

The First Responder Network and Next-Generation Communications for Public Safety: Issues for Congress

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Summary

Since September 11, 2001, when communications failures contributed to the tragedies of the day, Congress has passed several laws intended to create a nationwide emergency communications capability. Yet the United States has continued to strive for a solution that assures seamless communications among first responders and emergency personnel at the scene of a major disaster. To address this problem, Congress included provisions in the Middle Class Tax Relief and Job Creation Act of 2012 (P.L. 112-96) for planning, building, and managing a new, nationwide, broadband network for public safety communications, and assigned additional spectrum to accommodate the new network. In addition, the act has designated federal appropriations of over $7 billion for the network and other public safety needs. These funds will be provided through new revenue from the auction of spectrum licenses. The cost of construction of a nationwide network for public safety is estimated by experts to be in the tens of billions of dollars over the long term, with similarly large sums needed for maintenance and operation. In expectation that public-private partnerships to build the new network will reduce costs to the public sector, the law has provided requirements and guidelines for shared use.

The act has mandated that technical standards developed for the new network incorporate commercial standards for Long Term Evolution (LTE). LTE is a fourth-generation wireless technology that bases its operating standards on the Internet Protocol (IP). IP-enabled networks and wireless devices provide higher capacity and transmission speeds than earlier generations of technology. LTE represents the convergence of wireless technology with the Internet, bringing the capacity and resiliency of packet-switched networks to emergency communications. It is generally believed that the use of LTE and IP standards will greatly enhance communications for emergency response and recovery.

There are many challenges for public safety leaders and policy makers in establishing IP-enabled technologies as the baseline for the development of future solutions for response and recovery. One of the immediate challenges in developing standards is the need for a clear policy on the use of spectrum for commercial and public safety LTE. Because public safety planning has lagged behind commercial efforts to build LTE networks, the work on design and development of technical requirements is incomplete. Many experts are concerned that these delays may place safety officials at a disadvantage in negotiating with potential partners, increase costs, and add further delays in moving forward to build a nationwide broadband network. Requirements in the act for standards development may be insufficient to overcome current technical obstacles for desired network features such as roaming between public safety and commercial networks.

In addition to monitoring progress in building the new broadband network for public safety, Congress may want to consider reviewing the role of commercial networks in emergency response and recovery. Once communications lines are compromised because of infrastructure failures, interdependent public safety networks are threatened and the ability to communicate vital information to the public is diminished. New policy initiatives may be needed to identify critical gaps in communications infrastructure and the means to fund the investments needed to close these gaps.

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Introduction

The importance of wireless communications in emergency response has expanded in parallel with increasing reliance on mobile communications across all sectors of the American economy. The consequences of failure in emergency communications networks have also grown, as the nation witnessed on September 11, 2001, and in the days that followed, as first responders and other emergency workers struggled to communicate with each other. The need for robust emergency communications was again underlined by network failures in the wakes of Hurricanes Katrina and Rita, in 2005. Fixing the problems of communications interoperability and operability that hampered response and recovery in these and other catastrophic events has been and remains a long-term goal of policy makers.[1]

After September 11, many experts recognized that a first responder communications network with national coverage would provide the standards and connectivity needed for interoperability and survivability. The National Commission on Terrorist Attacks Upon the United States (9/11 Commission) also recognized the role of networks in providing interoperability, citing the Army Signal Corps as a possible model in recommendations to Congress.[2]

From 2002 through 2007 Congress passed several laws intended to provide the Department of Homeland Security with the tools to plan for a national network. Efforts fell short of congressional expectations, however, in part because federal resources were directed to maintaining local jurisdiction in decision-making at the expense of coordinating a nationwide network.[3]

[1] Hearings in the 112th Congress include Senate, Committee on Science, Commerce and Transportation, "Safeguarding our Future: Building a Nationwide Network for First Responders," February 16, 2011; House, Committee on Homeland Security, "Public Safety Communications: Are the Needs of Our First Responders Being Met?," March 30, 2011; House, Committee on Energy and Commerce, Subcommittee on Communications and Technology, "Using Spectrum to Advance Public Safety, Promote Broadband, Create Jobs, and Reduce the Deficit," April 12, 2011; House, Committee on Energy and Commerce, Subcommittee on Communications and Technology, "Creating an Interoperable Public Safety Network," May 24, 2011; House, Committee on Energy and Commerce, Subcommittee on Communications and Technology, "Legislative Hearing to Address Spectrum and Public Safety Issues," July 15, 2011; House, Committee on Homeland Security, "Hearing on the Attacks of September 11: Where are We Today," September 8, 2011; House, Committee on Energy and Commerce, Subcommittee on Communications and Technology, markup of the Discussion Draft of the Jumpstarting Opportunity with Broadband Spectrum (JOBS) Act of 2011, December 1, 2011.

[2] Discussed in Congressional Research Service General Distribution Memorandum, "Communications Support for Public Safety: The 9/11 Commission Report and Alternative Approaches," by Linda K. Moore, August 25, 2004, and in CRS Report RL31375, *Emergency Communications: Meeting Public Safety Spectrum Needs* by Linda K. Moore, 2002-2003 (out of print; available from the author).

[3] Some of the actions by Congress and by federal agencies were summarized in testimony by Linda K. Moore, Specialist in Telecommunications Policy, Congressional Research Service, before the House Committee on Homeland Security, Subcommittee on Emergency Preparedness, Response, and Communications, "Ensuring Coordination and Cooperation: A Review of Emergency Communications Offices Within the Department of Homeland Security," November 17, 2011. The GAO has also addressed these issues in reports such as *Emergency Communications: Various Challenges Likely to Slow Implementation of a Public Safety Broadband Network*, February 2012, GAO-12-343 at http://www.gao.gov/assets/590/588795.pdf. CRS reports on the topic include CRS Report R41842, *Funding Emergency Communications: Technology and Policy Considerations*; CRS Report R40859, *Public Safety Communications and Spectrum Resources: Policy Issues for Congress*; CRS Report RL34054, *Public-Private Partnership for a Public Safety Network: Governance and Policy*; CRS Report RL33838, *Emergency Communications: Policy Options at a Crossroads*, all by Linda K. Moore.

With the passage of the Middle Class Tax Relief and Job Creation Act of 2012 (P.L. 112-96) on February 22, 2012, the Administration, Congress, the public safety sector, and many other stakeholders have come together to begin the process of developing, constructing, and operating a nationwide network designed to meet public safety communications needs. The act has given government agencies and public safety officials new tools for providing nationwide availability of state-of-the art communications capability for emergency response and recovery. A new network is to be built to provide broadband communications using Internet Protocol (IP) standards to support high-speed delivery of data-rich content and video (broadband). The IP-based technology mandated for the nationwide public safety broadband network is Long Term Evolution (LTE). Mission critical voice communications using standards designed for Land Mobile Radio (LMR) will be carried on separate networks. In time, many anticipate that IP standards for radios will replace LMR, bringing new economies of scale and higher levels of performance. The development of a unified effort to provide a national network places the nation on the path to achieve the long-sought goal of robust, interoperable communications for first responders.

Vulnerabilities from Commercial Network Failures

One of the many considerations in planning and building FirstNet is how it may be interoperable with commercial infrastructure. Part of the impetus for building a new network dedicated primarily to public safety is to assure that additional investments are made to harden the network. Hardening refers to protective measures such as redundant network connectivity, auxiliary power generators, and reinforcement of cell tower structures. The design for the new network, still in the early stages of fact-finding, will almost certainly rely in part on existing commercial installations such as towers, switches, network connections, and data and operations centers.

The devastation caused by Superstorm Sandy to parts of the Atlantic Seaboard in October 2012 dramatically underscored the value of hardening communications networks. Whereas approximately 25% of commercial wireless towers were out of service immediately after the storm, emergency communications links in New York City remained fully operational.[4] Since September 11, 2001, New York City has made substantial investments in network survivability and interoperability. Some surrounding communities that have not upgraded their networks reported problems, however.

The deployment of FirstNet is intended to overcome existing shortcomings and assure communications for first responders everywhere in the country. The kinds of investments in emergency communications undertaken in localities such as New York City and envisioned for the nationwide public safety network have for the most part not been made by the commercial wireless industry. Measures proposed by the FCC, after Hurricanes Katrina and Rita in 2005, to require back-up power for towers and operations centers, were successfully challenged by the wireless industry. FCC Commissioner Jessica Rosenworcel noted past failures to implement standards for back-up power in a speech delivered in mid-November, 2012. She called for "an honest conversation about network reliability in the wireless and digital age."[5] Members of Congress also have urged action. For example, Senator Charles Schumer wrote to FCC Chairman

[4] "NY Public Safety Systems Remained at 100% During Sandy," Government Technology, November 15, 2012, http://www.govtech.com/public-safety/NY-Public-Safety-Systems-During-Sandy.html.

[5] Silicon Flatirons Center, "Looking Back to Look Forward: The Next Ten Years of Spectrum Policy" Washington, DC, November 13, 2012. Text of speech at http://www.fcc.gov/document/commissioner-rosenworcel-remarks-silicon-flatirons-conference.

Julius Genachowski urging "that, under your leadership, representatives from industry and consumer groups can come together to develop an effective plan that protects the population against crisis without compromising the business interests of the communications world."[6]

The FCC subsequently announced its intention to make recommendations and actions to improve network resiliency. To this end, a series of hearings during 2013 will focus on "challenges faced by communications service providers, state and local officials, emergency personnel, and consumers before, during, and after ... natural disasters."[7] Although commercial operations appear to be the focus of the inquiry, a number of questions raised by the FCC are relevant to the decisions being faced for the design of FirstNet.

Key New Legislative Provisions to Improve Public Safety Communications

A program to provide nationwide coverage for public safety communications is to be developed and managed by a new authority created in Title VI of the Middle Class Tax Relief and Job Creation Act of 2012 (P.L. 112-96). The First Responder Network Authority, or FirstNet, has been established by the act and given broad powers to ensure that the nationwide public safety broadband network is built, maintained, and kept up-to-date as technology evolves.[8] In consultation with federal and state authorities, FirstNet will develop proposals to construct and manage the network with partners from the private sector, among others. Following is a discussion of major provisions in the act that pertain to public safety communications, including provisions to improve the nation's 911 emergency call system.

Among federal agencies designated by the act to provide consultation and support are the Federal Communications Commission (FCC), the National Telecommunications and Information Administration (NTIA), the National Institute of Standards and Technology (NIST), and the Office of Emergency Communications (OEC). The FCC manages commercial and non-federal spectrum use, including spectrum allocated to public safety. The NTIA manages federal spectrum resources and, along with NIST, is an agency within the Department of Commerce. OEC is part of the Office of Cybersecurity and Communications, Department of Homeland Security.

Spectrum Assignment

Radio frequency spectrum is an essential resource for wireless communications. The energy in electronic telecommunications transmissions converts airwaves into channels to deliver voice, text, and images. These channels are allocated for specific purposes, such as television broadcasting or WiFi,[9] and assigned to specific users through licenses. Allocating sufficient spectrum for wireless emergency communications has long been a concern for Congress. The

[6] Press Release, November 19, 2012 at http://www.schumer.senate.gov/Newsroom/record.cfm?id=337945.

[7] FCC *News,* November 21, 2012 at http://www.fcc.gov/document/chairman-genachowski-announces-post-superstorm-sandy-field-hearings.

[8] P.L. 112-96, Section 6204 (a).

[9] WiFi, for wireless fidelity, operates on unlicensed frequencies that are not assigned to a specific owner but instead are available to support any device approved by the FCC.

Balanced Budget Act of 1997 (P.L. 105-33), for example, directed the FCC to allocate 24 MHz[10] of spectrum in the 700 MHz band for public safety use.[11]

With the passage of the Middle Class Tax Relief and Job Creation Act of 2012, some existing public safety licenses in the 700 MHz band[12] and an additional license (known as the D Block),[13] together totaling 22 MHz, have been designated by Congress to support a broadband communications network for public safety. The initial, 10-year license is required to be assigned by the FCC to FirstNet. It is renewable for an additional 10 years, on condition that FirstNet has met its duties and obligations under the act.[14]

A total of 34 MHz of spectrum capacity will therefore be available for public safety networks within the 700 MHz band: the 22 MHz designated for broadband and 12 MHz allocated for narrowband communications, primarily voice.[15] Additionally, there are public safety networks on adjacent frequencies within the 800 MHz band. Time and technological advances may someday bring these spectrum assets together, but at present there are three distinct public safety network technologies in use or planned within the 700 MHz and 800 MHz bands. These are: broadband communications at 700 MHz; interoperable narrowband communications at 700 MHz; and narrowband communications at 800 MHz. Some of the narrowband networks at 700 MHz and 800 MHz can share infrastructure and radios but older narrowband networks at 800 MHz are often not easily integrated with narrowband networks being built on 700 MHz frequencies.

All of the 700 MHz band spectrum assigned for public safety use can support broadband networks. At present, however, there is no tested technology to deliver voice communications over LTE broadband that meets first responder needs. The act gives the FCC the authority to "... allow the narrowband spectrum to be used in a flexible manner, including usage for public safety broadband communications.... " subject to technical and interference protection measures.[16] This provision might open an opportunity for public safety agencies that want to be in the vanguard of using voice communications technology on LTE networks.

To offset the reassignment of the D Block from commercial to public safety use, the act requires the eventual return of frequencies known as the T-Band.[17] These are frequencies between 470 and 512 MHz allocated for television that have been made available for public safety use in 11 urban areas.[18] Since the transition to digital television, radio transmissions on some of these frequency assignments have experienced interference and the public safety agencies that use them are considering moving to new networks at 700 MHz. Other areas have recently invested to upgrade

[10] Spectrum is segmented into bands of radio frequencies and typically measured in cycles per second, or hertz. Standard abbreviations for measuring frequencies include kHz—kilohertz or thousands of hertz; MHz—megahertz, or millions of hertz; and GHz—gigahertz, or billions of hertz. The 700 MHz band includes radio frequencies from 698 MHz to 806 MHz.

[11] 47 U.S.C. §309 (j) (14).

[12] 763-768 MHz, 793-798 MHz, 768-769 MHz and 798-799 MHz; P.L. 112-96, Section 6201.

[13] 758-763 MHz and 788-793 MHz; P.L. 112-96, Section 6101.

[14] P.L. 112-96, Section 6201.

[15] 769-775 MHz and 799-805 MHz.

[16] P.L. 112-96, Section 6102.

[17] P.L. 112-96, Section 6103.

[18] Metropolitan areas: Boston, MA, Chicago, IL, Dallas/Fort Worth, TX, Houston, TX, Los Angeles, CA, Miami, FL, New York, NY/Newark NJ, Philadelphia, PA, Pittsburgh, PA, San Francisco/Oakland, CA, and Washington, DC.

networks built on the T-Band frequencies and are concerned about the loss of this communications capacity. The act requires that the FCC act by February 2021 to establish a relocation plan that would free up the T-Band for reassignment through competitive bidding. Proceeds from the auctions of T-Band frequencies are to be available for grants to cover relocation costs. There are no requirements in the law as to how the NTIA, the designated grants administrator, is to structure the grant program or determine eligible costs, although the agency might decide to follow procedures for reallocating federal spectrum. The FCC and the NTIA might choose to work together to develop a transition plan that would allow public safety agencies that want to reallocate to 700 MHz to do so on an expedited basis.

Some of the earliest spectrum assignments for public safety are in channels below 512 MHz. Public safety and other license-holders in designated channels below 512 MHz are required to reband their holdings to conform to an FCC mandate to improve spectrum efficiency.[19] This narrowbanding requirement, as it is called, requires that assigned channels be reduced from a width of 25 khz to 12.5 khz, thereby freeing up new spectrum capacity for public safety and other uses. The deadline to meet the narrowbanding requirement is January 1, 2013. To accommodate public safety licenseholders in the T-Band that now fall under requirements established in the act, the FCC has ruled to exempt them from the narrowbanding requirements.[20]

Other spectrum assets available for public safety communications include 50 MHz of spectrum at 4940-4990 MHz (4.9 GHz). Current technology limits these frequencies to local area networks covering a small area. Many experts believe that short-range applications can be incorporated with broadband networks to provide additional resources and better coverage, for example in responding to emergencies in high-rise buildings.[21]

To maximize the effectiveness of these multiple spectrum holdings, many believe that additional technological development and planning should be undertaken. FirstNet's mandate appears to limit it to the public safety broadband network to be operated on the spectrum licensed to it. Although not specifically required by the act, several federal agencies do have broad powers to undertake research and development that might further goals for improved performance of emergency communications systems, and more efficient and effective use of all spectrum resources allocated for public safety use.

Expenditures and Revenue Sources

The cost of building a new wireless communications network is likely to be in the tens of billions of dollars.[22] The expectation is that FirstNet will have access to existing infrastructure for some of the network's components and that it will be able to invest through partnerships—with

[19] Details at http://transition.fcc.gov/pshs/public-safety-spectrum/narrowbanding.html.

[20] FCC, "Waiver of Narrowbanding Deadlines for T-Band (470-512 MHz) Licenses," Docket No. WT 99-87, released April 26, 2012.

[21] The FCC has opened a proceeding regarding the 4.9 GHz public safety band, proposing rules and asking for comment on a number of issues to improve spectrum efficiency and encourage greater use of the 4.9 GHz band for public safety broadband communications, http://www.fcc.gov/document/comment-and-reply-comments-date-5th-fnprm-49-ghz-band.

[22] Some cost estimates for building and operating a public safety broadband network are provided in CRS Report R41842, *Funding Emergency Communications: Technology and Policy Considerations*, by Linda K. Moore.

commercial wireless carriers or other secondary users of its spectrum and infrastructure—that generate revenue.

The Middle Class Tax Relief and Job Creation Act of 2012 provides over $7 billion in funding either to FirstNet and states participating in the nationwide network, or as grants to states that have opted out of participating in the FirstNet nationwide network program, but have qualified to build their state's portion of the nationwide network. There is an initial loan of $2 billion (repayable from spectrum-license auction proceeds) to set up FirstNet and begin its operation.[23] The remaining $5 billion will become available as auctions for spectrum licenses are concluded and the revenues deposited in the Public Safety Trust Fund.

Public Safety Trust Fund

The law provides for transfers from a Public Safety Trust Fund that is created by the act to receive revenues from designated auctions of spectrum licenses.[24] The designated amounts are to remain available through FY2022, after which any remaining funds are to revert to the Treasury, to be used for deficit reduction. Auction proceeds are to be distributed in the following priority:

- To the NTIA, to reimburse the Treasury for funds advanced to cover the initial costs of establishing FirstNet: not to exceed $2 billion.
- To the State and Local Implementation Fund for a grant program: $135 million.
- To the Network Construction Fund for costs associated with building the nationwide network and for grants to states that qualify to build their own networks: $7 billion, reduced by the amount advanced to establish FirstNet.
- To NIST for public safety research: $100 million.
- To the Treasury for deficit reduction: $20.4 billion.
- To the NTIA and the National Highway Traffic Safety Administration for a grant program to improve 911 services: $115 million.
- To NIST for public safety research: $200 million.
- To the Treasury for deficit reduction: any remaining amounts from designated auction revenues.

The NTIA has determined that distributions to fund these programs are subject to sequestration and may be reduced.

Network Construction Fund

The Network Construction Fund is established in the Treasury to be used by FirstNet for expenditures on construction, maintenance, and related expenses to build the nationwide network

[23] P.L. 112-96, Section 6207.

[24] P.L. 112-96, Section 6413.

required in the act, and by the NTIA for grants to those states that qualify to build their own radio access network links to the FirstNet core infrastructure.[25]

FirstNet: Limit on Expenditures

The act caps FirstNet's administrative expenses at $100 million in total over the first 10 years of operation. Costs attributed to oversight and audits are not included in the expense cap.[26]

FirstNet: Fee Income and Other Revenue

FirstNet has the authority to obtain grants and to receive payment for the use of network capacity licensed to FirstNet and of network infrastructure "constructed, owned, or operated" by FirstNet.[27] Specifically, FirstNet is authorized to collect network user fees from public safety and secondary users[28] and to receive payments under leasing agreements in public-private partnerships.[29] These partnerships may be formed between FirstNet and a secondary user for the purpose of constructing, managing, and operating the network. The agreements may allow access to the network on a secondary basis for services other than public safety. FirstNet and its partners may also receive payments for leasing access to infrastructure, such as towers.[30] The act requires that these fees be sufficient each year to cover annual expenses of FirstNet to carry out required activities,[31] with any remaining revenue going to network construction, operation, maintenance, and improvement.[32] There is a prohibition on providing service directly to consumers; this does not impact the right to collect fees from a secondary user or enter into leasing agreements.[33]

State and Local Implementation Fund

The State and Local Implementation Fund was allocated $135 million from the Public Safety Trust Fund. The NTIA, which administers the grant program for this fund, may borrow up to the full amount.[34] The grants are to go to states to develop a plan on how to use a nationwide public safety broadband network to meet their emergency communications needs. The program is to be established as a matching grant program. Federal grants from the fund are not to exceed 80% of the projected cost to the state, however, the NTIA may make the decision to waive the matching funds requirement.[35] The distribution of available funds among the states will be established by the NTIA in consultation with FirstNet.[36]

[25] P.L. 112-96, Section 6206 (e).

[26] P.L. 112-96, Section 6207 (b).

[27] P.L. 112-96, Section 6206 (b) (4).

[28] P.L. 112-96, Section 6208 (a) (1).

[29] P.L. 112-96, Section 6208 (a) (2).

[30] P.L. 112-96, Section 6208 (a) (3).

[31] P.L. 112-96, Section 6208 (b).

[32] P.L. 112-96, Section 6208 (d).

[33] P.L. 112-96, Section 6212.

[34] P.L. 112-96, Section 6301.

[35] P.L. 112-96, Section 6302 (b).

[36] P.L. 112-96, Section 6302 (a).

In compliance with the act's deadline for setting up the State and Local Implementation Fund, the NTIA has published initial programmatic requirements under which it will award grants.[37] The notice states that the NTIA expects to consult with FirstNet on the scope of the grants with the goal of issuing grant requirements in the first quarter of 2013. Funding is planned for distribution in two phases. The first phase will provide funding for initial planning and related activities. The second phase will begin after FirstNet has consulted with the 56 states and territories eligible to receive grants under the program. The second phase will address states' needs in preparing for additional consulting with FirstNet, and for planning to undertake data collection activities. Among the requirements that the NTIA is considering for grant eligibility are requirements for states to identify potential public safety users of the network; to develop standard Memoranda of Understanding to facilitate the use of existing infrastructure; and to prepare a comprehensive plan "describing the public safety needs that they expect FirstNet to address in its design" of the network.[38]

Other Sources of Funds

The construction of this new network represents a significant investment for all participants. State public safety agencies have multiple obligations to build or upgrade, and equip, other networks and may not be in a position to contribute to building and maintaining the new broadband network. The ability of FirstNet to procure funding from the private sector may be crucial to its success.

Planning Authority

The Middle Class Tax Relief and Job Creation Act of 2012 creates FirstNet as an independent entity within the NTIA and empowers it to oversee the establishment of an interoperable broadband network for public safety. The act requires that state and local agencies have a consulting role in the development, deployment, and operation of the nationwide network. The act further provides an opportunity for states to build their own radio access networks within the framework of the nationwide broadband network.

FirstNet

FirstNet is to be headed by a board of 15 members of which 12 are appointed by the Secretary of Commerce according to criteria established by the law, which are intended to provide both representation from key stakeholders and expertise. The other three members of the board are the Secretary of the Department of Homeland Security, the Attorney General of the United States, and the Director of the Office of Management and Budget. The Secretary of Commerce is required to appoint a chairman of the board for an initial term of two years.[39] FirstNet has the statutory authority to exercise all powers specifically granted by the act and "such incidental

[37] *Federal Register*, Vol. 77, No. 162, August 21, 2012, Notice, http://www.ntia.doc.gov/federal-register-notice/2012/development-programmatic-requirements-state-and-local-implementation-gr.

[38] Ibid., Paragraph C, Allowable Grant Activities.

[39] P.L. 112-96, Section 6204.

powers as shall be necessary."[40] Appointments to the board were announced on August 20, 2012.[41]

FirstNet is required to create a public safety advisory committee to assist in carrying out its mandate.[42] The committee is to take "all actions necessary to ensure the building, deployment, and operation" of the network in consultation with federal, state, tribal, and local public safety entities, the Director of NIST, the FCC, and the public safety advisory committee.[43] There are no requirements in the statute as to the composition of the committee. By-laws adopted at the organizing meeting of the First Net Board of Directors on September 25, 2012 created a Public Safety Advisory Committee.[44] It was further agreed that the members of the committee would be chosen from the Advisory Committee to SAFECOM, within the Department of Homeland Security, to be chosen in consultation with the Secretary of Homeland Security. The organizations chosen to be represented on the committee were announced on February 20, 2013.[45]

Other board committees established in the By-Laws are the Executive Committee; the Planning and Technology Committee; the Audit, Budget and Finance Committee; and the Governance and Personnel Committee.

FirstNet appears to be an autonomous organization, with broad powers to carry out its mandate, within the requirements established by the law. It has for example sole power to select the program's manager and its agents, consultants, and other experts subject to the requirement that they be chosen "in a fair, transparent, and objective manner."[46] In managing proposals and contracts, it is to "take such other actions as may be necessary" to accomplish the network buildout.[47]

As part of its management of the network, FirstNet is required at a minimum:

- To establish network policies, including development of detailed requests for proposals to build the network, and operational matters such as terms of service and billing practices.[48]
- To consult with states on expenditures, as part of the preparation of policies and requests for proposals.[49]

[40] P.L. 112-96, Section 6206 (a).

[41] Announcement and background information at http://www.ntia.doc.gov/other-publication/2012/acting-secretary-rebecca-blank-announces-board-directors-first-responder-netw.

[42] P.L. 112-96, Section 6205 (a).

[43] P.L. 112-96, Section 6206 (b) (1).

[44] Board Resolution 1, By-Laws, http://www.ntia.doc.gov/files/ntia/publications/firstnet_resolution_no._1_on_bylaws_adopted_9.25.12.pdf.

[45] NTIA, "FirstNet Names members of Public Safety Advisory Committee," February 20, 2013, http://www.ntia.doc.gov/press-release/2013/firstnet-names-members-public-safety-advisory-committee.

[46] P.L. 112-96, Section 6205 (b) (1).

[47] P.L. 112-96, Section 6206 (b) (4) (D).

[48] P.L. 112-96, Section 6206 (c) (1).

[49] P.L. 112-96, Section 6206 (c) (2).

- To enter into agreements to use existing communications infrastructure, including commercial and federal infrastructure, "to the maximum extent economically desirable."[50]
- To ensure the construction, maintenance, operation, and improvement of the broadband network, taking into account new and evolving technologies.[51]
- To enter into agreements with commercial networks to allow public safety roaming on their networks.[52]
- To represent the interests of the network's users before standards-setting boards, in consultation with NIST, the FCC, and its own Public Safety Advisory Committee.[53]

As a first step in developing plans for the FirstNet infrastructure, a network proposal was submitted at the September 25, 2012 board meeting.[54] The NTIA subsequently issued a Notice of Inquiry requesting comments by November 1, 2012.[55]

State and Local Participation

Every state has one or more agencies that plan for public safety, homeland security, and emergency communications. Most states have a Statewide Interoperability Coordinator (SWIC) to administer its Statewide Communication Interoperability Plan (SCIP).[56] SCIPs are written to conform with federal guidelines and requirements, such as the National Emergency Communications Plan. FirstNet is required to consult with regional, state, tribal, and local authorities regarding decisions such as those concerning the costs of the policies it formulates, as required in the law, including expenditures for the core network, placement of towers, coverage areas, security, and priority access for local users. Consultation will be through a state-selected coordinator as specified in the act.[57] Appointment of an individual or governmental body as the point-of-contact is also required as a condition of state participation and eligibility to receive grants established by the act.[58] States may decide to use the existing SWIC as the required single point-of-contact or may choose to appoint a separate coordinator.

The governor of each state is to be notified by FirstNet when it has completed its requests for proposals regarding construction, operation, maintenance, and improvement of a nationwide network. The governor or his designee will receive the details of the proposed plans and

[50] P.L. 112-96, Section 6206 (c) (3).

[51] P.L. 112-96, Section 6206 (c) (4).

[52] P.L. 112-96, Section 6206 (c) (5).

[53] P.L. 112-96, Section 6206 (c) (7).

[54] FirstNet Network (FNN) Proposal, http://www.ntia.doc.gov/files/ntia/publications/firstnet_fnn_presentation_09-25-2012_final.pdf.

[55] Deadline extended to November 9, 2012. Notice at http://www.ntia.doc.gov/federal-register-notice/2012/notice-inquiry-firstnet-conceptual-network-architecture; comments posted at http://www.ntia.doc.gov/federal-register-notice/2012/comments-nationwide-interoperable-public-safety-broadband-network-noi.

[56] See "Statewide Interoperability Coordinators" at http://www.dhs.gov/files/programs/gc_1286986920144.shtm.

[57] P.L. 112-96, Section 6206 (c) (2) (B).

[58] P.L. 112-96, Section 6302 (d).

notification of the amount of funding available to the state if it participates in the FirstNet program.[59]

A state that does not want to participate in FirstNet must submit an alternative plan for construction, operation, maintenance, and improvement of the radio access network within the state. The state must demonstrate to the FCC, which the law requires to review the plan, that its planned network would comply with minimum technical requirements and be interoperable with FirstNet. The state has 90 days to agree to participate or to notify FirstNet, the NTIA, and the FCC of its intent to deploy its own part of the radio access network, and an additional 180 days to provide its plan to the FCC.[60]

If the FCC does not approve the plan, the state might be obliged to participate in FirstNet.[61] If a state's plan is approved it will be eligible to apply for a grant, administered by the NTIA, that will be funded from the Network Construction Fund created by the act. The amount available will be less than what would have been provided if the state had opted in to the FirstNet program, because the grant will be applied only toward building the radio access network and may be subject to matching grant requirements. Approval of the grant is contingent on meeting additional requirements established by the NTIA, including sustainability, timeliness, cost-effectiveness, security, coverage, and services that are comparable to FirstNet.[62] The state would be required to pay a user fee for access to FirstNet.[63] It would not be permitted to enter commercial markets or lease access to its network except through a public-private partnership. Any revenue to the state from a partnership must be used only for costs associated with its broadband network.[64]

Some industry observers have expressed concern about the impact on the success of the nationwide broadband network if many states choose to build their own radio access networks. The cost to FirstNet of building the nationwide network may go up, for example, if anticipated economies of scale are diminished. It may be more difficult for FirstNet to negotiate the partnerships that are expected to provide much of the needed funding for the network. A state that has its plans approved by the FCC may not be able to meet stipulated requirements when its network is built; absent any action by the FCC to enforce technical requirements, the goal of seamless interoperability across all broadband systems may be jeopardized. States may also have difficulty in finding the funds to complete radio access network build-outs, leaving significant gaps in what is intended to be nationwide coverage. The law only identifies two options for a state: join FirstNet or build a statewide radio access network subject to the provisions of the act. It does not say whether states may choose to opt-out of the broadband network entirely, choosing neither to join FirstNet nor to build a broadband network on the frequencies assigned to FirstNet. Some states may prefer to concentrate their resources on improving mission-critical voice networks and acquire broadband access from a commercial provider or through other means.

One advantage for states building their own radio access networks on FirstNet spectrum is that they will have greater control over any partnerships formed and on expenditures within their states. Although the act requires states to use any revenue from partnerships only to cover costs

[59] P.L. 112-96, Section 6302 (e) (1).

[60] P.L. 112-96, Section 6302 (e) (2) and (3).

[61] P.L. 112-96, Section 6302 (e) (3) (C) (iv).

[62] P.L. 112-96, Section 6302 (e) (3) (D).

[63] P.L. 112-96, Section 6302 (f).

[64] P.L. 112-96, Section 6302 (g).

associated with the state's network, the states will be able to make their own decisions about priorities, with more confidence that revenues will be available when needed. Although there are many potential benefits for states to participate in a nationwide network, such as economies of scale, more secure and robust communications, and a unified base for collaborative efforts, there are also a number of risks, especially if FirstNet fails to deliver the benefits. The success of FirstNet as an accepted planning authority and leader may depend on whether it makes a compelling business case in the requests for proposals required by the act.

FirstNet's plans for partnerships with the private sector and the nature of the network development plans proposed to each state may be of particular interest to Congress as an early indicator of the viability of FirstNet in meeting the goals required by the act.

Federal Governance

Federal governance of the nationwide public safety broadband network, as required by the Middle Class Tax Relief and Job Creation Act of 2012, is primarily through consultation and oversight. Planning, investment, operating, and other related decisions are to be made by the FirstNet board and the experts it is to hire on a permanent or consultative basis. The designated appropriate congressional committees are, in the Senate, the Committee on Commerce, Science, and Transportation; in the House, the Committee on Energy and Commerce.[65] These committees and other committees with jurisdiction are likely to take an active role in oversight, many believe.

Examples of statutory obligations for Congress and the Administration in the direction of FirstNet include the following.

Membership on FirstNet board. The members of the FirstNet board are to be chosen by the Secretary of Commerce, within the parameters established in the act. The Department of Homeland Security, the Attorney General, and the Office of Management and Budget each have one member on the board in permanence. The Secretary of Commerce is required to appoint a chairman of the board for an initial term of two years.[66]

Grant programs for planning. The NTIA is to establish and administer the State and Local Implementation Fund. Grant provisions are to be in accordance with decisions made by FirstNet.[67]

Grant programs for state networks. The NTIA is to administer grants from the Network Construction Fund to states that qualify to build their own radio access networks and choose to apply for a grant.[68]

Spectrum leases for state networks. The NTIA sets the terms and is responsible for enforcing the requirement that states qualifying to build their radio access networks must sublease spectrum through FirstNet, the assigned license-holder.[69]

[65] P.L. 112-96, Section 6001 (3).

[66] P.L. 112-96, Section 6204.

[67] P.L. 112-96, Section 6302 (a).

[68] P.L. 112-96, Section 6302 (e) (3) (C) (iii) (I).

[69] P.L. 112-96, Section 6302 (e) (3) (C) (iii) (II).

License review. The FCC is required to review the initial 10-year license assigned to FirstNet and consider its renewal based on performance criteria.[70]

Performance review. The Government Accountability Office (GAO), within 10 years, is to prepare a report assessing the effectiveness of FirstNet with recommendations on "what action Congress should take" regarding the mandated termination of authority.[71]

Fee schedule. The NTIA is to review and approve the annual schedule of fees charged to public safety agencies and other users for access to FirstNet's resources.[72]

Annual audit. The Secretary of Commerce is to contract for an annual audit of FirstNet's finances and activities. The reports are to be submitted to Congress, the President, and FirstNet.[73]

Report to Congress. FirstNet is required to submit annual reports to Congress on its "operations, activities, financial conditions, and accomplishments."[74]

Although there are several platforms for oversight and guidance provided in the act, it seems likely that the primary responsibility for monitoring progress will fall to the NTIA. The agency may choose to seek assistance from other agencies beyond what is specified in the act, possibly through memoranda of understanding.

Public-Private Partnerships

Partnerships are expected to play a critical role in building and operating the network. Electric utility companies, for example, are upgrading their networks to meet Smart Grid requirements,[75] and some companies have expressed an interest in partnering with FirstNet or state authorities. Some commercial wireless service providers have also expressed an interest in working in partnership with public safety entities to develop and operate new broadband networks.

The Middle Class Tax Relief and Job Creation Act of 2012 requires FirstNet to issue "open, transparent, and competitive" requests for proposals to private sector entities for building, operating, and maintaining the network[76] that leverage to the extent "economically desirable" existing commercial wireless infrastructure, in order to expedite network deployment.[77] It is charged with managing and overseeing the resulting contracts or agreements. As part of a separate requirement to assure substantial rural coverage during all phases of deployment, the act

[70] P.L. 112-96, Section 6201 (b).

[71] P.L. 112-96, Section 6206 (g).

[72] P.L. 112-96, Section 6208 (c).

[73] P.L. 112-96, Section 6209.

[74] P.L. 112-96, Section 6210.

[75] "Smart Grid" is the name given to the evolving electric power network as new information technology systems and capabilities are incorporated. See also CRS Report R41886, *The Smart Grid and Cybersecurity—Regulatory Policy and Issues*, by Richard J. Campbell.

[76] P.L. 112-96, Section 6206 (b) (1) (B).

[77] P.L. 112-96, Section 6206 (b) (1) (C).

requires that industry proposals and contracts include, if possible, partnerships with existing commercial mobile providers.[78]

Decisions by FirstNet about the network's design, construction, and operation are likely to have a significant impact on commercial participation in a public safety broadband network or networks. These decisions may also influence decision-making by states as to whether or not to pursue radio area network construction independently or through their own partnerships.

Congress may be interested in the composition of private sector partnerships formed by FirstNet and individual states, not only for their business plans but also for the inclusion of a wide variety of stakeholders. For example, are rural and tribal wireless carriers included as business partners? Do secondary access agreements support services that meet social goals, such as for telemedicine, or are they exclusively for commercial purposes? Is competition in providing wireless services being enhanced or hindered?

Infrastructure

Infrastructure for the new network includes operations centers, towers, antennae, and other communications equipment, as well as radios and the software that links them to the network. For wireless communications, an important infrastructure component is the network that links radio towers to communications backbones. These networks, which usually operate over fiber-optic cable or microwave connection, are typically referred to as backhaul.

The Middle Class Tax Relief and Job Creation Act of 2012 requires FirstNet to establish a nationwide, interoperable public safety network,[79] with a "single, national network architecture that evolves with technological advancement.... "[80] Network infrastructure components that are specifically required include

- Core network of national and regional data centers and other elements, all based on commercial standards.
- Connectivity between the radio access network and the public Internet or the Public Switched Telephone Network, or both.
- Network cell site equipment, antennas, and backhaul equipment, based on commercial standards, to support wireless devices operating on frequencies designated for public safety broadband.

FirstNet is required to leverage existing infrastructure by entering into agreements to use commercial or other communications infrastructure including federal, state, tribal, or local infrastructure.[81] Planned phases for infrastructure deployment are to include "substantial rural coverage."[82]

[78] P.L. 112-96, Section 6206 (b) (3).

[79] P.L. 112-96, Section 6202 (a).

[80] P.L. 112-96, Section 6202 (b).

[81] P.L. 112-96, Section 6206 (c) (3).

[82] P.L. 112-96, Section 6206 (b) (3).

FirstNet's ability to build the required network may depend on the timeliness, scope, and outcome of its negotiations to share infrastructure with other parties in order to focus resources on providing elements deemed essential for public safety use of broadband communications.

Timeframe

The requirements of the Middle Class Tax Relief and Job Creation Act of 2012 must be substantially met and the viability of the project demonstrated no later than the end of FY2022, if not sooner. The State and Local Implementation Fund and the Network Construction Fund expire in 2022, with any balances reverting to the Treasury. By 2022, the GAO must have begun an assessment of the performance of FirstNet and the FCC must decide whether or not to renew the licenses for the public safety broadband network. Within this 10-year timeframe, there are few deadlines beyond requirements for the initial establishment of the planning and implementation framework.

Deadlines for the FCC required the prompt preparation of recommendations for minimum technical requirements for interoperability to be presented to FirstNet.[83] The Secretary of Commerce was given a somewhat longer deadline to appoint the board members of FirstNet (180 days from enactment).[84] Within the same timeframe, the NTIA is to establish grant program requirements for the State and Local Implementation Fund, in consultation with the FirstNet board.[85] Many of the next important steps for building the network have no required deadline. Some milestones, such as rural coverage, are mandated in the act, but the deadlines are not specified. There are, for example, no deadlines in provisions that require FirstNet to:

- Develop requests for proposals that include a requirement for timetables; and to consult with states on establishing state and local planning processes.[86]
- Complete the request for proposal process that is to be given to each state governor regarding the request for proposal and its details, and the funding level for each state as determined by the NTIA.[87]

However, FirstNet Board member F. Craig Farrill, speaking at the September 25, 2012 meeting, targeted implementation to begin on 2013-2014.

Mandated deadlines for states include

- Within 90 days of receipt of notice from FirstNet, the governor shall choose either to participate in deployment of FirstNet or to conduct its own deployment within the state.[88]
- Within 180 days of giving notice to opt out of FirstNet, the governor shall complete requests for proposals for a state network.[89]

[83] P.L. 112-96, Section 6203.

[84] P.L. 112-96, Section 6204.

[85] P.L. 112-96, Section 6302 (c).

[86] P.L. 112-96, Section 6206, (c) (1) and (2).

[87] P.L. 112-96, Section 6206 (c).

[88] P.L. 112-96, Section 6302, (e) (2).

[89] P.L. 112-96, Section 6302, (e) (3) (B).

No deadline is established in the statute for the FCC to approve or disapprove state proposals for their own portion of the nationwide broadband network.[90] There are also no specified deadlines for a state to apply to the NTIA for a grant to construct the radio access network and to lease spectrum capacity from First Net, if FCC approval is received for a state network.[91] However, one condition of eligibility for a grant to a state to build its own radio access network is that the state's plan must demonstrate "the ability to complete the project within specified comparable deadlines.... "[92]

FirstNet and the FCC may need to be expeditious in completing all steps for the preparation, review, and acceptance of requests for proposals so that construction of the required core network begins in a timely manner. Too many delays in administrative processes may erode the feasibility of the project. An official of the NTIA has reportedly predicted that it will take at least a year for the initial planning and preparatory work to be completed before network construction might begin.[93]

Next Generation 9-1-1

Today's 911 system is built on an infrastructure of analog technology that does not support many of the features that most Americans expect to be part of an emergency response. Efforts to splice newer, digital technologies onto this aging infrastructure have created points of failure where a call can be dropped or misdirected, sometimes with tragic consequences. Callers to 911, however, generally assume that the newer technologies they are using to place a call are matched by the same level of technology at the 911 call centers, known as Public Safety Answering Points (PSAPs). However, this is not always the case. To modernize the system to provide the quality of service that approaches the expectations of its users will require that the PSAPs and state, local, and possibly federal emergency communications authorities invest in new technologies. As envisioned by most stakeholders, these new technologies—collectively referred to as Next Generation 911 or NG9-1-1—should incorporate Internet Protocol standards. An IP-enabled emergency communications network that supports 911 will facilitate interoperability and system resilience; improve connections between 911 call centers; provide more robust capacity; and offer flexibility in receiving and managing calls. The same network can also serve wireless broadband communications for public safety and other emergency personnel, as well as other purposes.

Recognizing the importance of providing effective 911 service, Congress has passed three major bills supporting improvements in the handling of 911 emergency calls. The Wireless Communications and Public Safety Act of 1999 (P.L. 106-81) established 911 as the number to call for emergencies and gave the Federal Communications Commission (FCC) authority to regulate many aspects of the service. The most recent of these laws, the NET 911 Improvement Act of 2008 (P.L. 110-283), required the preparation of a National Plan for migrating to an IP-enabled emergency network. Responsibility for the plan was assigned to the E-911 Implementation Coordination Office (ICO), created to meet requirements of an earlier law, the ENHANCE 911 Act of 2004 (P.L. 108-494). Authorization for the ICO terminated on September

[90] P.L. 112-96, Section 6302 (e) (3) (C) (i).

[91] P.L. 112-96, Section 6302, (e) (3) (C) (iii).

[92] P.L. 112-96, Section 6302, (e) (3) (D) (i) (III).

[93] "NTIA Official Provides Timelines for Nationwide Broadband Network," by Donny Jackson, urgentcomm.com, March 20, 2012.

30, 2009. ICO was jointly administered by the National Telecommunications and Information Administration and the National Highway Traffic Safety Administration.

The Middle Class Tax Relief and Job Creation Act of 2012 re-establishes the federal 9-1-1 Implementation Coordination Office (ICO) to advance planning for next-generation systems and to administer a grant program.[94] ICO is to provide matching grants to eligible state or local governments or tribal organizations for the implementation, operation, and migration of various types of 911 and IP-enabled emergency services, and for public safety personnel training.[95] States that have diverted fees collected for 911 services are not eligible for grants under the program.[96] Based on the act's prioritized plan for funding programs with spectrum license auction revenue, the funds for the grant program will be made available only after $27.635 billion of available auction revenue has been applied to other purposes.

Provisions in the act regarding 911 programs include

- The GAO is required to study how states assess fees on 911 services and how those fees are used.[97]
- The General Services Administration is required to prepare a report on 911 capabilities of multi-line telephone systems in federal facilities and the FCC is to seek comment on the feasibility of improving 911 identification for calls placed through multi-line telephone systems.[98]
- The FCC is to assess the legal and regulatory environment for development of NG9-1-1 and barriers to that development, including state regulatory roadblocks.[99] The FCC is also to (1) initiate a proceeding to create a specialized Do-Not-Call registry for public safety answering points, and (2) to establish penalties and fines for autodialing (robocalls) and related violations.[100]
- ICO, in consultation with NHTSA and DHS is to report on costs for requirements and specifications of NG9-1-1 services, including an analysis of costs, and assessments and analyses of technical uses.[101]
- Immunity and liability protections are provided—to the extent consistent with specified provisions of the Wireless Communications and Public Safety Act of 1999—for various users and providers of Next Generation 911 and related services, including for the release of subscriber information.[102]

[94] P.L. 112-96, Section 6503, "Section 158 "(a).

[95] P.L. 112-96, Section 6503, "Section 158 "(b).

[96] P.L. 112-96, Section 6503, "Section 158 "(c).

[97] P.L. 112-96, Section 6505.

[98] P.L. 112-96, Section 6504.

[99] P.L. 112-96, Section 6509.

[100] P.L. 112-96, Section 6507.

[101] P.L. 112-96, Section 6508.

[102] P.L. 112-96, Section 6506.

The act also requires FirstNet to promote integration of the nationwide public safety broadband network with PSAPs.[103] Since the NTIA has responsibilities for both ICO and FirstNet, the agency is in a position to improve interoperability between PSAPs and First Responders as they move to common IP-based platforms.

Technology and Standards

Standardization of network components, including radios, is generally considered essential to achieving interoperability, improving service, and reducing operating costs. The mandated standard for the new public safety network is Long Term Evolution (LTE), with technical requirements based on commercial standards for LTE.[104] LTE is a fourth-generation (4G) technology based on the Internet Protocol. The commercial sector has begun the transition to operating on IP-enabled networks such as LTE. Wireless carriers around the world are installing LTE networks for consumers and planning for the next generation of LTE: LTE Advanced.[105] LTE Advanced technologies will be able to operate across noncontiguous spectrum bands, thereby increasing channel widths for greater capacity and performance. Most experts agree that LTE Advanced will facilitate the transition to new technologies by making it easier and less expensive to phase out older infrastructure.

FirstNet

The Middle Class Tax Relief and Job Creation Act of 2012 requires FirstNet to assure nationwide standards for use of and access to the network it is tasked with developing. The act specifies the use of commercial standards for some of the network components.[106]

To promote competition, devices for public safety network radios and other wireless devices are required to be built to open, non-proprietary, commercially available standards, "capable of being used by any public safety entity and by multiple vendors across all broadband networks operating in the 700 MHz band" and backward compatible with existing commercial networks where necessary and feasible.[107]

FCC

The act requires the FCC to establish a Technical Advisory Board for First Responder Interoperability, and sets out criteria for the selection and participation of board members.[108] The primary purpose of the Interoperability Board, as it is called, is to agree on minimum technical requirements for nationwide interoperability on the public safety broadband network. The Interoperability Board is required to develop these technical recommendations in consultation with the NTIA, NIST, and the OEC.[109] The board's technical recommendations are to be based on

[103] P.L. 112-96, Section 6206 (b) (2) (C).

[104] P.L. 112-96, Section 6203 (c) (2).

[105] Also known as 3GPP Release 10, see http://www.3gpp.org/LTE-Advanced.

[106] P.L. 112-96, Section 6206 (b) (1) (A).

[107] P.L. 112-96, Section 6206 (b) (2) (B).

[108] P.L. 112-96, Section 6203.

[109] P.L. 112-96, Section 6203 (c) (1).

commercial standards for LTE.[110] The recommendations are to be delivered to the FCC by the end of May 2012.[111] The FCC then has 30 days to approve, modify if necessary, and deliver the recommendations to FirstNet.[112] The Interoperability Board is to be disbanded after the recommendations have been transmitted.[113]

The establishment of minimum technical requirements has a two-fold purpose. One, the requirements are to be presented to the Board of Directors of FirstNet as recommended requirements for interoperability. Second, the minimum technical requirements are to be used by the FCC as a standard of interoperability for evaluating state plans in cases where states have asked to build their own radio access networks.

In the report it submitted,[114] the Interoperability Board, in addition to minimum technical standards, also provided additional considerations that it judged to be important for achieving interoperability.

NIST

The Director of NIST, in consultation with the FCC, DHS, and the National Institute of Justice, Department of Justice, is to "conduct research and assist with the development of standards, technologies and applications to advance wireless public safety communications."[115] More specifically, in consultation with FirstNet and the Public Safety Advisory Committee, NIST is to

- Document technical requirements for public safety wireless communications.
- Accelerate the development of interoperability between currently deployed systems and the public safety broadband network.
- Establish a research plan and direct research for next-generation wireless public safety needs.
- Accelerate the development of broadband network features such as mission-critical voice, prioritization, and authentication.
- Accelerate the development of communications equipment and technology to facilitate the eventual migration of public safety narrowband communications to the public safety broadband network.[116]

Furthermore, the Director of NIST, in consultation with FirstNet and the FCC, "shall ensure the development of a list of certified devices and components meeting appropriate protocols and

[110] P.L. 112-96, Section 6203 (c) (2).

[111] P.L. 112-96, Section 6203 (c) (1).

[112] P.L. 112-96, Section 6203 (c) (3).

[113] P.L. 112-96, Section 6203 (f).

[114] *Recommended Minimum Technical Requirements to Ensure Nationwide Interoperability for the Nationwide Public Safety Broadband Network*, prepared by the Technical Advisory Board for First Responder Interoperability, Final Report, May 22, 2012, at http://www.fcc.gov/document/recommendations-interoperability-board.

[115] P.L. 112-96, Section 6303 (a).

[116] P.L. 112-96, Section 6303 (b) (1 – 5).

standards for public safety and commercial vendors" for those seeking to have the use of the public safety broadband network.[117]

OEC

The act's requirements for protecting and monitoring the network against cyberattack[118] are being addressed through the OEC, among others, in coordination with the NTIA. The OEC is leading a Cyber Risk Assessment for the nationwide public safety broadband network, analyzing the risk to cyber infrastructure in four parts: interoperability; operability; continuity; and security.[119]

Need for Standards Development

Narrowband and broadband networks for public safety will by most accounts be incompatible with each other and with other networks for the foreseeable future.[120] Only a small part of the existing public safety infrastructure is expected to be usable in the development of new networks at 700 MHz. To maximize the utility of new investments in infrastructure and radios, many believe that standards that support public safety applications for IP-enabled technologies must be completed in the early stages of planning and building. Just as access to the Internet has revolutionized business and social cultures worldwide, the transition to IP-enabled networks is likely to expand the capability and scope of emergency communications.

The act variously requires NIST, the FCC, and the NTIA[121] to develop standards and take steps to improve spectrum efficiency and support the development of the next generation of wireless technology. These agencies already have a number of initiatives in place, notably the Public Safety Communications Research program (PSCR). PSCR provides research, development, and testing to advance public safety communications interoperability. The program is a joint effort between NIST's Office of Law Enforcement Standards and NTIA's Institute for Telecommunication Sciences and is sponsored by the Office for Interoperability and Compatibility at DHS, and the Department of Justice Community Oriented Policing Services.[122]

The funding for the federal research and development efforts described in the act is provided from spectrum license auction revenue. The timing of the auctions and the prioritization for distributing

[117] P.L. 112-96, Section 6206 (c) (6).

[118] P.L. 112-96, Section 6206 (b) (2) (A).

[119] House, Committee on Energy and Commerce, Subcommittee on Communications and Technology, "Cybersecurity: Threats to Communications Networks and Public-Sector Responses," testimony of Roberta Stempfley, Acting Assistant Administrator, Office of Cybersecurity and Communications, National Protection and Programs Directorate, Department of Homeland Security, March 28, 2012.

[120] Discussed in GAO report, *Emergency Communications: Various Challenges Likely to Slow Implementation of a Public Safety Broadband Network*, February 2012, GAO-12-343.

[121] In addition to assigning NTIA responsibilities to develop public safety broadband communications, the act also specifies the NTIA's responsibility to promote efficient use of spectrum by the federal government. P.L. 112-96, Section 6410.

[122] More information is available at the PSCR website at http://www.ntia.doc.gov/category/public-safety. PSCR activities were discussed in testimony by Mary H. Saunders, Director, Standards Coordination Office, NIST before the House Committee on Homeland Security, Subcommittees on Emergency Preparedness, Response, and Communications and Cybersecurity, Infrastructure Protection, and Security Technologies, "First Responder Technologies: Ensuring a Prioritized Approach for Homeland Security Research and Development," May 9, 2012.

auction revenues are such that the funds designated for research and development may not be available for several years, if at all. Some of the act's provisions require the FCC to auction designated spectrum within three years.[123] Auction procedures require several steps that are published for comment before final rulemaking, and the process typically takes a year or more before an auction commences. The first round of funding for NIST ($100 million) would occur once the proceeds from spectrum license auctions deposited in the Public Safety Trust Fund surpass $7.135 billion. The second funding round for NIST would occur after deposits reach $27.75 billion. Although resources in existing federal programs may be shifted to give priority to the implementation of the Middle Class Tax Relief and Job Creation Act of 2012,[124] the federal government may not be able to fund all of the standards and other technological research that is required by the act or needed for public safety. Timely development of public safety applications for LTE and LTE Advanced may come primarily from the private sector, where some vendors are developing components needed for the broadband network and its devices. To meet its responsibilities under the act, FirstNet may choose to allocate some of the funding provided to it by the act, or raise additional funds, to facilitate standards development.

If no solution is found to coordinate private and public work on standards development and new technologies for emergency communications, the development of IP-enabled technologies for public safety may continue to lag behind that of the commercial sector, perpetuating the high costs and inefficiencies that have plagued first responder communications for decades.

Interoperability Within the 700 MHz Band

In its *National Broadband Plan*, the FCC indicated that it wanted to make commercial networks in the 700 MHz band available for public safety use and requested that Congress confirm the FCC's authority to act.[125] The Middle Class Tax Relief and Job Creation Act of 2012 provides the FCC with statutory authority to establish rules in the public interest to improve the ability of public safety networks to roam on commercial space and to gain priority access.[126]

FirstNet and the states that build their own networks are empowered by the act to enter into agreements with commercial providers that would allow public safety network users to roam on partnering networks. Agreements might also cover rules for priority access in times of high demand for network capacity. Priority access can take several forms, such as "ruthless pre-emption," in which non-public-safety transmissions are immediately terminated to make way for emergency communications, or negotiated priority agreements that might, for example, place public safety users at the head of the line for network access as capacity becomes available. The act stipulates that the FCC's authority may not require roaming or priority access unless (1) the public safety and commercial networks are technically compatible; (2) the commercial network is reasonably compensated; and (3) access does not preempt or otherwise terminate or degrade existing traffic on the commercial network.[127] Within these limits, the FCC appears to have some

[123] P.L. 112-96, Section 6401 (b).

[124] The PSCR, for example, has changed its plans for testing public safety interoperability in response to provisions in the act, http://www.pscr.gov/about_pscr/press/broadband/pscr_to_focus_on_public-safety_broadband_interoperability_tests_042012-mission_critical.pdf.

[125] FCC, *Connecting America: The National Broadband Plan*, http://www.broadband.gov/download-plan/.

[126] P.L. 112-96, Section 6211.

[127] P.L. 112-96 Section 6211.

leeway to use its regulatory authority to support public safety in negotiations with partners. The FCC cannot, under the act, mandate ruthless pre-emption, although the act does not preclude contractual negotiations that would allow it.

The act's provisions for roaming and priority access do not require a commercial vendor to make additional investments to insure technical compatibility, and the act's language might be interpreted as precluding an FCC mandate to that effect. Interpretation and enforcement of the compatibility provision may pose an obstacle to achieving desired levels of network interoperability and cross-network roaming because the current technical standards for the 700 MHz band preclude affordable full-spectrum roaming, that is, the ability of any network within the 700 MHz to roam on any other network within the 700 MHz band. Full-spectrum roaming is considered by many to provide advantages for public safety and also for the public at large. For example, it makes more network capacity available for shared emergency communications of all types, not just for first responders. Many believe that full-spectrum access supports competitiveness among wireless carriers—in particular assisting small wireless carriers serving rural areas to offer new broadband services—by providing access to all customers within the band.

Achieving full-spectrum roaming on the 700 MHz band requires modifications of technical requirements for LTE, the preferred technology for mobile broadband within the 700 MHz band. The standards for LTE are agreed on a global basis by the 3GPP, a standards setting group.[128] For a number of technical considerations, including maximizing spectrum efficiency and minimizing interference across spectrum channels, the 3GPP divided the 700 MHz commercial spectrum into different band classes. As documented by the FCC,[129] the 70 MHz of commercial spectrum within the 700 MHz band is the only non-interoperable commercial service band.

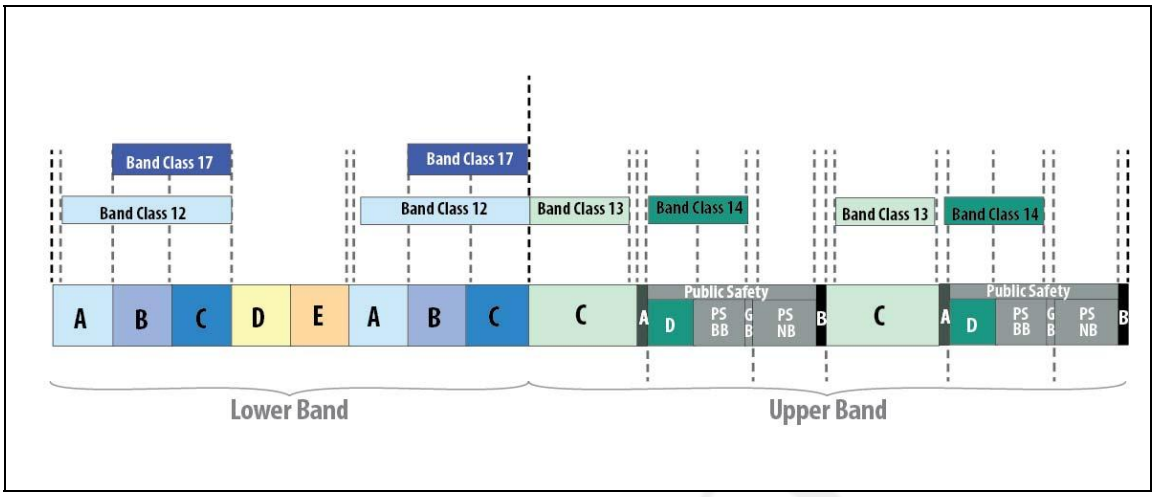
The band classes apply to spectrum blocks that were determined by the FCC. In preparing for an auction of spectrum licenses, the FCC follows a number of procedural steps and seeks comment on planned actions. A key first step is to develop a band plan for the spectrum and make decisions about geographical coverage and technical requirements. Allocation of spectrum blocks within the 700 MHz band occurred in several steps. To protect public safety allocations for narrowband networks in the upper end of the band from harmful interference, the FCC divided the band into an Upper 700 MHz Band and a Lower 700 MHz band. Both bands included paired spectrum licenses, that is, each license had two sets of channels, one for the uplink and the other for the downlink. The Lower 700 MHz Band conformed to industry standards for global cellular bands in the placement of the uplink and downlink; in the upper 700 MHz Band, the direction of the uplink and downlink were reversed. The auction of the majority of licenses for the 700 MHz band concluded on March 18, 2008. Standards for LTE (Release 8) were finalized in December of the same year.[130] A schematic of the auction blocks and band classes is provided in **Figure 1**.

[128] The 3G Partnership Project, known in the United States as 4G Americas, is a consensus-driven, international partnership of industry-based telecommunications standards bodies.

[129] FCC, "Promoting Interoperability in the 700 MHZ Commercial Spectrum," Notice of Proposed Rulemaking, WT Docket No. 12-69, released March 21, 2012.

[130] LTE mobile broadband standard at http://www.3gpp.org/LTE.

Figure 1. License Blocks and Band Classes in the 700 MHz Band



Source: FCC Notice of Proposed Rulemaking, "Interoperability of Mobile Use Equipment Across paired Commercial Spectrum Blocks in the 700 MHz Band," March 21, 2012.

Note: Within the public safety bands, spectrum allocated for broadband is BB, spectrum designated for narrowband is NB and guard bands to protect against interference are GB.

The 700 MHz auction gave Verizon Wireless and AT&T Mobility dominant holdings in Band Class 17, corresponding to licenses in the B Block and C Block in the Lower 700 MHz Band, and in Band Class 13, corresponding to licenses in the C Block of the Upper 700 MHz Band. Many of the licenses in the A Block were acquired by smaller carriers. Because of restrictions on usage, licenses for frequencies in the A Block were less expensive than licenses in the B and C Blocks. The restrictions were largely, but not solely, to protect transmissions on these frequencies from potential interference from high-power TV broadcast signals located in TV channel 51, which is adjacent to the lower end of the 700 MHz band.

Public safety holdings include the D Block, which was originally designated for commercial use and assigned Band Class 14 by 3GPP. Band Class 14 was extended to include the part of the spectrum allocated to the nationwide public safety broadband network, as the FCC's band plan called for the two spectrum blocks to be shared. The narrowband public safety spectrum holdings at 700 MHz were not part of the 3GPP standards-setting process, as they are not commercial networks. Some licenses, such as the D and E Blocks in the Lower 700 MHz band, were auctioned before the development of LTE and have different technical requirements.

As a consequence of incompatibility among the band classes, competition in the commercial sector and interoperability for public safety communications may be at risk. The difference between the standards for Band Class 12 and the other band classes has reportedly had the effect of isolating the A Block license-holders from the mainstream of development for LTE devices. Producers of the new equipment have tailored their first offerings for LTE deployment for the markets with the greatest demand: Band Classes 13 and 17. Smaller carriers have reported to the FCC that they are having difficulty in acquiring equipment, especially handsets, for Band Class 12, the only technical standard applicable for licenses in the A Block.

To address the concerns of carriers with licenses in the A Block, the FCC has opened a proposed rulemaking to address how to mitigate interference in Band Class 12 and to increase interoperability within the lower 700 MHz. The rulemaking does not specifically address the impact on public safety roaming and interoperability.

As is the case for Band Class 12, the costs of developing and producing the chipsets, software, and other components for equipment operating on Band Class 14 are likely to be spread across a relatively smaller customer base, increasing marginal costs and the prices paid by users. Because the band classes are not interoperable across the 700 MHz band, public safety network users are likely to incur not only higher costs for equipment to operate within their assigned frequencies, but also higher costs for roaming and priority access on commercial channels.

If FirstNet and any statewide network deployed in Band Class 14 choose different commercial partners, roaming and priority access may be limited. A network agreement, for example, with C Spire Wireless (formerly Cellular South) might lead to the development of equipment to operate on Band Classes 12 and 14; an agreement with Verizon, Band Classes 13 and 14; with AT&T, Band Classes 17 and 14. Some experts have raised concerns about the limitations that will be placed on public safety roaming as a result of the lack of interoperability within the 700 MHz band. The cost of public safety radios that can operate on all band classes will be high, if they can be engineered at all. A radio that only works on Band Class 14 and one other band class may be cut off from roaming in areas where that other band class has no coverage. Many industry experts, however, believe that it is preferable for the nationwide public safety broadband network to have more than one commercial partner, to improve network redundancy and capacity, and to promote competition that might reduce costs in the long term.

Many believe that full-spectrum interoperability will, in the long term, maximize the benefits of LTE and LTE Advanced technologies deployed on the 700 MHz band. Coordinating development of 700 MHz band standards among network participants provides an opportunity to maximize the benefits inherent in IP-enabled networks for the safety of the general public. For example, it is possible to create smart phone applications that can link personal mobile devices to emergency command centers, integrating information from those devices into an action plan for response and recovery. Fully implemented within the 700 MHz band, these communications links might help emergency situation managers determine where to most effectively deploy emergency medical service personnel, firefighters, HazMat teams, utility repair crews, or other response and recovery personnel, as appropriate. As a situation stabilizes, evaluations about evacuation routes, shelters, and other post-disaster services could be expedited and information disseminated through wireless and other emergency alert systems.

Whether standards for LTE use within the 700 MHz band can be changed, how they might be changed, and when, are subjects of intense debate within the wireless industry. The debate may be fully resolved only through the transition to LTE Advanced. Development and change in wireless technology are fast-paced. A rapid transition from LTE to LTE Advanced might eliminate separate band classes, negating the need for interoperable work-arounds, some say.

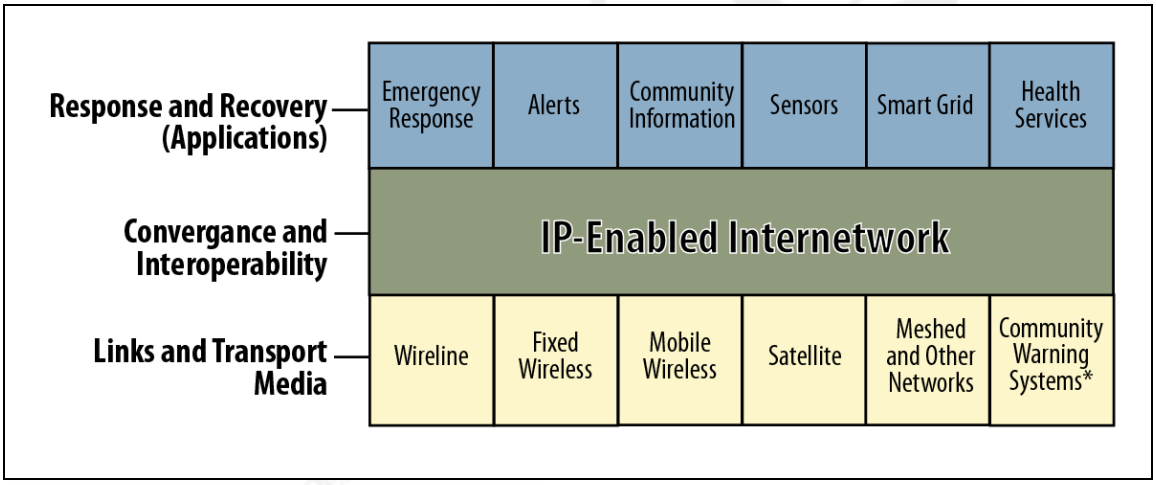
The Future

One of the goals of effective spectrum management is to create opportunities for the development of innovative technologies. Wireless technology transforms air into desirable services, providing an engine for economic growth and development. The evolution of public safety communications has lagged behind the commercial sector and the military in receiving the benefits of recent innovations. By providing some of the resources needed to build IP-enabled networks for first responders, Congress has created an opportunity to expand the reach and effectiveness of emergency communications for the entire population.

Many experts in advanced communications technology believe that the transition to IP-enabled technologies is likely to bring about the convergence of commercial, military, and emergency response (federal and nonfederal) technologies on common, interoperable platforms.[131] In this view, compatible communications devices will be differentiated by applications developed by stakeholders to meet their mission needs. Infrastructure, spectrum, and mobile devices will be sharable, and it is envisaged that sharing will be encouraged.

The military is linking many of its communications through IP-enabled networks,[132] similar to plans by the public safety community for investment in first responder LTE devices and NG9-1-1. The Department of Defense (DOD) has used the term internetwork to refer to the IP-enabled networks that drive its Global Information Grid (GIG) for network communications.[133] The internetwork, also known as the Convergence Layer, provides analysis and organization of communications activity to facilitate transport. The communications layer that provides the entry and distribution links to services supported by the internetwork is referred to as the Link and Transport Layer by DOD. An Emergency Communications Grid, similar to the military's GIG, might use a common IP-enabled network structure to connect with any type of IP-enabled system, network, or device to support a wide range of services. (See **Figure 2**.)

Figure 2. Emergency Communications Grid



Source: Based on Department of Defense Global Information Grid Architectural Vision; vision for a net-centric, service-oriented, DoD enterprise, prepared by the DOD CIO, June 2007.

*Including sirens, highway and other electronic signs, electronic mailing lists, phone notification systems, and local broadcasting media.

DOD's internetwork is the equivalent of public safety wireless backhaul, NG9-1-1 network connectivity, or any other network connection that serves the public interest. The Emergency Communications Grid shown in **Figure 2** can also send out emergency alerts to endangered populations,[134] capture information from sensors, manage the Smart Grid to prevent power

[131] See for example reports and meeting discussions of the Visiting Committee on Advanced Technology established by NIST, http://www.nist.gov/director/vcat/.

[132] *Department of Defense Global Information Grid Architectural Vision; vision for a net-centric, service-oriented, DoD enterprise,* prepared by the DOD CIO, June 2007, http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA484389.

[133] Ibid., Figure 8, p. 22.

[134] FEMA and the FCC have announced the introduction of the Personal Localized Alerting Network (PLAN) that can (continued...)

outages, and support other response and recovery actions. In nonemergency mode, the shared internetwork serves as the conduit for the daily workload of communications. The Emergency Communications Grid represents a unified approach to assuring access and interoperability among all types of communications devices and applications, but it is not envisioned as a single network. The internetwork would be a convergence of many IP-enabled networks that support all the necessary devices and provide the needed links to the Response and Recovery level.

Infrastructure and Spectrum Management

The wireless industry has sometimes compared their licensed radio frequency channels to traffic lanes.[135] These proprietary lanes (access rights assigned for specific frequencies) are used by the vehicles (wireless devices) approved by and often obtained directly from the carrier owning the access rights. Wireless customers have access to their carriers' lanes and usually to other carriers' lanes (roaming privileges) if their vehicles are of the same type used by the lane's owner. Adding more lanes to the highway, that is, providing more spectrum for carriers to expand their networks, is the policy advocated by most representatives of the wireless industry. An increasing number of wireless technology experts are arguing, however, that wireless technology has reached a stage of development where it is possible to allow for a broader variety of vehicles by building a new type of highway. This shift in technology is deemed by many to be a crucial factor in public safety use of commercial technologies. It is argued that as long as there are different classes of wireless devices built to operate on a limited number of predetermined frequencies, the military, public safety, and a number of other users with specific requirements, such as the railroad industry and utilities, will be constrained by high costs distributed among a small number of users.

The successful introduction of the iPhone in 2007 accelerated the convergence of the Internet with mobile technology. The United States is a global leader in wireless technology innovation and adoption.[136] A convergence of technology policy and spectrum policy may be needed to help the country maintain its leadership in innovation. As the nation moves to develop next-generation technologies for public safety communications, wireless industry policies and emergency response and recovery policies may need close coordination to provide a comprehensive safety net forged from sturdy communications links. FirstNet and its private-sector partners have the opportunity to lay the foundation for next-generation communications for public safety.

Considerations for Congress

FirstNet is required to submit annual reports to Congress containing "a comprehensive and detailed report" of its activities and finances, and to make recommendations for legislative or

(...continued)

deliver geo-targeted text alerts to enabled smart phones. PLAN is the implementation of the Commercial Mobile Alert Service as required by the Warning, Alert, and Response Network Act (WARN Act), P.L. 109-347, §603 (a). FCC Fact Sheet, http://transition.fcc.gov/cgb/consumerfacts/cmas.pdf.

[135] CTIA–The Wireless Association, for example, provides a "Spectrum 101" graphic that uses improvements in transportation as an analogy for changes in the wireless environment, http://files.ctia.org/pdf/Spectrum_Brochure_111111.pdf.

[136] House Committee on Homeland Security, Subcommittee on Emergency Preparedness, Response, and Communications, "Growing the Wireless Economy Through Innovation," April 18, 2012, spoken and written testimony from various witnesses at the hearing.

administrative action that might help FirstNet achieve its goals.[137] Congress may want to pursue additional oversight by, for example, monitoring the participation of states in FirstNet and how state decisions to participate or not participate are affecting network build-out. Congress may also wish to evaluate the level of collaboration in standards development among FirstNet, commercial participants in the network, and federal agencies charged with standards development and certification for network components available to public safety. A comparison of adoption rates for new wireless technologies by the private sector, the military, and public safety agencies may also be of interest to Congress in identifying additional legislative or administrative actions that might further advance the transition to needed new technologies.[138]

Congress may also evaluate the role of commercial infrastructure in supporting emergency communications, for the general public as well as among first responders. Underinvestment in commercial communications infrastructure may need greater consideration in emergency planning at all levels of government.

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[137] P.L. 112-96, Section 6210.

[138] Additional analysis in CRS Memorandum CD1289, "Establishment of the First Responder Network Authority," September 19, 2012, available upon request.