



Public Safety Communications and Spectrum Resources: Policy Issues for Congress

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Summary

Effective emergency response is dependent on wireless communications. To minimize communications failures during and after a crisis requires ongoing improvements in emergency communications capacity and capability. The availability of radio frequency spectrum is considered essential to developing a modern, interoperable communications network for public safety. Equally critical is building the radio network to use this spectrum. Opinions diverge, however, on such issues as how much spectrum should be made available for the network, who should own it, who should build it, who should operate it, who should be allowed to use it, and how it might be paid for.

To resolve the debate and move the planning process forward, Congress may decide to pursue oversight or change existing law. Actions proposed to Congress include (1) authorizing the Federal Communications Commission (FCC) to reassign spectrum and (2) changing requirements for the use of spectrum auction proceeds. In particular, legislation in the Deficit Reduction Act of 2005 (P.L. 109-171) might be modified. This law mandated the termination of analog television broadcasting and the release of those channels for other uses, including public safety.

Congress may consider additional legislation to meet desired levels of emergency communications performance. A bill that would increase the amount of radio frequency spectrum assigned for public safety has been introduced (H.R. 5081, Representative King). A Senate bill contains similar provisions for spectrum assignment and would add a number of new provisions, including funding (S. 3625, Senator Lieberman). Both bills would require the FCC to transfer a spectrum license intended for commercial use, the D Block, to the license-holder for adjacent frequencies already assigned to public safety, known as the Public Safety Broadband License. Other bills and oversight activities are likely.

Congress has before it an opportunity to bring public safety communications into the 21st century by assuring that a nationwide, interoperable communications network is put in place. The tools at its disposal include homeland security policy, spectrum policy, funding programs, and leadership.

Among the actions that Congress might take, those dealing with governance and funding are often cited by public safety officials and others as the areas most in need of its consideration. They have recommended that, for the proposed network project to go forward on a sustainable footing, funding sources need to be identified for investment and operating expenses over the long term. To ensure the resources are wisely used, many analysts point to the primacy of putting in place a well-grounded but flexible governance structure. They argue that good governance is essential to complete development of needed technologies and standards, and to plan for and execute their deployment. In its National Broadband Plan, the FCC proposed that it assume the needed leadership role and has since taken a number of steps to realize the goals it has set for itself.

Since September 11, 2001, Congress has passed several laws that empowered the Department of Homeland Security to recognize and respond to technological developments in wireless and Internet protocol (IP) communications, and to apply this knowledge to guiding the development of a nationwide, interoperable network for public safety. By choosing to focus on interim solutions, the Department might appear to have passed on the opportunity to provide the needed leadership and planning to move public safety communications toward a next-generation emergency communications network.

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The Issues Before Congress

Since September 11, 2001, Congress has passed several significant pieces of legislation intended to help surmount failures in public safety radio communications such as (1) insufficient interoperability among radio systems, a problem that hampered rescue efforts on and after September 11; and (2) insufficiently robust networks, a shortcoming revealed after Hurricane Katrina struck in August 2005. To achieve a higher standard of communications performance might require, among other elements, improvements in communications capacity and quality. Increased capacity is achievable through a number of means. Increasing the amount of radio frequencies available for public safety use is one solution for adding capacity. Building additional infrastructure to use existing airwaves more effectively is another solution, as is investment in more spectrum-efficient technologies. Sharing networks also can provide additional capacity for operations. All of these measures have been proposed for improving public safety communications, with different groups voicing preferences for one means over another.

Many representative of the public safety community have argued that additional spectrum assignments are needed to meet the future needs of emergency communications, while the Federal Communications Commission (FCC) has presented an action plan that would develop capacity through investing in network infrastructure, public-private sharing of development costs for efficient radios, and creating a regulatory regime that would allow public safety and commercial users to share infrastructure. All of the measures under consideration by the FCC or proposed by public safety agencies would require substantial funding—many billions of dollars—of which some is expected to come from the federal government.

Two bills have been introduced that would require the FCC to assign additional spectrum, known as the D Block, for a public safety broadband network and take steps to ensure construction of an interoperable network.¹ Senator John D. Rockefeller, IV has announced plans for another bill that would include similar provisions for assigning the D Block to public safety and also provide funding.² A draft discussion bill was released in June that would support the FCC's plans for using spectrum and developing infrastructure, funded in part by auction proceeds that would include the sale of the D Block.³ Additional measures, as amendments or new bills, may be under consideration.

¹ H.R. 5081, the Broadband for First Responders Act of 2010, Representative King, introduced April 20, 2010, referred to the House Committee on Energy and Commerce and S. 3625, the First Responders Protection Act of 2010, Senator Lieberman, referred to the Senate Committee on Commerce, Science, and Transportation.

² Recent Press Release, "Chairman Rockefeller Statement—Will Introduce the Public Safety Spectrum and Wireless Innovation Act in the Coming Days," July 21, 2010, at http://commerce.senate.gov/public/index.cfm?p=PressReleases&ContentRecord_id=f682dc37-772c-4a75-9c80-12bafbf37949&ContentType_id=77eb43da-aa94-497d-a73f-5c951ff72372&Group_id=4b968841-f3e8-49da-a529-7b18e32fd69d&MonthDisplay=7&YearDisplay=2010.

³ Staff discussion draft, the Public Safety Broadband Act of 2010, House Committee on Energy and Commerce, Subcommittee on Communications, Technology, and the Internet, presented June 14, 2010; <http://energycommerce.house.gov/documents/20100615/Public.Safety.Broadband.Act.Discussion.Draft.pdf>.

Debate Over Spectrum Resources: The D Block

Congress last addressed the public safety community's need for spectrum capacity by mandating the release of 24 MHz⁴ of frequencies that were originally designated for public safety use in the late 1990s.⁵ This crucial resource, part of the 700 MHz band,⁶ remained largely unavailable as long as its airwaves were used for analog television transmissions. By providing a deadline for the transition from analog to digital television, Congress ensured that valuable radio frequency spectrum would be released by 2009.⁷

The assignment of one set of frequencies in the 700 MHz band, referred to as the D Block, has been widely debated. The D Block was slated for auction in 2008 along with other available frequencies identified in the Deficit Reduction Act of 2005.⁸ In compliance with instructions from Congress to auction all unallocated spectrum in this band, the FCC conducted an auction, which concluded on March 18, 2008. As part of its preparation for the auction (Auction 73), the FCC sought to increase the amount of spectrum available to public safety users in the 700 MHz band. The FCC proposed to assign 10 MHz—part of the original 24 MHz designated for public safety use—to a Public Safety Broadband Licensee specifically for public safety broadband communications. Of the balance, 12 MHz were designated for mission critical voice communications on narrowband networks and 2 MHz were set aside as a guard band to protect against interference. A section of the 700 MHz band plan, showing the location of public safety licenses and the D Block, is provided in **Appendix B**.

In the FCC plan for Auction 73, the Public Safety Broadband License (PBSL) was to have been matched with a commercial license of 10 MHz, known as the D Block. The D Block was to be auctioned under rules that would require the creation of a public-private partnership to develop the two 10-MHz assignments as a single broadband network, available to both public safety users and commercial customers. The D Block license was offered for sale in 2008 but did not find a buyer. The FCC then set about the task of writing new rules for a reauction of the D Block.⁹

FCC's Announced Plans for the D Block

The FCC subsequently decided to auction the D Block for commercial use with conditions deemed beneficial for public safety users, such as assumption by the license-holder of the cost of developing mobile devices, and guarantees that public safety networks would have roaming and

⁴ Spectrum is 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.

⁵ The Deficit Reduction Act of 2005, P.L. 109-171, Title III, Sec. 3002 120 STAT. 21 set a deadline for releasing the frequencies. Initial legislation requiring the release was in the Balanced Budget Act of 1997, P.L. 105-33, Title III, Sec. 3003 and Sec. 3004, 111 STAT. 265 *et seq.*

⁶ Spectrum resources are typically segmented into bands of radio frequencies. The 700 MHz band includes radio frequencies from 698 MHz to 806 MHz. Public safety has frequency allocations within this band totaling 24 MHz.

⁷ Expediting the release of these frequencies was among the recommendations of the 9/11 Commission. *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States*, p. 397, Washington: GPO, 2004.

⁸ The Deficit Reduction Act of 2005, P.L. 109-171, Title III, Sec. 3003 120 STAT. 22.

⁹ A summary of FCC actions regarding the D Block is included as Background in FCC, *Order*, released May 12, 2010, PS Docket No. 06-229, concerning waivers to allow early establishment of public safety broadband networks at 700 MHz, at http://fjallfoss.fcc.gov/edocs_public/attachmatch/FCC-10-79A1.pdf.

priority access rights to the D Block network. The decision was announced in the National Broadband Plan (NBP),¹⁰ released March 16, 2010. The NBP proposed several actions to be taken to facilitate development of a national wireless broadband network for public safety use.¹¹ Public safety needs, such as developing standards and establishing procedures, would be addressed through a newly established Emergency Response Interoperability Center (ERIC).¹²

Legislation to Assign the D Block to Public Safety

The Broadband for First Responders Act of 2010 (H.R. 5081, Representative King) would amend the Communications Act of 1934 by requiring the FCC to allocate the D Block for public safety services. The bill would require the FCC to establish rules to encourage the rapid deployment of an interoperable national wireless broadband network, and to allow public safety license-holders to share spectrum with other entities, as long as requirements for roaming and priority access were met. The First Responders Protection Act of 2010 (S. 3625, Lieberman) would require the same steps, rule-making procedures, and requirements.

Legislation in Support of a Public Safety Network Without the D Block

The discussion draft of the Public Safety Broadband Act of 2010 includes the presumption that the D Block will be auctioned, in that it provides that proceeds from its auction be applied to the construction and operation costs of public safety broadband networks. The draft bill would permit sharing of spectrum designated for broadband networks between public safety and other entities. It would also direct the FCC to allow flexible use of other frequencies in the 700 MHz band designated for public safety.

Communications Infrastructure and Governance

The First Responders Protection Act of 2010, the Broadband for First Responders Act of 2010, the discussion draft of the Public Safety Broadband Act of 2010, and several inter-connected initiatives of the FCC address the complex issue of how to plan, build, and fund a national network for public safety communications.

Public Safety Broadband Network Requirements

Developments in mobile broadband communications are changing the public safety community's expectations about how to best use the 700 MHz airwaves allocated for their use. Public safety representatives have argued that this spectrum should be used for a wireless network customized to meet needs that they have indentified. Arguments in favor of building a network exclusively for public safety revolve around the shortcomings of current commercial wireless services such as

¹⁰ FCC, *Connecting America: The National Broadband Plan*, <http://www.broadband.gov/download-plan/>.

¹¹ *Connecting America*, Recommendation 5.8.2.

¹² *Connecting America*, Recommendation 16.1. FCC *Order* establishing ERIC was released April 23, 2010, http://fjallfoss.fcc.gov/edocs_public/attachmatch/FCC-10-67A1.pdf.

poor availability, inadequate coverage in rural areas, lack of security features, and absence of priority access.

Network infrastructure requirements for public safety communications that are frequently discussed include¹³

- Broadband applications should facilitate emergency response by providing data and images, including video.¹⁴
- The network should cover all areas of the United States, ensuring service to meet a public safety emergency anywhere.
- Broadband services should include voice communications as a back up to mission critical voice channels on other frequencies and offer the same features such as push-to-talk and one-to-one or one-to-many connectivity.
- Network software should provide traffic management services such as prioritizing service. If multiple networks were built separately and then linked together, interoperability¹⁵ and nationwide roaming¹⁶ would need to be ensured.
- Radio software should provide mobile broadband applications designed for public safety. In particular, radio chipsets need to be developed for wireless devices that can connect to a Long Term Evolution (LTE) network.
- Radio software should support encryption and authentication.
- Cell towers in the network should be strengthened against natural hazards and furnished with back-up power supplies that can outlast extended power outages.
- Robust backhaul should be ensured. Backhaul typically refers to connectivity between access points like cell towers and high capacity, landline communications networks. Backhaul is an essential component of wireless network infrastructure.

FCC's Proposals for Communications Infrastructure

In the NBP, the FCC made these key recommendations for promoting public safety wireless broadband Communications.¹⁷

¹³ These requirements are included in presentations by Ralph A. Haller, Chairman of the National Public Safety Telecommunications Council, and Chief Harlin R. McEwen, Chairman of the Public Safety Spectrum Trust, at an FCC National Broadband Plan Staff Workshop on August 25, 2009. The presentations are available at <http://www.npstc.org/index.jsp>.

¹⁴ Broadband refers to the capacity of the radio frequency channel. A broadband channel can transmit live video, complex graphics and other data-rich information as well as voice and text messages whereas a narrowband channel might be limited to handling voice, text, and some graphics.

¹⁵ One frequently cited definition of interoperability has been provided by the government agency SAFECOM: "In general, interoperability refers to the ability of public safety emergency responders to work seamlessly with other systems or products without any special effort. Wireless communications interoperability specifically refers to the ability of public safety officials to share information via voice and data signals on demand, in real time, when needed, and as authorized." <http://www.safecomprogram.gov>.

¹⁶ The practice of transferring a wireless call from one network to another—or roaming—is described in *Understanding Wireless Telephone Coverage Areas*, FCC Consumer Facts at <http://www.ifap.ru/library/book385.pdf>.

- Create an administrative system that ensures access to sufficient capacity on a day-to-day and emergency basis.
- Ensure there is a mechanism in place to promote interoperability and operability of the network.
- Establish a funding mechanism to ensure the network is deployed throughout the United States and has necessary coverage, resiliency, and redundancy.
- Conform existing programs to operate with the public safety broadband network.

The FCC has recommended that the public safety community leverage the availability of commercial technologies and networks to assure system-wide capacity and has encouraged partnerships and administrative agreements with commercial operators and others.

Emergency Response Interoperability Center

The FCC would address public safety needs such as developing standards and establishing procedures through the newly established Emergency Response Interoperability Center (ERIC). ERIC was established within the FCC Public Safety and Homeland Security Bureau, in April 2010.¹⁸ It is intended for ERIC to work closely with the Public Safety Communications Research program, jointly managed by the National Institute of Standards and Technology (NIST) and the NTIA, to develop and test the technological solutions needed for public safety broadband communications.¹⁹ The Department of Homeland Security is to participate in the areas of public safety outreach and technical assistance, as well as best practices development, through its Office of Emergency Communications. ERIC has been tasked with implementing standards for national interoperability and developing technical and operational procedures for the public safety wireless broadband network in the 700 MHz band. In the future, ERIC may perform similar functions for other public safety communications systems.

One of the expectations is that ERIC will be able to guide the development of standards for crucial radio components, with the participation of commercial providers and public safety representatives. The participation of commercial carriers in developing and deploying, for example, a common radio interface, is expected to put the cost of public safety radios in the same price range as commercial high-end mobile devices (\$500). By contrast, interoperable radios for the narrowband networks at 700 MHz cost \$3,000 and up, each.

Within the 700 MHz band, ERIC might use the regulatory powers of the FCC to require the cooperation of commercial wireless operators in establishing roaming rights and access rules between the public safety broadband network and other networks built to use the 700 MHz frequencies. In particular, the FCC's powers to write rules for spectrum license auctions and set service rules for auction winners are to be brought to bear on the winner or winners of licenses in the D Block. In addition to cooperation for sharing network resources, the FCC has anticipated

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¹⁷ *Connecting America*, Recommendation 16.1.

¹⁸ FCC, *Order*, PS Docket No. 06-229, released April 23, 2010 at http://fjallfoss.fcc.gov/edocs_public/attachmatch/FCC-10-67A1.pdf.

¹⁹ NIST, "Demonstration Network Planned for Public Safety 700 MHz Broadband," December 15, 2009 at http://www.nist.gov/eeel/oles/network_121509.cfm.

that the D Block owner or owners will lead, and fund, the development costs of the air interface that will operate within the band comprised of the Public Safety Broadband License and the D Block. LTE has been specified by the FCC as the network technology for these frequencies. The FCC has also assumed that the other networks at 700 MHz will use LTE or a compatible fourth-generation (4G) technology and it has anticipated that it will be able to negotiate roaming and priority access across the 700 MHz band. Its authority to enforce access requirements is uncertain, however, and might be successfully challenged in court.

Requirements for Conditional Build-Outs

Some states and localities have petitioned the FCC to allow them to use frequencies from the 10 MHz assigned to the PSBL for their own public safety networks. Plans would be developed based on local and regional needs, with anticipated funding from sources such as existing programs, partnerships with commercial providers, and federal grants. The FCC has therefore adopted an order to provide the framework for nationwide interoperability and mobile broadband and grant waivers to public safety entities that meet its requirements.²⁰ Providing evidence of funding is among the conditions established by the FCC.

ERIC will play a lead role in approving and coordinating the technical aspects of the waiver requests. Technical components of the waiver requests include specifications for system architecture, required applications, and network operations, administration and maintenance. System requirements to support interoperability must include radio access network and core network architectures. Plans for supporting roaming, priority access, Quality of Service (QoS), and security are required. Specifications must be provided regarding the devices planned for use on the network, including information on type (form factor), operational specifications, and spectrum coverage.²¹

Additional development work is needed to advance from the planning stages to testing and deployment of mobile devices on the LTE radio network. The term profile is generally used in referring to the range of technical specifications needed for mobile devices using LTE technology to operate on a designated network. The primary group coordinating standards-setting for LTE²² has established four profiles for commercial bands using LTE in the 700 MHz band: Band 12, Band 13, Band 14, and Band 17. Band 14 includes the D Block and can include the public safety frequencies assigned to broadband and possibly the frequencies assigned to narrowband as well. The LTE profile for Band 14 needs to be modified to support public safety requirements. Part of the challenge for ERIC and network developers participating in the early-build-out program will be to establish a profile for public safety requirements that can be developed in conjunction with the Band 14 profile for the D Block and, possibly, other LTE bands at 700 MHz.

²⁰ FCC, *Order*, Request for Waiver of Various Petitioners to Allow the Establishment of 700 MHz Interoperable Public Safety Wireless Broadband Networks, P.S. Docket No. 06-229, released May 12, 2010 at http://fjallfoss.fcc.gov/edocs_public/attachmatch/FCC-10-79A1.pdf.

²¹ FCC, *Public Notice*, "Public Safety and Homeland Security Bureau Offers Further Guidance to Conditional Waiver Recipients on Completing the Interoperability Showing Required by the 700 MHz Waiver Order," P.S. Docket No. 06-227, DA 10-923, released May 21, 2010, at http://fjallfoss.fcc.gov/edocs_public/attachmatch/DA-10-923A1.pdf.

²² 3rd Generation Partnership Project (3GPP) coordinate telecommunications standards bodies as "Organization Partners," see <http://www.3gpp.org/About-3GPP>. 3GPP is addressing commercial standards for 4th Generation technologies, including LTE; see <http://www.3gpp.org/technologies>.

Legislative Proposals for Communications Infrastructure

Both the First Responders Protection Act of 2010 and the Broadband for First Responders Act of 2010 would require the FCC to establish rules for the construction and operation of a wireless public safety broadband network. The requirements would cover interoperability, roaming, priority access, network survivability, and cybersecurity. The FCC would also be required to develop a statement of requirements for standards that would take into account: commercial availability of technologies; licensing terms; adaptability; transmission priority; security; and other considerations, as appropriate.

The discussion draft of the Public Safety Broadband Act of 2010 eliminates requirements for roaming privileges but otherwise would make similar requirements. It would direct the FCC to “take all actions necessary” to develop and implement technical standards and rules for a nationwide public safety interoperable broadband network that would include user authentication and encryption. This and other provisions in the bill would support the FCC’s regulatory authority to mandate sharing of 700 MHz infrastructure. The FCC would be required to establish “an appropriate rule, or set of rules” to ensure interoperability, taking into account: commercial availability of technologies; licensing terms; adaptability; transmission priority; and security.

The First Responders Protection Act of 2010 does not include any provisions that support the FCC’s position to mandate that commercial networks provide access for roaming or make other accommodations to public safety users. These provisions therefore are likely to be part of separate contractual agreements between public safety network users and commercial network owners as part of negotiations among multiple players.

The First Responders Protection Act of 2010 and the discussion draft both provide funding mechanisms for construction and operation of the wireless broadband network. Projects eligible for funding that are mentioned in the bills include “construction of a new public safety interoperable broadband network using commercial infrastructure or public safety infrastructure, or both, in the 700 MHz band” and “improvement of the existing commercial networks and construction of new infrastructure to meet public safety requirements...” There is no provision in either bill for funds to cover the cost of development and testing of new radio technologies that allow public safety broadband radios to operate on the new networks, which are expected to be built in accordance with commercial standards for LTE.

Funding

At the time of the attempted auction of the D Block, the cost of building the mobile broadband network under the public-private partnership proposed by the FCC was estimated at from \$18 billion to as much as \$40 billion.²³ These projected costs did not include radios.

²³ Cyren Call Communications Corporation, in *ex parte* comments filed with the FCC on June 4, 2007, set the cumulative capital expenditure for building a public-private network at \$18 billion, of which roughly a third of the cost would be for enhancements for public safety use. An estimate from Northrop-Grumman Corporation placed the cost at \$30 billion, when service applications are included. (Statement by Mark S. Adams, Chief Architect Networks and Communications, at WCA 2007, Washington, DC, June 14, 2007.) These estimates do not include the cost of radios. An estimated range of \$20 billion to \$40 billion for network infrastructure was discussed at a House of Representatives hearing held by the Committee on Energy and Commerce, Subcommittee on Communications, Technology, and the Internet, “A National, Interoperable Broadband Network for Public Safety: Recent Developments,” September 24, (continued...)

FCC's Proposals for Funding Infrastructure

In the NBP, the FCC has recommended that a grant program be established to ensure that needed infrastructure is fully deployed.²⁴ It has recommended that the grants program be administered by a single agency and only be applied to projects that comply with requirements set by ERIC. The four recommended uses of these grants would be: construction of a public safety network, including use of commercial infrastructure; coverage of rural areas; hardening existing commercial networks for public safety use, including reimbursement of non-recoverable engineering costs; and deployable capabilities for public safety.

The NBP provided an estimate of up to \$6.5 billion for capital expenditures over ten years and operating costs of \$1.3 billion a year. A subsequent report providing details on these projections were later released.²⁵ The report included a comparison of costs that concluded that building a dedicated public safety broadband network would require \$15.7 billion in capital expenditures. A substantial part of the projected savings would come from the ability for public safety to use commercial towers.

The NBP stated that it was “essential that the United States establish a long-term, sustainable and adequate funding mechanism to help pay for the operation, maintenance and upgrade of the public safety broadband network.”²⁶ To provide these funds, the plan recommended that a “minimal public safety fee” be assessed on all U.S. broadband users.

Legislative Proposals for Funding Infrastructure

The Broadband for First Responders Act of 2010 would rely on existing authorizations for funding public safety communications, such as the Interoperable Emergency Communications Grant program. This law authorized appropriations as necessary for fiscal year 2008 and appropriations of up to \$400 million for fiscal years 2009 through 2012, with such sums as may be necessary in subsequent years.²⁷ The first appropriations were provided for fiscal year 2008 in the amount of \$50 million, appropriations in subsequent years have also been for \$50 million.²⁸

The First Responders Protection Act of 2010 and the discussion draft of the Public Safety Broadband Act of 2010 would fund network construction and operation with proceeds from future spectrum auctions. Both bills have designated several sets of spectrum bands for auction as sources of revenue over a specified time period. The D Block is included in the draft discussion bill. Two funds would be created to receive auction proceeds. The first \$5.5 billion would be destined for a Construction Fund; subsequent proceeds would be administered through a

(...continued)

2009.

²⁴ *Connecting America*, p. 317.

²⁵ FCC, A Broadband Network Cost Model: A Basis for Public Funding Essential to Bringing Nationwide Interoperable Communications to America's First Responders, OBI Technical Paper No. 2, May 2010 at <http://www.fcc.gov/pshs/docs/ps-bb-cost-model.pdf>.

²⁶ *Connecting America*, p. 319.

²⁷ P.L. 110-53, Title III, 121 STAT. 299; 6 U.S.C. 579.

²⁸ PSIC grants are discussed in CRS Report R40632, *FY2010 Department of Homeland Security Assistance to States and Localities*, by Shawn Reese.

Maintenance and Operation Fund. The NTIA would have primary responsibility for grants programs covered by the funds. Construction projects that would be eligible would be for new construction for a public safety broadband network; improvements to existing commercial networks and other improvements to infrastructure needed to operate an interoperable, public safety broadband network in the 700 MHz band. The bills have described eligibility for reimbursement of maintenance and operational costs and related provisions.

Spectrum Auctions as a Source of Funds

Congress has twice enacted laws to create special funds to hold the revenue of certain spectrum auctions for specific purposes. These funds represent a departure from existing practice, which requires that auction proceeds be credited directly to the Treasury as income. The Deficit Reduction Act of 2005 (P.L. 109-171, Title III) required the auctioning of licenses for spectrum currently used by TV broadcasters for analog transmissions. It established the Digital Television Transition and Public Safety Fund to receive this auction revenue and use some of the proceeds for the transition to digital television, public safety communications, and other programs. The Commercial Spectrum Enhancement Act (P.L. 108-494, Title II) established a Spectrum Relocation Fund to hold the proceeds of certain spectrum auctions for the specific purpose of reimbursing federal entities for the costs of moving to new frequency assignments.

The Public Safety Interoperable Communications (PSIC) grant program, now administered through the Department of Homeland Security, was funded under provisions in the Deficit Reduction Act of 2005.

Conclusion

Homeland security depends on effective communications for prevention, preparedness, and response to a range of threats. First responders and the larger public safety community that supports them rely heavily on effective radio communications to meet their responsibilities for homeland security. More important to the average American is the role that public safety services play in daily life and in responding to natural disasters. Flash floods, forest fires, tornados, hurricanes—Mother Nature provides endless variations for the scenarios of response and recovery.

The FCC and the Department of Homeland Security (DHS) have different perspectives on radio technology and infrastructure. DHS policies favor reliability and familiarity in their requirements and guidelines for technology and in their emphasis on training and repeated use of equipment. Spectrum policy at the FCC promotes spectrum efficiency and competition among commercial license-holders.

Congress has separately conferred authority on DHS and the FCC to act on behalf of public safety. In the case of DHS, this includes requirements to coordinate and support specific goals, such as interoperability and a national communications capability.²⁹ None of the actions required of DHS by Congress relate specifically to using 700 MHz spectrum to achieve these objectives. The FCC brings to the process several important mandates from Congress, such as an obligation

²⁹ Discussed in detail in **Appendix A**, “Congressional Efforts on Behalf of Public Safety Communications.”

to “promote safety of life and property through the use of wire and radio communication,”³⁰ as well as specific instructions regarding the assignment of frequencies at 700 MHz.

The bills introduced so far would increase the powers and responsibilities of the FCC in shaping the public safety communications network of the future, placing DHS in an advisory role. Governance of the public safety network at a national level would be dependent almost entirely on the FCC and its willingness to write and enforce regulations. The Public Safety Broadband Licensee Board of Governors and the Technical Advisory Committee of ERIC appear to be the primary conduits for presenting public safety views and requirements to the FCC. The Public Safety Broadband License, the charter for the Public Safety Broadband Licensee, and ERIC were established by the FCC through its rule-making process.

³⁰ 47 U.S.C. § 151. The FCC relied partly on this authority in requiring the relocation of commercial licenses because transmissions were interfering with public safety radio communications in the 800 MHz band. See CRS Report RL32408, *Spectrum Policy: Public Safety and Wireless Communications Interference*, by Linda K. Moore.

Appendix A. Congressional Efforts on Behalf of Public Safety Communications

Many of the statutes passed since 2001 have provided guidelines and set performance goals for public safety communications while delegating decisions about implementation to federal agencies and state officials. Although Congress has appropriated money for public safety communications it has not directly addressed the question of investment in network infrastructure, leaving it largely to federal agencies to set priorities for how public safety grants can be used. Most of the grant programs are now administered through the Department of Homeland Security (DHS).³¹ Grants for emergency communications have been used to purchase equipment that facilitates interoperability, for planning, and for training.

To facilitate planning and coordination, and to provide direction, Congress authorized the creation of an Office of Emergency Communications (OEC) within DHS. The OEC was given the responsibility of preparing a National Emergency Communications Plan (NECP). The resulting plan set goals for improving emergency communications and interoperability but did not address developing a network infrastructure for public safety communications or for using the 700 MHz spectrum for that purpose.³²

To support its vision³³ of interoperability as a system of systems, DHS sponsored an Emergency Response Council (ERC) composed of several dozen agencies, associations, and other entities involved in public safety and emergency response planning. In 2007 the ERC provided a set of agreements on a Nationwide Plan for Interoperable Communications. The ERC published 12 guiding principles deemed essential to their key goals of forging partnerships, designing interoperable systems, educating policymakers, and allocating resources.³⁴ To date, the council's role has been primarily to establish a base for advocacy and communication among representatives of public safety agencies and associations.

Congress first addressed the issue of emergency communications interoperability in the Homeland Security Act of 2002 (P.L. 107-296). Two years later, responding to recommendations of the National Commission on Terrorist Attacks Upon the United States (9/11 Commission), Congress included a section in the Intelligence Reform and Terrorism Prevention Act of 2004 (P.L. 108-458) that expanded its requirements for action in improving interoperability and public safety communications. Also in response to a recommendation by the 9/11 Commission, Congress set a firm deadline for the release of radio frequency spectrum needed for public safety radios, as part of the Deficit Reduction Act of 2005 (P.L. 109-171). These laws provided the base from which the Department of Homeland Security (DHS) could develop a national public safety communications capability as required by the Homeland Security Appropriations Act, 2007 (P.L.

³¹ DHS grants programs are discussed in CRS Reports CRS Report R40632, *FY2010 Department of Homeland Security Assistance to States and Localities*, and CRS Report R40246, *Department of Homeland Security Assistance to States and Localities: A Summary and Issues for the 111th Congress*, both by Shawn Reese.

³² DHS, National Emergency Communications Plan, July 2008 at http://www.dhs.gov/xlibrary/assets/national_emergency_communications_plan.pdf

³³ "Our vision was developed at the 2003 SAFECOM/AGILE Joint Program Planning Meeting in San Diego, CA.", Emergency Response Council, *Agreements on a Nationwide Plan for Interoperable Communications*, Summer 2007, footnote 1.

³⁴ *Op. cit.*, *Agreements on a Nationwide Plan for Interoperable Communications*.

109-295). Title VI, Subtitle D of the act, referred to as the 21st Century Emergency Communications Act of 2006, placed new requirements on DHS. Additional requirements were included in the Implementing Recommendations of the 9/11 Commission Act of 2007 (P.L. 110-53).

Balanced Budget Act of 1997

The initial allocation to public safety of frequencies in the 700 MHz band was required by Congress in the Balanced Budget Act of 1997 (P.L. 105-33),³⁵ which directed the Federal Communications Commission (FCC) to designate 24 MHz of spectrum capacity for public safety. To carry out the process of assigning this newly allocated spectrum asset, the FCC created the Public Safety National Coordination Committee (NCC) as a Federal Advisory Committee. Active from 1999 through 2003, the NCC had a Steering Committee from government, the public safety community, and the telecommunications industry. The NCC developed technical and operational recommendations for the 700 MHz band, including plans for interoperable channels. The existing governance for these channels is through Regional Planning Committees (RPCs),³⁶ established and loosely coordinated by the FCC, with the participation of the National Public Safety Telecommunications Council (NPSTC), a group consisting primarily of public safety associations. The RPCs are responsible for submitting 700 MHz band plans to the FCC for approval, and for managing these plans.

The Homeland Security Act of 2002 and Actions by the Department

Provisions of the Homeland Security Act instructed DHS to address some of the issues concerning public safety communications in emergency preparedness and response and in providing critical infrastructure. Telecommunications for first responders is mentioned in several sections, with specific emphasis on technology for interoperability.³⁷

The newly created DHS placed responsibility for interoperable communications within the Directorate for Science and Technology, reasoning that the focus of DHS efforts would be on standards and on encouraging research and development for communications technology. Responsibility to coordinate and rationalize federal networks, and to support interoperability, had previously been assigned to the Wireless Public SAFETY Interoperable COMMUNICATIONS Program—called Project SAFECOM—by the Office of Management and Budget as an e-government initiative. With the support of the George W. Bush Administration, SAFECOM was placed in the Science and Technology directorate and became the lead agency for coordinating federal programs for interoperability.³⁸ The Secretary of Homeland Security assigned the responsibility of preparing a national strategy for communications interoperability to the Office of Interoperability and Compatibility (OIC), which DHS created, an organizational move that was later ratified by Congress in the Intelligence Reform and Terrorism Prevention Act.³⁹ SAFECOM continued to operate as an entity within the OIC, which assumed the leadership role.

³⁵ 47 U.S.C. § 309 (j) (14).

³⁶ Additional information at <http://www.fcc.gov/pshs/public-safety-spectrum/700-MHz/regional-planning.html>.

³⁷ Notably, P.L. 107-296, Sec. 232, 116 STAT. 2159 and Sec. 502, 116 STAT. 2213.

³⁸ “Homeland Security Starting Over With SAFECOM,” *Government Computer News*, June 9, 2003.

³⁹ P.L. 108-458, Title VII, Subtitle C, Sec. 7303 (a) (2), 118 STAT. 3843-3844.

Intelligence Reform and Terrorism Prevention Act

Acting on recommendations made by the 9/11 Commission, Congress included several sections regarding improvements in communications capacity—including clarifications to the Homeland Security Act—in the Intelligence Reform and Terrorism Prevention Act (P.L. 108-458).

The Commission’s analysis of communications difficulties on September 11, 2001, was summarized in the following recommendation.

Congress should support pending legislation which provides for the expedited and increased assignment of radio spectrum for public safety purposes. Furthermore, high-risk urban areas such as New York City and Washington, D.C., should establish signal corps units to ensure communications connectivity between and among civilian authorities, local first responders, and the National Guard. Federal funding of such units should be given high priority by Congress.⁴⁰

Congress addressed both the context and the specifics of the recommendation for signal corps capabilities. The Intelligence Reform and Terrorism Prevention Act amended the Homeland Security Act to specify that DHS give priority to the rapid establishment of interoperable capacity in urban and other areas determined to be at high risk from terrorist attack. The Secretary of Homeland Security was required to work with the Federal Communications Commission (FCC), the Secretary of Defense, and the appropriate state and local authorities to provide technical guidance, training, and other assistance as appropriate. Minimum capabilities were to be established for “all levels of government agencies,” first responders, and others, including the ability to communicate with each other.⁴¹ The act further required the Secretary of Homeland Security to establish at least two trial programs in high-threat areas. The process of development for these programs was to contribute to the creation and implementation of a national model strategic plan. The purpose was to foster interagency communications at all levels of the response effort. Building on the concept of using the Army Signal Corps as a model, the law directed the Secretary to consult with the Secretary of Defense in the development of the test projects, including review of standards, equipment, and protocols.⁴²

Congress also raised the bar for performance and accountability, setting program goals for the Department of Homeland Security. Briefly, the goals were to:

- Establish a comprehensive, national approach for achieving interoperability;
- Coordinate with other federal agencies;
- Develop appropriate minimum capabilities for interoperability;
- Accelerate development of voluntary standards;
- Encourage open architecture and commercial products;
- Assist other agencies with research and development;

⁴⁰ *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States*, Washington: GPO, 2004, p. 397.

⁴¹ P.L. 108-458, Title VII, Subtitle C, Sec. 7303, 118 STAT. 3843 *et seq.*

⁴² P.L. 108-458, Title VII, Subtitle C, Sec. 7304, 118 STAT. 3847-3848.

- Prioritize, within DHS, research, development, testing and related programs;
- Establish coordinated guidance for federal grant programs;
- Provide technical assistance; and
- Develop and disseminate best practices.

The act included a requirement that any request for funding from DHS for interoperable communications “for emergency response providers” be accompanied by an Interoperable Communications Plan, approved by the Secretary. Criteria for the plan were also provided in the act.⁴³

The act also provided a sense of Congress that the next Congress—the 109th—should pass legislation supporting the Commission’s recommendation to expedite the release of spectrum. This was addressed in the Deficit Reduction Act of 2005 (P.L. 109-171).

The Homeland Security Appropriations Act, 2007

The destruction caused by Hurricanes Katrina and Rita in August–September 2005 reinforced the recognition of the need for providing interoperable, interchangeable communications systems for public safety and also revealed the potential weaknesses in existing systems to withstand or recover from catastrophic events. Testimony at numerous hearings following the hurricanes suggested that DHS was responding minimally to congressional mandates for action, most notably as expressed in the language of the Intelligence Reform and Terrorism Prevention Act. Bills subsequently introduced in both the House and the Senate proposed strengthening emergency communications leadership and expanding the scope of the efforts for improvement. Some of these proposals were included in Title VI of the Homeland Security Appropriations Act, 2007 (P.L. 109-295). Title VI—the Post-Katrina Emergency Management Reform Act of 2006—reorganized the Federal Emergency Management Agency (FEMA), gave the agency new powers, and clarified its functions and authorities within DHS.⁴⁴

The act also addressed public safety communications in Title VI, Subtitle D—the 21st Century Emergency Communications Act of 2006. This section created an Office of Emergency Communications (OEC) and the position of Director, reporting to the Assistant Secretary for Cybersecurity and Communications. The Director was required to take numerous steps to coordinate emergency communications planning, preparedness, and response, particularly at the state and regional level. These efforts were to include coordination with Regional Administrators appointed by the FEMA Administrator to head ten Regional Offices. To assist these efforts, Congress required the creation of Regional Emergency Communications Coordination (RECC) Working Groups.⁴⁵

Other responsibilities assigned to the Director included conducting outreach programs, providing technical assistance, coordinating regional working groups, promoting the development of standard operating procedures and best practices, establishing non-proprietary standards for

⁴³ P.L. 108-458, Title VII, Subtitle C, Sec. 7303 118 STAT. 3843 *et seq.*

⁴⁴ Information on the FEMA reorganization is provided in CRS Report RL33729, *Federal Emergency Management Policy Changes After Hurricane Katrina: A Summary of Statutory Provisions*, coordinated by Keith Bea.

⁴⁵ P.L. 109-295, Title VI, Sec. 671(b), ‘Title XVIII, ‘Sec. 1805, 120 STAT. 1439.

interoperability, developing a national communications plan, working to assure operability and interoperability of communications systems for emergency response, and reviewing grants. Required elements of the National Emergency Communications Plan included establishing requirements for assessments and reports, and an evaluation of the feasibility of developing a mobile communications capability modeled on the Army Signal Corps. The feasibility study was to be done by DHS on its own or in cooperation with the Department of Defense. Congress also required assessments of emergency communications capabilities, including an inventory that identified radio frequencies used by federal departments and agencies.⁴⁶

Many of the functions Congress envisioned for the OEC were later assumed by the Command, Control and Interoperability Division in the Directorate of Science and Technology.

Regional Emergency Communication Coordination

Congress directed the OEC to coordinate with the Regional Emergency Communication Coordination (RECC) Working Groups established by FEMA.⁴⁷ These groups could provide a platform for coordinating emergency communications plans among states and were intended to include representatives from many sectors with responsibility for public safety and security. Plans for forming RECCs were announced in December 2007. In 2008 organization charts were developed, graphing how the RECCs were structured and where they would fit in the existing chain-of-command of the Federal Emergency Management Agency (FEMA). A National RECC Coordinator was appointed and plans were announced to appoint administrators for each of the regions.

A key proposal for the RECC structure is to “Establish and use the RECC’s as a single Federal emergency communications coordination point for Federal interaction with the State, local and tribal governments.”⁴⁸ It is not clear at this early stage whether the RECCs will become an effective conduit for interaction to develop policies and plan for shared infrastructure or a forum for FEMA’s Disaster Operations Directorate to relay guidelines and orders. Congress placed an emphasis on assisting first responders in its statement of RECC goals but did not limit the RECCs’ ability to set more inclusive goals. Based on the role of RECCs as assigned by the National Emergency Communications Plan, their focus will be narrowly on assisting first responders to prepare for disaster response. Leadership will be provided by FEMA and governance will be through the chain-of-command of the agencies’ directorates.

The formation of the regional working groups, the RECCs, responded in part to requests from the public safety community to expand interoperable communications planning to include the second tier of emergency workers. Non-federal members of the RECC are to include first responders, state and local officials and emergency managers, and public safety answering points (911 call centers). Additionally, RECC working groups are to coordinate with a variety of communications providers (such as wireless carriers and cable operators), hospitals, utilities, emergency

⁴⁶ P.L. 109-295, Title VI, Sec. 671(b), ‘Title XVIII, ‘Sec. 1803, 120 STAT. 1437-1438.

⁴⁷ P.L. 109-295, Title VI, Sec. 671(b), “Title XVIII, “Sec. 1805, 120 STAT. 1439.

⁴⁸ Presentation by Brian Carney, National RECC Coordinator, Disaster Operations Directorate, Federal Emergency Management Agency, Department of Homeland Security, “Regional Emergency Communications Coordination Working Groups (RECCWG)” at National Public Safety Telecommunications Council (NPSTC), Seattle, Washington, September 15, 2008 at http://www.npstc.org/meetings/GB_Carney_RECC%20Briefing_090208_NPSTC.ppt.

evacuation transit services, ambulance services, amateur radio operators, and others as appropriate.

National Emergency Communications Plan

In compliance with requirements of the Homeland Security Appropriations Act, 2007, the Department of Homeland Security issued the National Emergency Communications Plan (NECP) in July 2008.⁴⁹

The NECP sets three goals for levels of interoperability⁵⁰

- By 2010, 90% of all areas designated within the Urban Areas Security Initiative (UASI) will demonstrate response-level emergency communications, as defined in grant programs, within one hour for routine events involving multiple jurisdictions and agencies.
- By 2011, 75% of non-UASI will have achieved the goal set for UASIs.
- By 2013, 75% of all jurisdictions will be able to demonstrate response-level emergency communications within three hours for a significant incident as outlined in national planning scenarios.

These jurisdictional goals are to be knit together into a national communications capability through program efforts such as FEMA's Regional Emergency Communications Coordination (RECC) Working Group. The three goals are bolstered by seven objectives for improving emergency communications for first responders, dealing largely with organization and coordination.⁵¹ Each of these objectives have "Supporting Initiatives" and milestones.

Deficit Reduction Act of 2005 and the Public Safety Interoperability Grant Program

Provisions in the Deficit Reduction Act of 2005 planned for the release of spectrum by February 18, 2009⁵² and created a fund to receive spectrum auction proceeds and disburse designated sums to the Treasury and for other purposes,⁵³ including a grant program of up to \$1 billion for public safety agencies. The fund's disbursements were to be administered by the NTIA.⁵⁴ At the time, the Congressional Budget Office projected that the grants program for public safety would receive \$100 million in FY2007, \$370 million in FY2008, \$310 million in FY2009 and \$220 million in FY2010.⁵⁵ However, the 109th Congress, in its closing hours, passed

⁴⁹ DHS, National Emergency Communications Plan, July 2008 at http://www.dhs.gov/xlibrary/assets/national_emergency_communications_plan.pdf.

⁵⁰ National Emergency Communications Plan, "Executive Summary," page ES-1.

⁵¹ *Ibid.*, "Executive Summary," page ES-2.

⁵² P.L. 109-171, Sec. 3002 (a) (1) (B). The deadline was later extended through June 12, 2009, by the DTV Delay Act, P.L. 111-4, Sec. 2 (a) (1).

⁵³ P.L. 109-171, Sec. 3004, 120 STAT. 22-23.

⁵⁴ P.L. 109-171, Sec. 3006, 120 STAT. 24-25.

⁵⁵ Congressional Budget Office Cost Estimate, S. 1932, Deficit Reduction Act of 2005, January 27, 2006, p. 21, <http://www.cbo.gov/showdoc.cfm?index=7028&sequence=0>.

a bill with a provision requiring that the grants program receive “no less than” \$1 billion to be awarded “no later than” September 30, 2007.⁵⁶ Language in Implementing Recommendations of the 9/11 Commission Act of 2007 (P.L. 110-53) required some changes in the grant program and reaffirmed the 2007 fiscal year deadline.⁵⁷

In February 2007, the NTIA transferred the management of the public safety grant program to DHS, signing a memorandum of understanding (MOU) with the Office of Grants and Training.⁵⁸ The MOU included an overview of how the Public Safety Interoperable Communications (PSIC) Grant Program, as it is called, is to be administered. The overview was reiterated and explained in testimony.⁵⁹ Both the MOU and the testimony indicate that the priority was to fund needs identified through Tactical Interoperable Communications Plans and Statewide Interoperable Plans developed in conjunction with SAFECOM.

On July 18, 2007, the Secretaries of Commerce and Homeland Security jointly announced the details of the PSIC grant program.⁶⁰ The program, as announced, was to provide \$968,385,000 in funding for all 50 states, the District of Columbia, and U.S. Territories.⁶¹ The announcement of the top-level, statewide allocations met the September 30 deadline set by Congress. The states, however, have additional time to submit their detailed requests. Originally, states were eligible to receive funds through FY2010.⁶² New legislation (P.L. 111-96) extends the deadline through FY2012.⁶³ The status of the PSIC grant program was discussed at a hearing in March 2009. Testimony at the time indicated that all of the states, territories, and the District of Columbia had filed Statewide Communication Interoperability Plans, a prerequisite for receiving funds.⁶⁴

⁵⁶ P.L. 109-459, Sec. 2.

⁵⁷ P.L. 110-53, Implementing Recommendations of the 9/11 Commission Act of 2007, Title XXII, Sec. 2201, 121 STAT. 537 *et seq.*

⁵⁸ MOU at http://www.ntia.doc.gov/otiahome/psic/PSICMOU_Executed_2-16-2007.pdf.

⁵⁹ Testimony of Corey Gruber, Acting Assistant Secretary for Grants and Planning, Office of Grants and Training, Department of Homeland Security at hearing on “Public Safety Interoperable Communications Grants: Are the Departments of Homeland Security and Commerce Effectively Coordinating to Meet our Nation’s Emergency Communications Needs?” House of Representatives, Homeland Security Committee, Subcommittee on Emergency Communications, Preparedness, and Response, March 14, 2007.

⁶⁰ Press releases at http://www.dhs.gov/xnews/releases/pr_1184783934669.shtm and http://www.ntia.doc.gov/ntiahome/press/2007/PSIC_071807.pdf.

⁶¹ See http://www.dhs.gov/xgovt/grants/gc_1184774852768.shtm. The NTIA website main page has a section devoted to PSIC at <http://www.ntia.doc.gov>.

⁶² For details, see <http://www.ntia.doc.gov/psic/awards.html>.

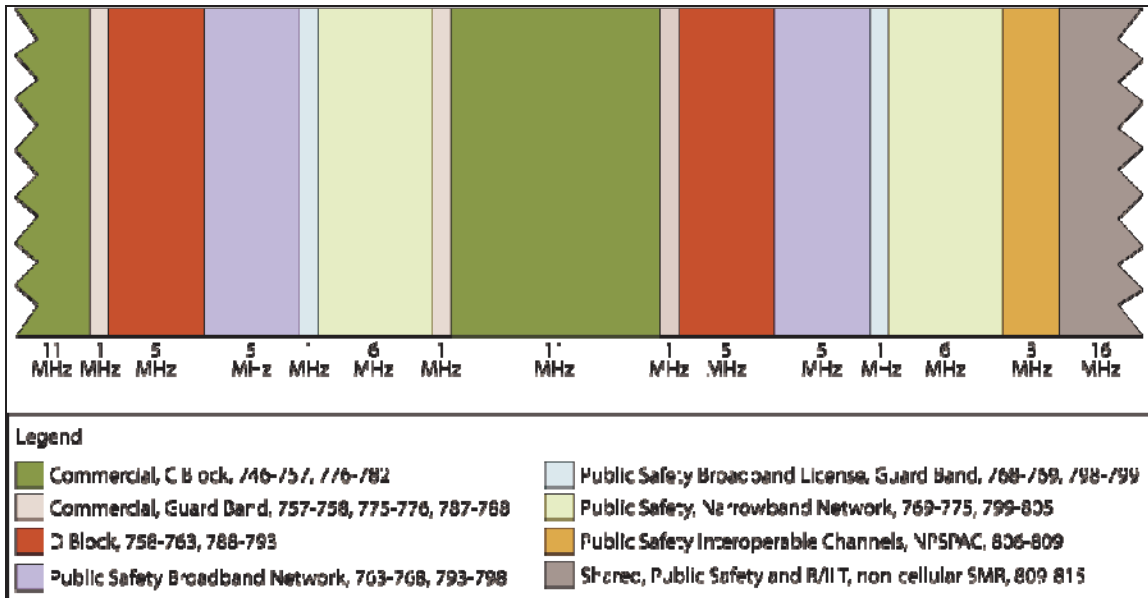
⁶³ S. 1694, signed into law November 6, 2009.

⁶⁴ Testimony of W. Ross Ashley, III, Assistant Administrator, Grant Programs Directorate, FEMA, Hearing, “Interoperable Communications,” House of Representatives, Committee on Appropriations, Subcommittee on Homeland Security, March 17, 2009.

Appendix B. Spectrum Chart

Below is an excerpt of the 700 MHz band plan that shows the location of public safety allocations and the D Block, and their relation to other adjacent spectrum holdings.

Figure B-1. Public Safety and the D Block



Source: Federal Communications Commission, Revised 700 MHz Band Plan for Commercial Services.

Appendix C. Managing Technology and Spectrum Resources

Within the federal government, the Department of Homeland Security (DHS) has authority for planning and implementing public safety communications solutions. The Federal Communications Commission (FCC) created a Public Safety and Homeland Security Bureau in 2006 to consolidate its many programs oriented toward public safety.⁶⁵ The FCC and DHS have each approached the goal of communications interoperability from a different perspective. The following discussion provides snapshot summaries of the approaches adopted by the two agencies and the technologies and network design concepts that might be applied by the FCC. The section also discusses the trend to Internet-based concepts for networks and spectrum management.

Ideas for managing emergency communications have moved along an evolutionary path from the 1990s, when agreement was reached on developing standards for interoperable communications, to the system-of-systems concept embraced by DHS, to the network-oriented proposals of the FCC, Public Safety Spectrum Trust (PSST), National Public Safety Telecommunications Council (NPSTC),⁶⁶ and others. The ubiquity of the Internet and the standards that support it are leading to a new path for managing spectrum and network resources.

System-of-Systems

The communications solutions advocated by DHS have focused on developing what is often referred to as a “system of systems.” The choice of terminology implies that independent systems are made to work with each other through bridges and gateways that connect incompatible technology choices into a larger system. This approach maximizes the value of past investments but does not represent an efficient use of resources. Backward-compatible radio equipment that can support several generations of different technologies, for example, is more expensive than equipment designed to work only with newer network technology. Spectrum usage is inefficient because more than one channel is often used to convey a single communication from system to system.

Essentially, the system-of-systems concept starts with the radio user and works its way up, adding and connecting the different levels of command and control needed to respond to specific situations. DHS refers to this as a practitioner-driven approach. Many of the DHS programs for public safety have focused on achieving interoperability within the existing framework of proprietary systems and by expanding the diffusion of Project 25, or P25, standards.⁶⁷ Backward compatibility with legacy systems is one of the principles behind the digital radio and

⁶⁵ See <http://www.fcc.gov/pshs/about-us/>.

⁶⁶ See, for example, NPSTC, *700 MHz Public Safety Broadband Task Force Report and Recommendations*, September 14, 2009 at http://www.npstc.org/documents/700_MHz_BBTF_Final_Report_0090904_v1_1.pdf.

⁶⁷ P25 conforms to recommendations made in 1996 by the Public Safety Wireless Advisory Committee (PSWAC) regarding the improvement of public safety communications over wireless networks, see “Final Report of the Public Safety Wireless Advisory Committee,” September 11, 1996. The committee was disbanded after publication of its recommendations. The Association for Public-Safety Communications Officials—International (APCO) is a principle player in the development of P25 standards. Currently, meetings to develop standards are managed by the Telecommunications Industry Association, an ANSI-standards-setting body. See http://www.tiaonline.org/standards/technology/project_25/index.cfm/.

interoperable gateway⁶⁸ standards of P25. Its use is advocated by many public safety agencies and by DHS.⁶⁹ P25-compliant technologies coordinate and connect specified radio channels.⁷⁰

Currently, the Command, Control, and Interoperability Division of the Science and Technology Directorate at DHS is testing and evaluating P25 multi-band radios.⁷¹ The initial phase of the program was announced July 1, 2009. Results will be documented in a report that “will provide details to manufacturers about the needs of the response community and assist officials in making informed radio purchasing decisions in the future.”⁷²

Shared Networks

The FCC has taken a more network-oriented approach to achieving interoperability by laying out a plan for a national network at 700 MHz that would eventually reach every community with the same technology and connectivity, providing a common base for individual applications. Network-centric solutions start with the network framework, which sets a common standard. Any traffic that wants to use this network has to accommodate that standard (although it can use additional standards as well). Network-centric solutions tend to be managed from the top down, with centralized control of core decisions. The FCC, primarily through the Emergency Response Interoperability Center (ERIC), is attempting to structure a central administration to lead the decision-making process for implementing a nationwide public safety network.

Interconnected Networks

The PSST was assigned the Public Safety Broadband License (PSBL) as part of the FCC’s plans to create a public-private partnership. The PSST considers that the new broadband network will serve primarily as a data exchange network (text, photos, video, etc.) that would operate as an adjunct to the current mission critical public safety voice systems. Existing voice communications systems and new narrowband systems at 700 MHz would operate independently of the broadband network with an interface to be established in a future development phase.⁷³

⁶⁸ Gateways, the current solution for interoperability, can connect radios using different technologies and frequencies.

⁶⁹ Guidance for standards are included, for example in “Recommended Guidance for Federal Grant Programs,” at <http://www.safecomprogram.gov/NR/rdonlyres/9DFFF882-1895-47F5-B724-9808BF1F9FE9/0/FY2009SAFECOMRecommendedGuidanceforFederalGrantProgramsFINAL110408.pdf>.

⁷⁰ A useful description of the development, benefits, and disadvantages of P25 was issued by the Department of Justice in 2007: Issue Brief Number 6, “Project 25: The Quest for Interoperable Radios,” by Dan Hawkins, May 2007 at <http://www.cops.usdoj.gov/files/ric/Publications/project25interopradios.pdf>.

⁷¹ Multi-band radios facilitate switching from one frequency to another in as many as four different bands.

⁷² DHS Press Release, “DHS Announces Sites for Multi-Band Radio Pilot,” July 1, 2009 at http://www.dhs.gov/ynews/releases/pr_1246478388904.shtm, and S&T Snapshots—Command, Control & Interoperability, “The Beginning of the End of the Single Band Radios for Public Safety,” October 20, 2009, at http://www.dhs.gov/files/programs/gc_1258141690101.shtm.

⁷³ This is the description supplied by PSST, the current Public Safety Broadband Licensee, in an e-mail from Chief Harlin R. McEwen to CRS on August 3, 2009. A similar description was provided in testimony by Chief McEwen at the hearing held by the House of Representatives, Committee on Energy and Commerce, Subcommittee on Communications, Technology, and the Internet: “A National, Interoperable Broadband Network for Public Safety: Recent Developments,” September 24, 2009.

The Board of Directors of the PSST received recommendations from NPSTC on how to achieve interoperability among different public safety networks operating in 700 MHz allocations for public safety broadband. These were submitted to the FCC for consideration in December 2009.⁷⁴ The recommendations were oriented toward paving the way for the early construction of networks by states and cities. The interoperable framework provided by the task force is based on connecting independent public safety networks. Interoperability would be facilitated by a number of guiding principles and requirements, such as access to the Internet and IP-based voice interoperability gateways. In general, the recommendations of the task force would facilitate these expectations.

- Regional (including state and local) broadband systems will operate within the framework of a Nationwide Broadband Data System (NBDS).
- The NBDS will use Long Term Evolution (LTE) technology and it is assumed that regional systems will as well.
- Defining minimum requirements for public safety broadband networks at 700 MHz will enable national interoperability.
- An advisory council will provide governance among individual operators and the PSBL.
- Public-private partnerships will be allowed.
- Different scenarios for assignment of the D Block will be accommodated by the Task Force requirements and recommendations.
- Regional operators will have the right to deploy systems in advance of final requirements and to select and deploy applications beyond what is required.
- Technical requirements will be specified to facilitate roaming and interoperability.
- Those that have filed requests to the FCC for permission to build systems will be able to fulfill their 700 MHz broadband objectives as quickly as possible.
- Best practices for network architecture and configurations will be provided but not required.

Among other recommendations made to the FCC in the same filing, the PSST asked the FCC to authorize it “to establish the technology standard for the 700 MHz nationwide public safety broadband network....”

The Association for Public-Safety Communications Officials—International (APCO) has announced its intention to develop standards for the broadband networks at 700 MHz. Specifically, APCO “will identify gaps and set standards in those areas where none currently exist and where standards are necessary to ensure roaming and interoperability ...” and will “establish basic requirements necessary to ensure interoperability” for the network.⁷⁵ APCO is accredited by the American National Standards Institute as a Standards Development Organization.

⁷⁴ Submitted December 15, 2009, as an *Ex Parte* communication, PS Docket No.06-229, WT Docket No. 06-150 at <http://www.psst.org/documents/PSST-Minimum-Recommendations-121509.pdf>.

⁷⁵ APCO News, “APCO Announces Intent to Develop Standards for Build Out of 700 MHz Broadband Network,” October 14, 2009 at http://www.apcointl.org/new/news/standards_700mhz.php.

IP-Enabled Networks

As part of the discussion about how to bring broadband to public safety users, several organizations recommended Long Term Evolution (LTE), a fourth-generation wireless technology,⁷⁶ for the underlying network infrastructure on the 700 MHz frequencies.⁷⁷ The FCC has concluded that it will require LTE technology for the network infrastructure for the D Block and the PSBL.⁷⁸ Fourth-generation technologies such as LTE are being developed to use Internet Protocol (IP) standards, assuring a high degree of interoperability among other IP-based technologies. Developing standards for public safety interfaces on LTE networks could represent a shift in concept for public safety communications—to IP-based platforms and communications management at the network level. Some public safety representatives have shown a willingness to move from a model that connects disparate systems to a model that provides interoperability through network administration.⁷⁹

Some states have decided to deploy IP-enabled fiber optic networks to support their communications needs, including those of public safety. These networks use IP standards to achieve the same level of interoperability, availability, and flexibility associated with the Internet but do not necessarily link to the Internet.

Congress has recognized the value of IP-based networks for 911 communications by, for example, requiring the NTIA and the National Highway Traffic Safety Administration to prepare recommendations that would support the transition of out-dated 911 systems to IP-based technologies.⁸⁰ Congress has not previously considered giving the same attention to the adoption of IP-based technologies for public safety radio communications.

Adaptive Network Technologies

The FCC, DHS, PSST, and NPSTC approaches to interoperability, although different in perspective, are all based on managing radio channels as the way to meet common goals such as minimizing interference among wireless transmissions.

The concept of channel management dates to the development of the radio telegraph by Guglielmo Marconi and his contemporaries. In the United States, mitigation of radio interference was addressed in what is commonly known as the Radio Act of 1912. Passage of the bill, versions of which had been introduced in earlier Congresses, was prompted in part by Marconi's testimony at a congressional hearing investigating the sinking of the Titanic. The act established the basic principle of assigning licenses for specific channels through a central federal authority, which became the FCC with the passage of the Communications Act of 1934.

⁷⁶ A discussion of broadband technology is include in CRS Report R40674, *Spectrum Policy in the Age of Broadband: Issues for Congress* , by Linda K. Moore.

⁷⁷ APCO and NENA jointly endorsed LTE . NPSTC, and the PSST are among those that also have endorsed LTE.

⁷⁸ This decision is discussed in FCC White Paper, *The Public Safety Nationwide Interoperable Broadband Network: A New Model for Capacity, Performance and Cost*, June 2010, at <http://fcc.gov/pshs/docs/releases/DOC-298799A1.pdf>.

⁷⁹ In an interview, Richard Mignon, the incoming president of APCO, observed that broadband is “the future of public safety communications.... It’s almost like reinventing public safety technology and how we work together.” As reported in MissionCritical Communications TRANSMISSION, e-newsletter, August 19, 2009.

⁸⁰ Next Generation 911 technologies and congressional actions in support of 911 are discussed in CRS Report R41208, *Emergency Communications: Broadband and the Future of 911* , by Linda K. Moore.

In the age of the Internet, however, channel management is an inefficient way to provide spectrum capacity for mobile broadband.⁸¹ Innovation points to network-centric spectrum management as an effective way to provide spectrum capacity to meet the bandwidth needs of fourth-generation wireless devices. Network-centric technologies organize the transmission of radio signals along the same principle as the Internet. A transmission moves from origination to destination not along a fixed path but by passing from one available node to the next. Pooling resources, one of the concepts that powers the Internet now, is likely to become the dominant principle for spectrum management in the future.

The new generations of iPhones and Android-based⁸² mobile devices provide early examples of how the Internet is likely to change wireless communications as more and more of the underlying network infrastructure is converted to IP-based standards. The devices use Internet protocols to perform many of its functions; these require time and space—spectrum capacity—to operate.

The core Internet Protocol (TCP/IP) was conceived to work with high capacity landline networks. In a wireless environment, IP applications are bandwidth-intensive, consuming large amounts of channel capacity. Although future generations of mobile broadband devices will no doubt use IP applications that have been refined for the wireless environment, additional capacity will still be required to handle expected increases in activity.

More efficient spectrum use can be realized by integrating adaptive networking technologies, such as dynamic spectrum access (DSA),⁸³ with IP-based commercial network technologies such as LTE. Radios using DSA chipsets are more effective at managing interference and congestion than the channel management techniques currently in use. If a channel's link fails, the radio is cut off. When radios are networked using DSA, individual communications nodes continue to operate and can compensate for failed links. The effects of interference are manageable rather than catastrophic. The network is used to overcome radio limitations.

Adaptive networking has the potential to organize radio communications to achieve the same kinds of benefits that have been seen to accrue with the transition from proprietary data networks to the Internet. Adaptive technologies are designed to use pooled spectrum resources. Pooling spectrum licenses goes beyond sharing. Licenses are aggregated and specific ownership of channels becomes secondary to the common goal of maximizing network performance. For many, the construction of a new network for public safety communications represents an opportunity to reap the perceived benefits of shared infrastructure and pooled spectrum by using the technologies and principles of network-centric operations.

⁸¹ A leading advocate for replacing channel management of radio frequency with network-centric management is Preston Marshall, the source for much of the information about network-centric technologies in this report. Mr. Marshall is Director, Information Sciences Institute, University of Southern California, Viterbi School of Engineering, Arlington, Virginia. CRS also spoke with other experts who provided background on the topic.

⁸² Google, which uses the Android platform, describes it as “a software stack for mobile devices that includes an operating system, middleware, and key applications.”

⁸³ Dynamic Spectrum Access, Content-Based Networking, and Delay and Disruption Technology Networking, along with cognitive radio, and decision-making software, are examples of technologies that can enable Internet-like management of spectrum resources.

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