution requires a larger satellite dish requiring time to deploy, and therefore, is applicable to a vehicle that is temporarily fixed in its location (e.g., near a major incident). The COW can be equipped with cell site equipment to provide broadband service to devices within range, including handhelds. Similar to the option #4 (SoTM), this solution does not deliver 100% nationwide service due to obstructions and the satellite service footprint.

A sixth form of communications may become feasible in the future: GEO satellite communications to a handheld device. While service is available today using handheld devices from geostationary orbits, the service is not very reliable in public safety settings[7]. However, a recent satellite launch includes a very large high gain antenna that may enable reliable service to handheld devices. The higher power levels can leverage much lower cost subscriber devices. However, subscriber devices are not yet available to support this type of usage.

Where satellite solutions are employed to provide service, the model "equalizes" the equipment and service cost to typical commercial wireless services. The satellite equipment is generally much more expensive than a traditional cellular device and the service is far more expensive. In order to properly cover service rural areas and satisfy the rural component of the Act, the model includes the cost of the satellite equipment, beyond the cost of cellular equipment. The model also includes the cost of service for each user, but assess fees for service based on cellular rates. In other words, the devices and service are subsidized.

System Build Variables

Televate's economic model enables the selection of multiple build options for the nationwide network. The model is variable based on the unique circumstances of any state regarding public and private assets, coverage and local operational considerations. As depicted in Table 2, the system build variables, including the geographic extent of public safety grade coverage, hardening, and indoor/outdoor service, vary based on the scenario modeled.

[7] See, for example, this testimonial about the difficulties http://www.pcmag.com/article2/0,2817,2393970,00.asp

NPSBN Model Features	Initial Suburban Phase, Public Safety Leverage	Commercial Footprint, Multi-Carrier Partners	Commercial Footprint Public Safety Leverage	Extended Footprint Multi-Carrier Leverage, Outdoor Coverage Hardening	Extended Footprint Public Safety Leverage, Outdoor Coverage Hardening	Commercial Footprint, Single Large Commercial Partner	Commercial Footprint, Single Small Commercial Partner
Coverage Area							
Commercial Partnership							
Public Safety Asset Leveraging							
Site Hardening							
New Site Development							
Revenue							
Capital Cost							
	Low						High

Table 2: System Build Variables per Scenario

Geographic Coverage Area

Providing service to just five percent of the country costs much less than providing it to half of the land mass. Likewise, costs associated with urban, suburban, and rural coverage differ drastically. Televate's economic model accounts for such variables, and accommodates the analysis of multiple coverage scenarios and levels employing public safety, commercial and satellite service delivery. Televate assumes that any deployment of "new" coverage occurs using public safety's Band Class 14, and that service delivers, at a minimum, public safety priority service. Televate has considered several options for Band Class 14 coverage:

- **Suburban Only:** This coverage represents expending the available $7.0 billion to cover the most densely populated counties. This approach illustrates a strategy for allocating government funding to densely populated markets

- **Composite Commercial Cellular:** This coverage represents the aggregate total coverage available from any cellular carrier. According to the FCC, this represents roughly 74 percent of the total land mass of the United States and covers more than 99 percent of the population[8]. Televate estimates that 27 total cellular carriers[9] make up this commercial cellular coverage footprint.

- **Comprehensive Coverage:** This coverage represents coverage of the vast majority of the country. It excludes mountainous and remote areas of the United States where the cost of providing service is not justified by the benefit and may be better addressed by satellite services

[8] See the Sixteenth Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services at page 6.

[9] Since a number of these 27 carriers are partners of larger national carriers, there may be opportunities to obtain access to their networks through major carrier agreements.

where available. This scenario covers 85 percent of the total land mass of the United States, including Alaska.

Figure 1 depicts the coverage footprint of a large and small commercial carrier together with the composite coverage of all commercial carriers.

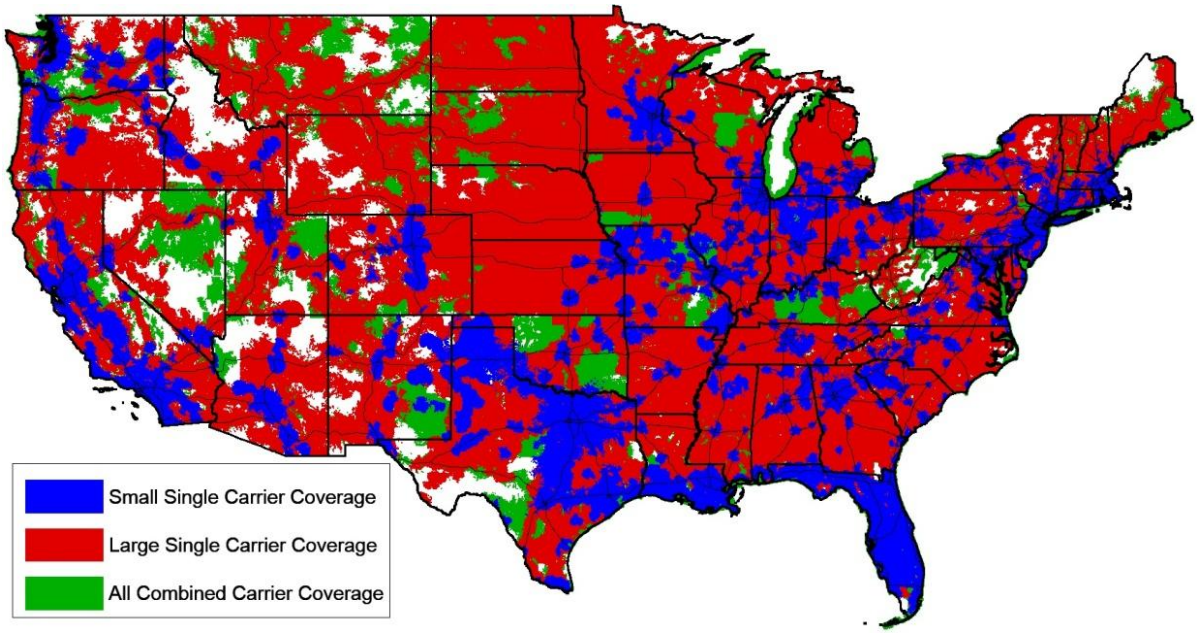


Figure 1: Commercial Carrier Coverage

System Build Variables

In addition, the model incorporates the variable ways in which the Band Class 14 service can be constructed:

- **Hardened versus Commercial Grade Sites:** The model can be modified to augment the transmission sites to include hardened elements. In this case, the goal is to minimize single-points-of-failure. For example, each site will have generator backup and redundant connections to the core network in the hardened scenario. The model can also accommodate a fractional deployment of hardened sites such as when hardened service is required only for outdoor service.

- **Indoor versus Outdoor Coverage:** It takes far more outdoor cell sites to provide consistent and extensive in-building coverage. Therefore, the model allows for both indoor and outdoor only coverage and the resulting cost differences.

Infrastructure Leverage Method

Public safety and commercial vendors have substantial nationwide assets. However, some of these are duplicative (serve the same area). As a result, the model allows for selecting either commercial assets or public safety assets as the foundation for the nationwide network. In urban and suburban areas, where commercial assets are plentiful, the model assumes that commercial assets can be leveraged where no public safety asset exists. Therefore, in urban and suburban areas, the leveraged method determines which sites take deployment priority. In the scenarios where a partnership with a wireless carrier is assumed , its current commercial sites are leveraged. In remote areas where commercial service is not available, the model assumes commercial assets are not available and uses public safety assets where they are thought to exist. Wherever public safety's assets are leveraged, the model assumes that those assets are offered in exchange for service "credit", and that the credits are used to secure additional service.[10]

Because the density of sites for LTE coverage is expected to be much greater than the public safety asset density, a percentage of public safety sites are used in models where public safety assets are prioritized or where only public safety assets are thought to exist. The remaining sites are secured from commercial assets (carriers and tower leasing companies), or in the case of remote areas, new tower construction is assumed. For each public safety asset, the model optimistically assumes the following elements exist and are leveraged for the NPSBN:

- Tower Space
- Generator Capacity
- Passive elements of a microwave backbone (assumes active elements must be upgraded to support the higher capacity)

In commercial wireless carrier partnership scenarios, the model presumes full leveraging of the carriers' assets. The model optimistically assumes commercial carrier facilities generally have sufficient capacity to accommodate the additional public safety infrastructure[11]. Lack of sufficient capacity could have dramatic impacts on overall costs. The model presumes the carrier has fiber backhaul (assumes the carrier has 3G or 4G service at the cell site) and has sufficient reserve capacity for public safety's needs. However, the model presumes the commercial carrier does not have redundant backhaul facilities, nor backup generator power required for hardening. The model presumes that the incremental tower fees

[10] If public safety is provided with a credit, it could either a) reduce its total spending and maintain the current number of users with access to broadband data service, or b) add new users. The model assumes the latter.

[11] Televate notes that commercial sites are often overloaded. Even in situations when they are not, they may not meet the stringent requirements of public safety, or may not otherwise be able to accommodate the necessary elements to provide public safety grade service.

are lower than a new lease (adding equipment to an existing site is less expensive than securing a new site lease). The model also considers labor savings from use of existing technical personnel maintaining existing commercial cell sites. An existing labor force can maintain a new frequency band with less effort than a labor force serving an entirely new area, especially if that labor force is already operating LTE in another frequency band. It is important to note that the model includes the above costs for the wireless carrier leverage models including use of a portion of its backhaul capacity[12]. It is feasible that a commercial carrier would allow the use of these resources at no cost to public safety; the model, however, is intended to shed light on the carrier's costs and requirements to create return on investment.

Commercial Service Method

Outside of the Band Class 14 coverage footprint, FirstNet could offer service via commercial roaming partner(s), satellite providers, or both. The model considers the cost structure of these commercial roaming service options. The model assumes the use of standard "off-the-shelf" solutions, and not priority or higher grade service. The model allows for consideration of both the Satellite on the Move (SoTM), and cell on wheels (COW) approaches. In the case of commercial cellular roaming partner, the model assumes that the revenue derived from that service is equivalent to the cost, and therefore, is neutral. If, for example, FirstNet establishes wholesale rates with roaming partners, the discount level is absorbed by FirstNet's costs to carry that customer. The model allows for selection of any of the five service delivery platforms mentioned above.

Service Delivery Methods Modeled

Televate's model is capable of a multitude of variations of the above options to support decision makers with a powerful modeling capability. It can be modified to address various scenarios in different types of areas (urban, suburban, rural), or accommodate alternative variants. The model can also be analyzed on an individual state-by-state basis and incorporate various commercial partnership options in each state. For example, the model can be customized to address the strongest cellular carrier in a state or for a state with more plentiful public safety assets.

These scenarios make various assumptions that may or may not become reality. For example, the model assumes a commercial carrier will leverage its tower space, backhaul, and field personnel. Carriers may not be willing to incorporate these capabilities into the business arrangement. In addition, public safety's requirements, from security to operational requirements or penalties, may prohibit carriers from participating at all. These scenarios are intended only to shed light on the net financial implications of high-level strategies that public safety could undertake in the construction and operations of the network. Televate does not have a preferred option among these options. Each

[12] Televate notes that while there may not be an incremental expense to the carrier for this capacity, it has some "opportunity cost" to the carriers, and therefore, must be recouped in the carrier's return on investment.

solution delivers unique results, and public safety's requirements, and the capabilities and desires of the partners will dictate the optimal model.

No.	Name / Description	Band Class 14 Coverage	Commercial Coverage Method	Hardening	Indoor vs. Outdoor Coverage	Partnership Model
1.	Initial Suburban Phase Public Safety Leverage	226 Most dense counties[13]	Not Considered	All sites	Indoor	Non-carrier (public safety asset priority)
2.	Commercial Footprint Multi-Carrier Partners	Composite commercial coverage	SoTM	All sites	Indoor	Commercial carriers
3.	Commercial Footprint Public Safety Leverage	Comprehensive coverage	SoTM	All sites	Indoor	Non-carrier (Public Safety asset priority)
4.	Extended Footprint Multi-Carrier Leverage, Outdoor coverage hardening	Comprehensive coverage	SoTM	Outdoor coverage sites	Indoor	Commercial carriers, then Public Safety Sites in remote areas
5.	Extended Footprint Public Safety Leverage, Outdoor coverage hardening	Composite commercial coverage	SoTM	Outdoor coverage sites	Indoor	Non-carrier (public safety priority)
6.	Commercial Footprint Single Large Commercial Partner	Composite Commercial Coverage	SoTM	All sites	Indoor	Single carrier, then public safety asset priority beyond its footprint
7.	Commercial Footprint Single Small Commercial Partner	Composite Commercial Coverage	SoTM	All sites	Indoor	Same as #6

Table 3: NPSBN Models Considered

There are other aspects of a business model not included in the cost analysis that result from the service delivery methods presented in Table 3. FirstNet will incur operational costs to support the sales and marketing activities required to secure customers. A customer service organization is also required to

[13] This scenario is intended to expend the full $7 billion in funding. It prioritizes the most dense counties to cover the most public safety personnel. The model indicated that coverage was feasible to the 226th most dense county, Winnebago, Illinois, covering nearly three percent of the land mass and nearly 50 percent of the public safety personnel.

support and retain customers. Accounting and billing systems and staff to collect fees and pay vendors are additional operational costs not modeled. Finally, FirstNet management and administrative functions must be considered. The costs associated with these functions can vary significantly depending on how FirstNet chooses to secure its customer base, how it services those customers, and how billing systems are implemented. Nonetheless, these service delivery components are not included in the model. These additional costs must be added into the net financial model, and the revenue generated from fees must recover the associated costs.

Televate's model accounts for both the capital and operating cost associated with each NPSBN scenario presented in this paper. The capital costs include equipment[14], engineering, installation labor, project management and other costs associated with the construction of the nationwide network. The operations costs include tower leases, backhaul (connectivity from cell sites to the core network), equipment maintenance, operations labor, roaming fees, satellite service fees, and other related expenses to operate the network and associated with delivering the service. As previously mentioned, customer service, sales, billing and general administrative costs are not included in the model. It is also important to note that the implementation of distributed antenna systems (DAS) required to extend reliable coverage into buildings, tunnels and other underground and underserved environments are not modeled. It is feasible that these costs could be borne by landlords via building codes. DAS implementations could result in substantial capital or operating expenses if new systems must be constructed, or if roaming onto commercial partner networks becomes common[15].

Cost and Partnership Model

The revenues associated with the FirstNet services will increase with the addition of new markets and as subscribers adopt the service. It will take months and perhaps years, depending on the pace of network deployment, to capture the vast majority of FirstNet's customers. Therefore, as common with start-up ventures, FirstNet must fund its "working capital" before it can expect to reach a break even position between expenses and revenues. The funding requirements for the working capital could be months, years, or even a decade to reach breakeven, and loses over this timeframe would need to be covered somehow. FirstNet could pursue two different approaches to managing this financial situation. FirstNet could assume the risk of operating the network at a roughly fixed price for services and fund the losses until sufficient revenues can be generated. Alternatively, FirstNet can retain a vendor that assesses service costs based on actual usage. In this case, the vendor assumes the financial risk associated with insufficient usage, or users on the network. And, as a result, the vendor will require some degree of

[14] Equipment constitutes the radio access network (RAN), evolved packet cores (EPC), microwave, fiber and all components and accessories required to construct and deploy the NPSBN.
[15] Assuming, of course, if commercial grade roaming is deemed acceptable to public safety users.

return on investment for that risk – in other words, it will cost FirstNet to enter into this partnership arrangement.

Figure 2 represents a hypothetical scenario whereby the business sustains losses in the first five periods of operations. As a result, the losses accumulate over that time and must be funded. Just prior to breaking even, in the sixth period, the cumulative losses are more than double the expenses per period.

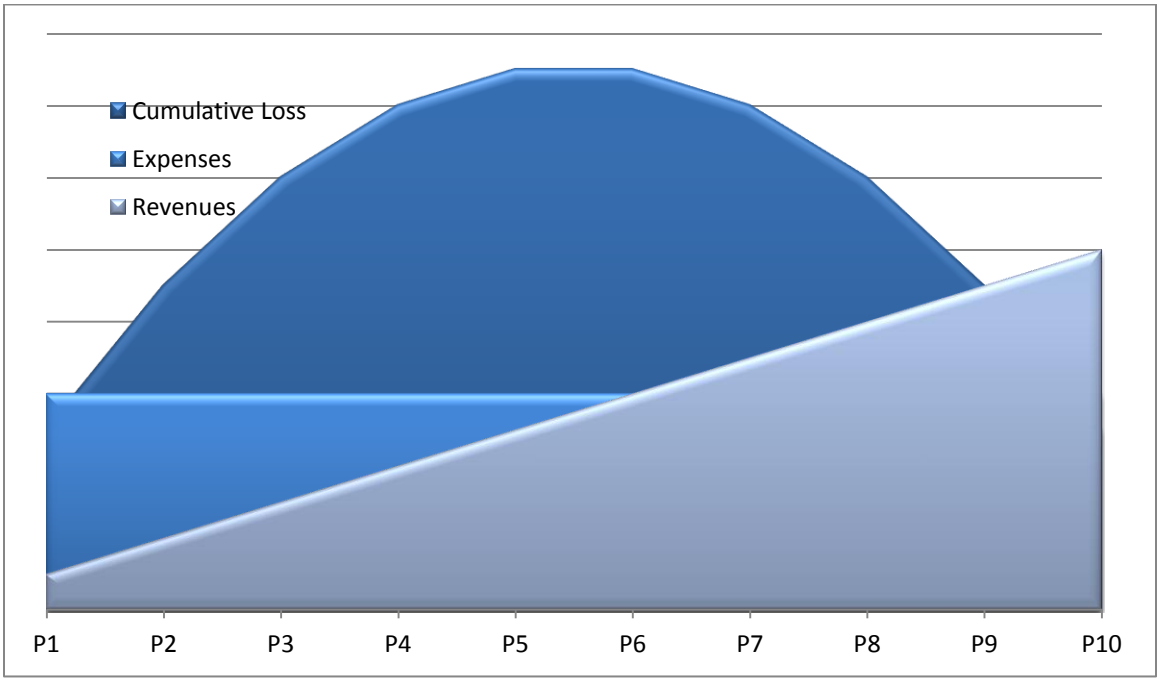


Figure 2: Cumulative Expense and Revenue

To accurately model the additional cost of doing business while the revenues ramp up would require an analysis of how quickly FirstNet, or the Mobile Network Operator (MNO), can generate the revenues. If a public safety entity is currently subscribing to commercial service under contract, honoring that contract could result in a delay in revenue from that user group for up to two years depending on the contract schedule. Select business partners may have greater opportunity to ramp up revenues more rapidly. For example, a commercial carrier with a large existing user base could upgrade its customers' subscriber devices to include Band Class 14 and migrate a large percentage of usage to the new system very quickly once devices are available.

Individual vendors could be retained serving as best partner within a specific functional area. For example, FirstNet could hire tower vendors, infrastructure vendors, system installers, and system operators separately to build and operate the network. This procurement approach would unlikely yield fees based on usage or users, and therefore, FirstNet would bear the financial risk associated with

initially lower revenue to expense ratio. Certainly, the partner(s) and the structure of the partnership will affect the overall NPSBN cost. The business details of the partnership and contractual arrangements will influence investment requirements and subsequent revenues and therefore affect the overall cost. Alternatively, a single vendor that provides all aspects of the network and its operations (subcontracting the various build and operate elements as necessary), is more likely to result in a fee or usage based approach.

Televate's model does not accommodate these factors within the context of this study, but the model can support their analysis and they can be readily incorporated into future modeling efforts. The modeling focus of this white paper is on the bottom line cost to deploy and deliver the service in any one year, after the revenues have matured. Furthermore, it assumes a largely fixed network operating cost (outside of roaming fees, internet access fees, and other costs that vary based on usage such as sites required to meet capacity. It does not include debt financing and other costs associated with the business that would be incorporated to model the "bottom line" financials.

Revenue Model

FirstNet must collect fees, or revenue, to cover the total expense of the network. It has limits, however, on how the fees can be assessed. FirstNet may have up to $7 billion to secure "assets" that can be leased, and excess capacity from 20 MHz of 700 MHz spectrum. Fees can be assessed for public safety services, covered leasing agreements, and asset lease of its assets. The approaches FirstNet can take to capture the full value for these attributes vary widely. Among the options, FirstNet could retain partners that operate the network and sell wholesale wireless broadband services to third parties.

The value of the excess capacity depends on a variety of factors. First, the extent of available excess capacity will impact the revenue generated. If public safety consumes a significant share of network capacity, the share available for resale is limited. A particular carrier partner may have a large existing customer base to leverage, or it could be a new market entrant that must amass its customer base. There may also be an opportunity to explore new revenue streams that have untapped potential – some of which may be willing to pay a premium for service over a hardened network. It is not possible at this time to project the opportunity participants, and how they might benefit from excess NPSBN capacity, or the FirstNet infrastructure. Therefore, the Televate model does not project these alternative revenues. Instead, the model highlights the secondary market revenues required to cover the operational costs.

User Fees

The user fee model is based predominately on the current market value for commercial services and Televate's projected public safety user population. Government budgets are limited. Therefore, Televate's model presumes that the total amount of government spending on broadband wireless

communications will remain relatively static, considering only cost of living increases. While public safety may pay more for a premium service (priority, pre-emption, unlimited access and hardening), a service cost increase over current service fees would ultimately reduce the public safety user base. Public safety needs to move in the opposite direction, toward more users that require access to the critical benefits of the NPSBN. In order to secure public safety subscribers, FirstNet will be competing with commercially available solutions from the cellular carriers. The cellular carriers currently offer considerable discounts to government users; therefore, Televate's model employs these current service costs.

Unfortunately, no nationwide database exists that indicates the total amount of spending by federal, state, and local governments on wireless services. Therefore, to estimate the current market value for commercial services, Televate's model incorporates our historical knowledge from urban, suburban, and rural wireless service use to assess the net revenue from user fees. Our estimate of the public safety user population is based predominantly on the United States Bureau of the Census annual census of Government Employees[16] (see Table 4).

Government Function	Full-time employees
Corrections	692,976
Electric Power	69,912
Firefighters Only	248,137
Highways	408,789
Other Fire Employees	22,537
Other Police Employees	182,632
Parks and Recreation	157,879
Police Officers Only	564,804
Solid Waste Management	82,521
Transit	219,490
Water Transport and Terminals	10,685

Table 4: Sample 2010 State and Local Employment Census Data

Devices Assigned to Individuals

Government wireless spending is restricted to a percentage of government employees. Large police departments simply can't afford to provide smartphones to all agency officers. In many cases, governments will only pay for individual devices of senior management personnel. While they may provide both a smartphone and wireless data card for a single user, state and local governments, in the aggregate, have operating budgets that would cover only a fraction of their total personnel base. Ideally,

[16] Televate used the 2010 census information available here http://www.census.gov//govs/apes/historical_data_2010.html

public safety agencies would prefer that all personnel subscribe to the network, but the subscription cost is a barrier.

The percentage of individual devices funded by any given agency varies dramatically depending on the functional need. For example, a police officer can benefit from applications that justify a handheld data device (e.g., for access to criminal databases), while the need for equipping a front-line firefighter with a handheld data device is less clear. As a result, government is more likely to fund an individually assigned device to a police officer than to a firefighter. And within police departments, it's more likely that the government will fund a device for police officers than civilian personnel in the agency. Televate's modeling approach adjusts the probability of government subsidized subscription based on the government function and on the need for the government to provide wireless data access to individuals in those function.

Given that cell phone ownership is approaching 100 percent in the United States, Televate's model also recognizes that first responders that do not have a government provided wireless device are likely to have their own device. First responders are likely to use these personal devices for their work, and therefore, it is defensible that these users need to operate on the FirstNet network. While it is unclear how FirstNet may "capture" these users to bring them onto the network, Televate suspects that many of these individuals will want to have service on the public safety grade broadband network, and to gain access to unique NPSBN only applications operating over a hardened network. As a result, Televate's model assumes that FirstNet will capture an additional portion of police, firefighter, and paramedic users who will personally fund wireless service in some manner[17].

Televate's model also considers volunteer firefighters. Volunteer firefighters typically hold day jobs not affiliated with firefighting and those employers may not be government entities. As a result, these individuals do not appear in the government population census. These individuals have incentive to be on the nationwide broadband network because it will provide emergency alerts, voice paging, and priority cell phone voice services that are critical to their operations. The Televate model assumes a portion of the nearly 800,000[18] volunteer firefighters will subscribe to the service.

The predominant device associated with individuals is presumed to be a voice and data device. As a result, the model assumes that handset style devices are available to public safety, that voice over LTE service is available to the public safety community, and that the revenue per user for these devices is comparable with today's carrier discounted charges for similar service. The model does not include

[17] If it is deemed contrary to the Act for the individual to personally purchase service from FirstNet, the first responder's employer could subscribe to the service and have the equivalent amount reduced from their paycheck.

[18] See http://www.nfpa.org/assets/files/PDF/Research/FireServiceFactSheet.pdf .

subsidies for user devices, and since the cellular carriers' fees are based on handheld device subsidies, the model reduces the perceived amount of subsidization from the revenues.

Televate's revenue model includes additional data only devices such as 4G enabled tablet and personal computers. While subscribership for cellular data enabled devices is expected to be smaller than that of handheld phone-type devices, Televate expects this segment to grow if devices become available. Importantly, as a data-only solution, Televate assumes lower revenue per user as is typical with commercial service. In the final analysis, the model also includes the value of the public safety credit derived from providing assets to incorporate into the NPSBN. These credits are a critical factor in helping to improve public safety adoption of broadband services.

Vehicle Based Devices

Public safety personnel also leverage wireless data via mobile data computers or modems that are permanently installed in their vehicles. In this case, many public safety personnel share the vehicle's connection to data systems and the Internet. So even though a police officer may not have a government provided device, the model assumes that they have access to a Mobile Data Terminal in the cruiser that provides access to data messaging, law enforcement databases, and other applications. The model includes the service (and revenue) associated with the modem and that the agency funds the hardware, software, and the maintenance of the system[19].

Other Potential Funding Sources

The Act allows for FirstNet to fund its operations through other means including leasing network capacity to a private entity for secondary use. According to the CTIA, United States wireless carriers have 321.7 million subscribers generating $178.4 billion in annual revenues[20]. This represents a substantial pool of users that could leverage the public safety network's capacity and offset annual operating costs. The Act also enables the leasing of infrastructure to third parties. It is therefore feasible that FirstNet could lease generator capacity, backhaul capacity, and, if constructed, tower space.

The model presumes that public safety agencies pay for user fees at a price point equal to what they are currently paying for commercial service. However, some states or local agencies may be willing to independently fund the cost of construction or operational enhancements within their geographic area. They could raise 911 fees or other taxes to cover the incremental cost associated with operating a portion of the nationwide network. Further, the Federal government can fund operations as needed through the national tax base. While the United States is seeking methods to reduce debt, the public may agree with funding a network that supports the responders who protect their lives and property. It may surprise some that the projected cost to operate this network would be less than one-tenth of one percent of the current $3.8 trillion dollar federal budget.

[19] Televate's model does not include any subsidization of these costs by FirstNet.
[20] See http://www.ctia.org/advocacy/research/index.cfm/AID/10323

Results and Summary

This initial output of Televate's financial model is intended to provide a rough order of magnitude perspective of the financial implications of various deployment and partnership scenarios. A detailed assessment of the costs would require the development of a specific scope for the entire network including the determination of the goals and objectives for the system, which in turn requires some level of engineering. The model uses high-level assumptions regarding the scope in order to estimate the costs and revenues for the chosen scenarios. Other scenarios can be modeled; however, the key findings are likely to be consistent with those summarized here.

The model generates capital costs, network operating costs, user fee revenue, and the "value" of the use of the public safety assets for various deployment and partnership scenarios. The "value" of public safety assets is deemed to be a "credit" for additional service. The following table represents the scenarios considered with this study and their respective financial implications and requirements.

No.	Scenario	Capital Costs (millions)	Annual Operating Costs (millions)	Annual Public Safety Revenue (millions)	Annual Public Safety Credit (millions)	Cost Recovery %	Credit Increase %
1.	Initial Suburban Phase Public Safety Leverage	$ 7,000	$ 1,490	$ 670	$ 370	45%	55%
2.	Commercial Footprint Multi-Carrier Partners	$ 13,500	$ 3,290	$ 1,400	$ 0	43%	0%
3.	Commercial Footprint Public Safety Leverage	$ 16,390	$ 3,370	$ 1,400	$ 850	42%	61%
4.	Extended Footprint Multi-Carrier Leverage, Outdoor coverage hardening	$ 12,450	$ 3,050	$ 1,400	$ 20	46%	1%
5.	Extended Footprint Public Safety Leverage, Outdoor coverage hardening	$ 12,980	$ 2,870	$ 1,400	$ 870	49%	62%
6.	Commercial Footprint Single Large Commercial Partner	$ 13,550	$ 3,280	$ 1,400	$ 10	43%	1%
7.	Commercial Footprint Single Small Commercial Partner	$ 14,430	$ 3,220	$ 1,400	$ 270	43%	19%

Table 5: NPSBN Financial Summary

The table also depicts the percentage of cost recovery from public safety user fees. This represents the degree to which public safety usage alone will cover network operating expenses. Again, this excludes other costs associated with running the FirstNet business such as sales, marketing, and customer service. Finally, the table also illustrates the percentage increase in public safety usage that is feasible

due to the public safety credits. This calculation is based on the net credit, divided by the total public safety revenue, and represents the potential increased public safety usage at no additional cost for that scenario.

The scenarios illustrate that in all circumstances, the cost to build a truly nationwide network exceeds the potential $7 billion funded by the Act. Smaller network footprint options, such as the suburban scenario modeled, may fit within the initial funding levels, but the nationwide network including rural service and more in line with public safety's requirements, is far more costly. The model demonstrates that the construction costs for various scenarios differ substantially. Likewise, the network operations costs also vary substantially. Importantly, the model shows that partnerships with the cellular carriers do not always yield the lowest costs. Furthermore, the model illustrates that carrier partnerships where public safety assets are also leveraged can be very cost effective.

As illustrated in Figure 3, this analysis underscores the significant cost differential associated with delivering nationwide service. All nationwide models cost more than $12 billion to build, far in excess of the available funding. The nationwide networks all cost on the order of $3 billion to operate, over $1.4 billion more than funds then projected from public safety user fees. The analysis also sheds light on some important tradeoffs public safety could consider. For example, the cost associated with extending the network coverage to 80 percent of the land mass of the United States can be offset by limited hardening of the network. There are significant costs associated with hardening the network.

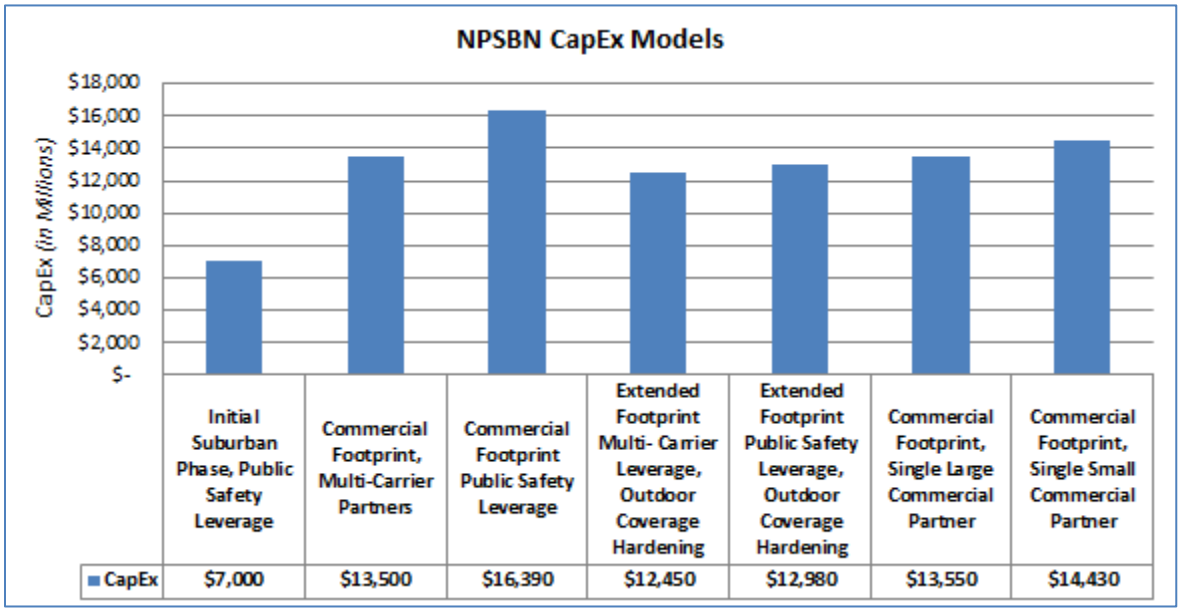
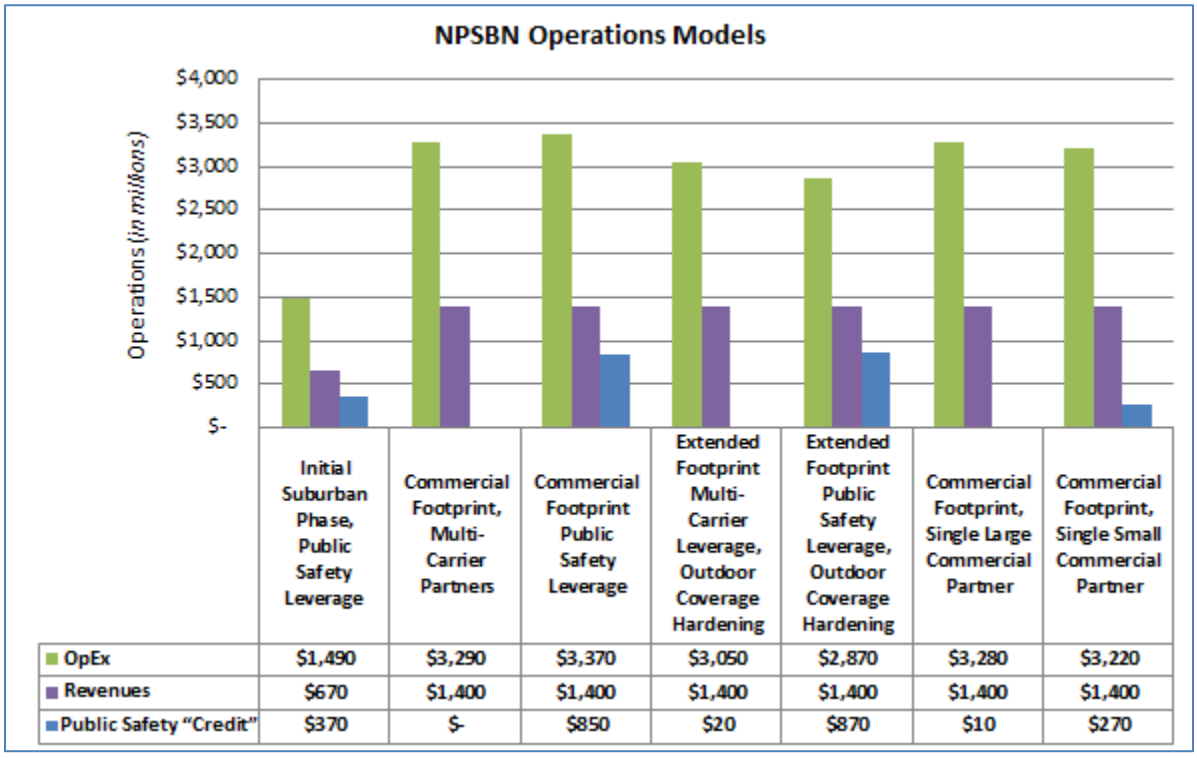


Figure 3: Capital Expenditures

The analysis also highlights the significant value of the public safety assets beyond the current commercial footprint. In the case of the existing commercial coverage levels, the capital costs are nearly $3 billion more for the public safety leverage model. In the extended coverage model, the incremental capital cost drops to $530 million. Furthermore, the operations costs are actually lower for the public safety case due to the $850 million in value from public safety assets.

As illustrated in Figure 4, none of the scenarios are sustainable on projected public safety user fees alone. The cost to operate the network exceeds the projected public safety user fee revenues for all scenarios. The results indicate that the service delivery methods model recover between 40 and 50 percent of the network operation costs – including the commercial partner models. This means that revenues must be roughly doubled beyond public safety usage to cover the costs. This shortfall could be derived from new users (e.g., utilities), doubling of user fees, or other revenue sources. The results also indicate that leveraging the public safety assets can have a significant impact on public safety adoption of broadband service. The public safety leverage scenarios result in credits that are 50 to 60 percent of wireless spending, implying service adoption could increase by more than 50 percent if public safety assets are heavily leveraged.



	Initial Suburban Phase, Public Safety Leverage	Commercial Footprint, Multi-Carrier Partners	Commercial Footprint Public Safety Leverage	Extended Footprint Multi-Carrier Leverage, Outdoor Coverage Hardening	Extended Footprint Public Safety Leverage, Outdoor Coverage Hardening	Commercial Footprint, Single Large Commercial Partner	Commercial Footprint, Single Small Commercial Partner
OpEx	$1,490	$3,290	$3,370	$3,050	$2,870	$3,280	$3,220
Revenues	$670	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400
Public Safety "Credit"	$370	$-	$850	$20	$870	$10	$270

Figure 4: NPSBN Operational Models

In the suburban model case, the results show that a network can be constructed with the expected $7 billion in funding, but that the revenue gap prevents sustainability on public safety user fees. This situation underscores the importance of ensuring that while public safety spends the funding allocated by the Act, it must ensure that ongoing service can be provided, and continue to upgrade and enhance the network to continually meet the needs of the public safety community.

The models depict the significant cost of operating a nationwide network. Leveraging existing assets, while reducing the capital costs, simply shifts the modeling cost to a service credit that essentially reduces revenues. A vendor may decide to provide its assets to FirstNet at no cost, but that vendor will require a return on investment. Ultimately, the primary asset with substantial value is the radio spectrum, monetized as leasable network capacity. Therefore, the annual "value" of the excess capacity must exceed the operating capital (OpEx) shortfall, or roughly $1.5 to $2.0 billion, to have both a sustainable network and affordable service.[21]

It is important to recognize that the commercial carriers may not be able to meet the public safety requirements. As public safety experienced in the D-Block auction, it is possible that the carriers could once again pass on the opportunity. Public safety may have mandatory requirements that the carriers simply cannot meet – requirements that the carriers may believe jeopardizes their financial or operational risks. Alternatively, a carrier or alternate partner may offer a compelling business model exceeding expectations.

Nonetheless, the capital and operating shortfalls underscore the need for private participation. Public safety needs private investment to build the network. According to the high-level model analysis, building the network requires some $5.5 to $9.4 billion of capital beyond the proposed $7 billion. Operating the network requires an additional $1.5 to $2.0 billion annually to operate for the models assessed. Therefore, it is critical that public safety carefully considers operational requirements and understands the cost implications of its decisions. Furthermore, it is critical that public safety understands how certain requirements can affect private participation. The time to fully investigate and address these issues is during the State and Local Implementation Grant Program (SLIGP). The SLIGP afford states and FirstNet the opportunity to define coverage, performance, application and governance requirements, to document possible assets to integrate into the NPSBN, and to document all potential government subscribers and state partners. Documenting usable public safety assets during the SLIGP will similarly provide valuable data and likely result in partnership incentives and return on investment for government. The blueprint for guiding the successful implementation, operation, and sustainment can begin with this program and provide valuable information to support FirstNet success.

[21] The modeling of revenues does not include spectrum leasing, 911 fees and other excise taxes, or revenue generating applications that could be included into the revenue model.