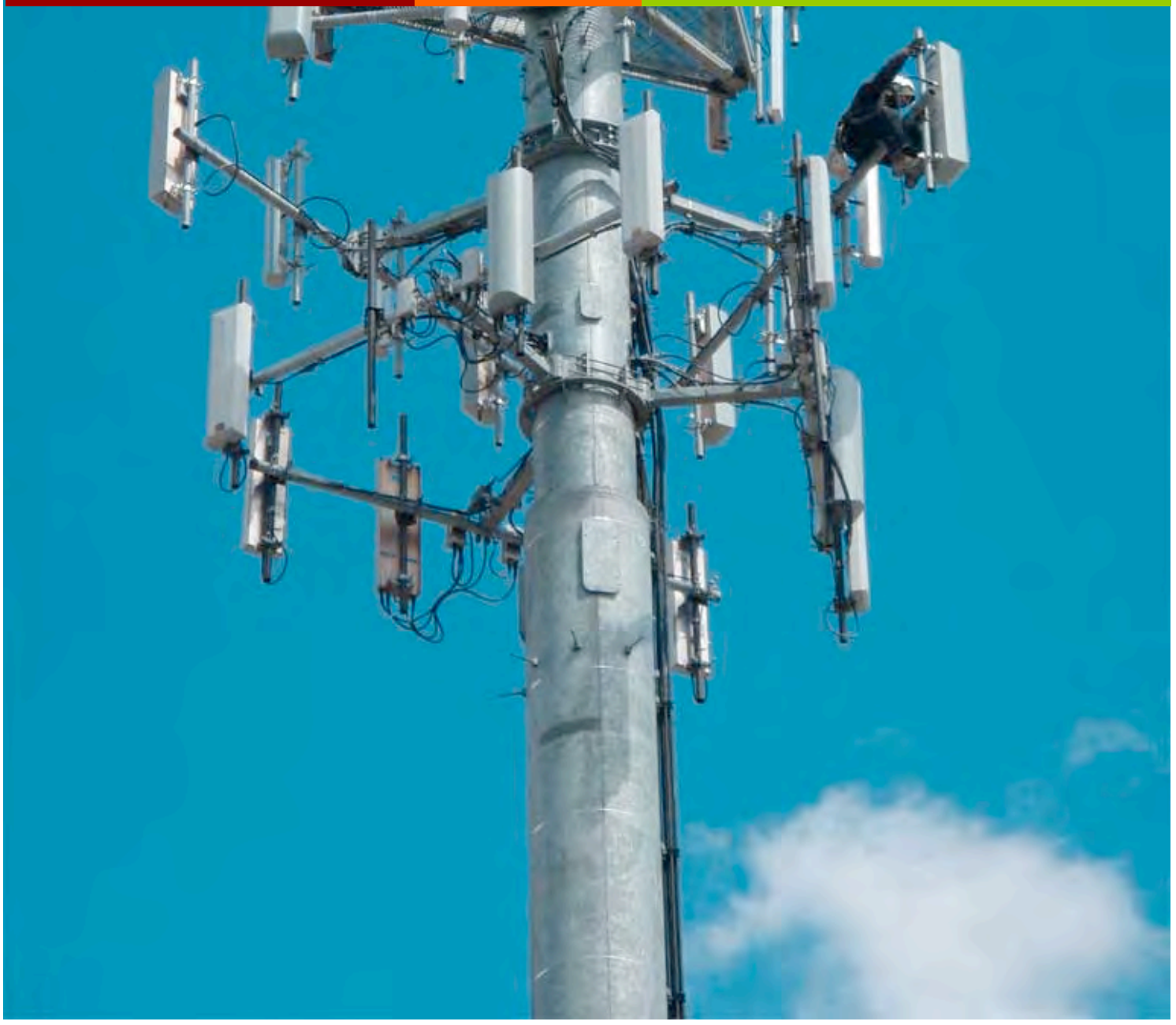
Building A Nationwide Public Safety Broadband Network

Public Safety Alliance



"We support the expeditious allocation of the D block spectrum to public safety. Congress must not approach this urgent matter at a leisurely pace, because quite literally lives are at stake." (Gov. Kean and Rep. Hamilton, Co-Chairs of the 9/11 Commission)

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The Public Safety Alliance (PSA) is a partnership among the nation's leading public safety associations, including the Association of Public-Safety Communications Officials (APCO) International, the International Association of Chiefs of Police, the International Association of Fire Chiefs, the National Sheriffs' Association, the Major Cities Chiefs Association, the Major County Sheriffs' Association, the Metropolitan Fire Chiefs Association, the National Emergency Management Association and the National Association of State EMS Officials. PSA is a program of APCO International.

The purpose of the Public Safety Alliance is to ensure law enforcement, fire and EMS agencies are able to use the most technologically advanced communications capability that meets the difficult, life-threatening challenges they face everyday as they protect America.

The goal of the Public Safety Alliance is to raise awareness in Congress and the White House about what our Nation's law enforcement, fire and emergency medical services need to build out a nationwide, interoperable 4G wireless communications network to protect America.

International Association of Chiefs of Police | International Association of Fire Chiefs
National Sheriffs' Associations | Major Cities Chiefs Association
Major County Sheriffs'' Association | Metropolitan Fire Chiefs Association
Association of Public-Safety Communications Officials International
National Emergency Management Association | National Association of State EMS Officials

I. Executive Summary

Congress, by its actions, has established spectrum policy as a significant national interest, and that electromagnetic spectrum is a finite and increasingly scarce national resource. They have mandated that the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA) within the United States Department of Commerce be vested with the authority and responsibility for the management, oversight and enforcement of spectral policy.

Congress further empowered the FCC with the authority to manage, oversee and enforce state and local government assignment and use of spectrum, as well as commercial assignment and use, and has likewise empowered NTIA with those same authorities with respect to the Federal government's assignment and use of spectrum. Congress also charged the FCC with management and oversight of spectrum auction activities.

Since its inception, the FCC has assigned state and local public safety entities with spectrum as needed, and has consistently utilized a policy of interweaving public safety spectrum with industry and other spectrum licensees in an effort to provide public safety with associated economies of scale based on the landscape of traditional voice-centric, Land Mobile Radio (LMR) technology. Therefore, spectrum assignments were traditionally provided to public safety on an "as needed" basis in small slivers of spectrum from throughout the entire spectrum map. The policy resulted in the current patchwork of spectrum that public safety maintains, which has resulted in multiple disparate networks only partially pieced together through expensive patching technologies. (See Appendix C titled APCO: Current Public Safety Spectrum Holdings Report for detailed breakdown of public safety's current spectrum assignments.)

With the advent of more advanced emergency communications systems, including cellular and wireless broadband technologies, the spectrum assignment policies of the past has put the public's safety, as well as the entire Nation at risk. Instead of utilizing multiple small slivers of spectrum to communicate through a 12.5 KHz or 25 KHz Land Mobile Radio (LMR) channel, current and emerging communications will utilize larger swaths of spectrum, commonly referred to broadband. Additionally, the traditional separation between Federal public safety, first responders and state-local public safety entities in a 21st Century post 9/11 world, have become dramatically less effective when coordinating both a day-to-day emergency response and major events/incidents. This requires the work of both the NTIA and FCC to significantly strengthen their cooperation, spectrum management oversight and policy development and implementation.

In the wake of the Oklahoma City bombing in 1995 - which at the time was the biggest terror attack ever struck on US soil - all of the major national public safety and government associations (referred to as the Big 7) came together with one voice to petition Congress, the Administration and the Nation to allocate 24 MHz of additional spectrum to alleviate the over congestion of then-current traditional, voice-centric LMR systems throughout the nation, and to allow for increased interoperability with new and existing LMR systems. Congress approved the assignment of the 24 MHz in 1997, and it was allocated to public safety from spectrum freed up by broadcasters' analog–to-digital transition. It was not until June, 2009 - 12 years later - that public safety finally obtained full access to utilize this spectrum.

In the intervening years, the attacks of 9/11, Hurricane Katrina, the Columbine school shootings and many other incidents further illustrated the need for additional spectrum, beyond the 24 MHz, to allow public safety and first responders to develop and deploy broadband networks for data and video usage. Meanwhile, the FCC established a spectrum policy that designated 10 MHz of the 24 MHz provided to state and local public safety for development of a public safety broadband network (assigned to the current Public Safety Broadband Licensee, which is the Public Safety Spectrum Trust). This public safety broadband network was to be coupled with 10 MHz of adjacent spectrum (commonly referred to as the D block) that would be auctioned with public safety encumbrances, including ruthless preemption, to a commercial provider to establish 20 MHz capacity for public safety through a public-private partnership. The subsequent auction of the D block was scheduled for early 2008 as part of the overall auction of the 700 MHz band. By all accounts the auction of the 700 MHz band was a success and derived $19 billion in revenue for the United States Treasury, even as the Congressional Budget Office's analysis projected a revenue of $12 billion dollars. This estimate of $12 billion included the auction of the D block, which in reality failed to receive a minimum bid and was never auctioned.

Once again in 2009, all major state and local public safety, first responder and Big 7 national associations came together with industry and other supporters in the wake of the failed auction of the D block to unify on a single effort to petition Congress and the Administration to allocate the D block to public safety. The overall goal of the coalition is to allocate the D block to public safety, provide sufficient funding derived from the auction of other spectrum, and the creation of an independent, nationwide governance structure with sufficient state and local government and public safety representation to allow for a Public Safety Broadband Network (PSBN), consistent with the vision of a public-private partnership.

Many leaders in Washington, as well as those in industry, academia, the public and non-profit sectors, have come to support and champion public safety's top legislative priority in the current and previous Congress. Indeed, after a comprehensive, government-wide analysis of the issue, President Obama and his Administration formally added their support in January 2011 as part of the President's State of Union (SOTU) address, as well as Secretary Napolitano's State of Homeland Security Union and the President's Fiscal Year 2012 Budget submission to Congress.

The first piece of bipartisan legislation, introduced in April 2010 during the 111th Congress by Congressman Peter King (R-NY) was ***H.R.5081; Broadband for First Responders Act of 2010***, which focused primarily on allocation of the D block to public safety. H.R. 5081 garnered 81 co-sponsors in less than eight months, roughly evenly divided among House Republicans and Democrats. Additionally, Senators Lieberman (I-CT) and McCain (R-AZ) introduced legislation, ***S. 3625; First Responders Protection Act of 2010***, which provided D block allocation, $11 billion in funding derived from other spectrum auction revenues for build-out of the Public Safety Broadband Network, and an expanded representation on the current PSBL. The final piece of legislation introduced in the last Congress was offered by Senate Commerce, Science and Transportation Committee Chairman John "Jay" Rockefeller, IV, as S.3756; Public Safety Spectrum and Wireless Innovation Act of 2010, which allocated D block to public safety and provided $11 billion in funding derived from "incentive" and other auction revenues.

Chairman Rockefeller reintroduced his legislation in January 2011 as ***S.28; Public Safety Spectrum and Wireless Innovation Act of 2011*** and declared public safety spectrum and the PSBN as his committee's highest priority in the new 112th Congress. In June 2011, the Senate Commerce Committee favorably reported out a bipartisan bill developed by Chairman Rockefeller and Ranking Member Kay Bailey Hutchison, ***S.911; Public Safety Spectrum and Wireless Innovation Act of 2011***, by a vote of 21-4. S.911 allocates D block to public safety, provides $11.75 billion in funding for the PSBN derived from "incentive" and other spectrum auctions, and creates the Public safety Broadband Corporation as an independent non-profit governance entity, as the new PSBL, to oversee the management and implementation of the PSBN. The bill is also designed to provide $10 billion from the aforementioned spectrum auctions to battle deficit reduction. The Congressional Budget Office's (CBO) July report estimated that the bill's auctions would derive $24.5 billion in revenue providing only $6.5 billion in deficit reduction, or $3.5 billion less than the bill sponsors had estimated. Chairman Lieberman and McCain reintroduced their own bill, ***S.1040; Broadband for First Responders Act of 2011***, in May, 2011, which again allocates D block to public safety, provides $11 billion in funding derived from other spectrum auctions revenue, and expands representation within the current PSBL.

We have a once in a lifetime opportunity to work together, across party lines, to meet a high national priority. It is an opportunity that addresses a pressing national homeland security need, promises to save lives, creates jobs, grows our digital wireless economy, pays for itself, and provides billions for deficit reduction."

Senators Rockefeller and Hutchison, Chair and Ranking Member of the Senate Commerce, Science and Transportation Committee

Meanwhile, House Homeland Security Chairman Peter King introduced new legislation, ***H.R.607; Broadband for First Responders Act of 2011***, along with Ranking Member Bennie Thompson (D-MS), which allocates D block to public safety and provides $11 billion in funding derived from other spectrum auction revenue. H.R. 607 currently has garnered 46 bipartisan co-sponsors, and awaits action by the House Energy and Commerce Committee, which is the committee with jurisdiction of spectrum policy in the House.

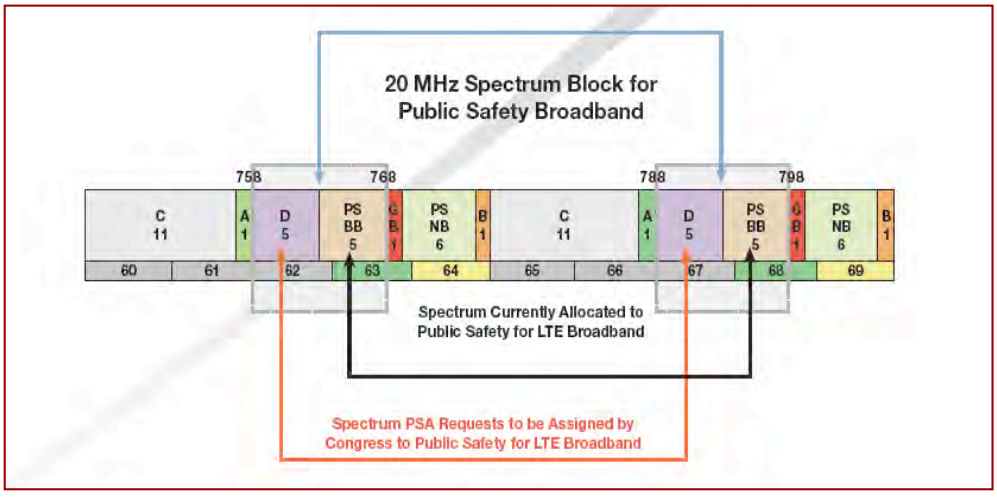
After holding four hearings since April 2011 on spectrum policy and the public safety broadband network, the House Energy and Commerce Committee recently circulated competing Majority and Democratic Staff Discussion Drafts that disagree on whether to auction or allocate D block, on how much funding to provide, where the revenue is acquired, and how the PBSN should be governed. The Democratic Discussion Draft is very similar to S.911, which is overwhelmingly supported by public safety as well as state and local governments. We have asked that the House Energy and Commerce Committee take up and vote on legislation immediately in an effort to move it through the legislative process.

Shortly before the August break, Senate Majority Leader Harry Reid (D-NV) proposed an amendment to the Budget Deal that included language largely taken from S.911, which would have allocated D block to public safety, provided $7 billion for build out of the PSBN as derived from "incentive" and other auctions, while establishing the PSBC and providing $13 billion for deficit reduction. The final agreement did not include the Reid Amendment, but the issue of spectrum policy and the public safety broadband spectrum needs is reportedly under consideration as part of the Joint Select Committee on Deficit Reduction, dubbed the Debt "Super Committee." The Super Committee held its first official meeting on September 8th.

As a solemn reminder to the tragic events of September 11th, a 9/11 Report Card was issued by the Bipartisan Policy Center, and the National Security Preparedness Group Co-Chairs, former Governor Thomas Kean (R-NJ) and former Congressman Lee Hamilton (D-NY), who also chaired the 9/11 Commission. The men urged Congress, once again, to "immediately" allocate the D block spectrum to public safety to finally realize one of the last unmet recommendations of the 9/11 Commission to build a nationwide, interoperable, and mission-critical public safety broadband network before another strike or major disaster happens.

II. Why The D Block?

Public safety is currently the license holder of 10 MHz of broadband-ready spectrum in the 700 MHz band. As the only remaining portion of unlicensed 700 MHz spectrum on a nationwide basis, public safety must be allocated the D Block, which is directly adjacent to the public safety spectrum, in order to build out a 20 MHz broadband network. From a fiscal standpoint, allocating the D Block to public safety would be the most financially and nationally responsible use of the spectrum, as the build-out of a 20 MHz network split between two separate bands would cost taxpayers billions more than simply building one 20 MHz network on a single spectral band. Allocating the D Block to public safety will allow for a nationwide interoperable broadband network on a contiguous 20 MHz spectrum swath.



The D Block is the only spectrum capable of accommodating public safety's needs, due to the unique propagation characteristics of 700 MHz spectrum. The combined 20 MHz of spectrum would provide the framework for an ideal broadband network for first responders because it would provide enough capacity necessary to transmit mission critical real-time high resolution video, voice and data with the in-building penetration required by police, EMS and fire services when responding to emergencies. The robust network would be strong and efficient enough to provide mission critical-grade

III. Why Broadband

Excerpt: Dr. Alan R. Shark, D. (2010). 700 MHz "D" Block Public Safety Application Needs Assessment. White Paper, Public Technology Institute.

How the 700 MHz D Block is ultimately allocated to public safety is critical to the deployment of a new and dynamic plethora of advanced high-tech public-safety applications. The 700 MHz band is exceptionally well suited for the new and demanding requirements of a new generation of video/data/voice devices.

The evolution of wireless communications continues at a rapid pace. In mid-2007 the iPhone was first launched - and lost in all the fanfare was that this phone was produced by a computer manufacturer and not a cell phone manufacturer. This device would change everything for consumers as every other manufacturer attempted to match or beat the iPhone. Today there are over 100,000 applications available, and there is no question that these devices have quietly morphed into powerful handheld computers that just happen to offer a decent phone as an "app."

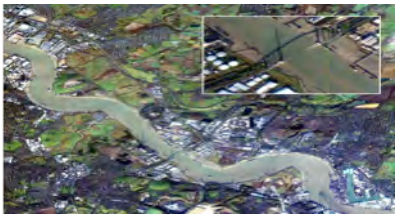
The following applications are either being deployed piecemeal or are being planned for the near future. Because public safety agencies lack a common spectrum for the newer technologies, the cost of equipment is far greater than it would be if the applications highlighted below were located in a single 20 MHz spectrum block, with appropriate rules and standards.

Most local enforcement agencies have mobile crime units of some kind; some in the form of buses, or vans. For mobile command applications to take better advantage of the latest technologies and communications systems, they will require greater bandwidth and spectrum to better integrate high-speed, high-definition video, data, and voice communications. Typically, the equipment used includes mobile, fingerprint reading and analysis, video crime scene analysis, and blood sample analysis, as well as perimeter protection and monitoring, and scene ID authentication.

Automated license plate reader technology allows public safety officers to passively or actively scan vehicle license plates, either moving or parked. Data is retrieved from a specialized video camera and automatically sent to a database for immediate response. Such devices are particularly helpful with event management, "amber" or "silver" alerts, and seeking out individuals of interest.

Mobile ticket writer systems allow for near-instant license look-up with full driver picture display, along with address, driving record, and any outstanding warrants. This type of system has been proven to dramatically increase productivity in ticket writing and leads to greater law enforcement personnel protection. Moreover, mobile ticket writing systems help ensure officer safety, as he or she would know instantaneously whether the subject is more than merely a traffic violator.

Streaming video from mobile devices require a huge amount of bandwidth – especially if offered as high-definition broadcast. Streaming video is required for mobile incident feeds and supplies critical visual information to various agencies and sites for improved coordination and multi-agency engagement.



Leading city, county, and state agencies are increasingly relying on accessing geospatial information databases where building schematics, wiring, ventilation systems, street conduits, underground structures, pipelines, subways, and other critical infrastructures are displayed. Mashed-up data is considered essential in being able to quickly respond to incidents and crises requiring immediate analysis and response.

Mobile Video surveillance offers public safety officials the ability to connect responding units within minutes and receive immediate feeds. The latest mobile video technology provides for extreme lowlight capture plus high-definition resolution. These must-have units also come with a large requirement for intensive bandwidth.

With a growing population it is more important than ever before to deploy technologies that can utilize facial recognition to seek out persons of interest, or to simply permit passage of authorized first responders to an incident or crime scene. Cities and counties are also looking to purchase multi-mode biometrics monitoring devices that are either fixed or mobile to help to track, guard, and monitor buildings, sites and events for suspicious behavior. Mobile units are designed to be deployed at planned incidents such as parades, festivals, etc, and to warn of potential threat.

New technology provides fire electronic command boards at the site where they are most needed and shared simultaneously with other command centers. A mobile command center is required to coordinate and establish a mobile command system when natural disasters, major structural fires, hazmat incidents, or terrorism incidents strike. The command board serves as the central hub for receiving and analyzing various voice communication paths, data monitoring and analysis, bio-monitoring, 3D building schematics and diagrams, GIS mapping, individual first-responder tracking, vehicle assets placement and tracking (AVL), and incident ID authentication.

Cities and counties have turned to Automatic Vehicle Location (AVL) and telemetry systems to better coordinate their dispatch of first responder units through improved tracking and system status management. ALS units can also broadcast key vital signs to medical experts in other locations, helping to better ensure life-saving care. With patient telemetry hospitals can be better prepared to offer life-saving measures before the patient arrives.

Ideally, the benefits are obvious if every public safety vehicle has the capacity to view floor plans and have access to records, photos, and other 3D graphical displays. Each vehicle would be required to have a more powerful data terminal and screen capable of viewing high-definition video and audio. The irony here is that many believe the general public will have access to similar features with the next generation of broadband devices - slowed only by network capability and non-public-safety-grade equipment devices.

Telemedicine allows emergency and trauma physicians to triage cases remotely, even while patients are in transit. The ability to transmit video and images of the patient in transit can save big dollars considering that each Level 1 trauma activation involves 18 to 20 people and costs the hospital $5,000. If a single physician or nurse triages the case by video, the system can prevent unnecessary trauma calls. (Hospitals and Health Networks (H&HN), 2009)

Bomb disposal units are increasingly relying on robots to take over the dangerous task of finding and defusing bombs. But robots are also taking on other hazardous duties, and their capabilities are evolving rapidly. To operate the robots and to see what they see, bomb squads need access to high-speed broadband data network.

In recent years, the emphasis on measures to combat terrorism has led to the development of technologies to detect nuclear, chemical and biological threats. Sensor capable of identifying nuclear, chemical and biological threats and alerting authorities can potentially reduce the risk from future terrorist actions.

FUTURE MISSION CRITICAL VOICE COMMUNICATIONS

Excerpt: Seybold, A. M. (2011, June 19). LTE Support for Mission Critical Voice for Public

Mission critical voice communication reflects the harsh realities on the emergency management scene: when every other commercial system is down, you expect mission critical voice to be there. The exacting standards for mission critical networks and devices disqualify many nascent technologies and devices in favor of proven, reliable standards. In a mission critical environment, all aspects of a device or technology must achieve interoperability, reliability, coverage, capacity, control and instant, real-time communications.

If LTE broadband can meet both the voice and the data requirements of the first responder community, a single device could be deployed that would provide not only data/video interoperability, but voice interoperability as well. This would be an ideal situation and one that is worth pursing. However, existing narrowband spectrum should not be reallocated for other uses until such time as LTE broadband can and does meet all of the requirements for Public Safety mission critical voice as well as data and video services.

LTE or fourth-generation (4G) wireless broadband was designed and implemented primarily as a data over broadband technology. Voice in the form of Voice over IP, which is being designed to implement voice calls in the traditional cellular fashion of dialing a number and completing the call using the LTE network as transport, is being developed. The issue is whether LTE can and will support other types of voice services, specifically Push-To-Talk (PTT) voice and most importantly, PTT off-network [point-to-point], when units are out of coverage of the network or when they need short-range communications in buildings and in other areas where the network does not provide coverage.

The standards for LTE are largely controlled by the 3GPP, an organization made up of hundreds of commercial members including chipset companies, infrastructure vendors, network operators, handset companies, software developers, and others. In order to add mission critical voice requirements to the LTE standard, the Public Safety community must petition the 3GPP for its inclusion AND there must be a number of other members of 3GPP that concur. Once (if) this happens, the amendment to the standard is assigned to a future release of LTE and when that release is being worked on, the amendment will be considered.

In order for the amendment to the standard to be considered, all of the requirements must be defined and support must be garnered from members of the 3GPP. At present, there is no incentive for network operators that largely drive the direction of 3GPP, to embrace mission critical voice, especially the part of mission critical voice that is of paramount importance to Public Safety: The ability to communicate between devices without having to make use of a network. Commercial network operators are not inclined to agree to this type of voice communications because they won't have control of their customers and the minutes of use cannot be billed to the customer.

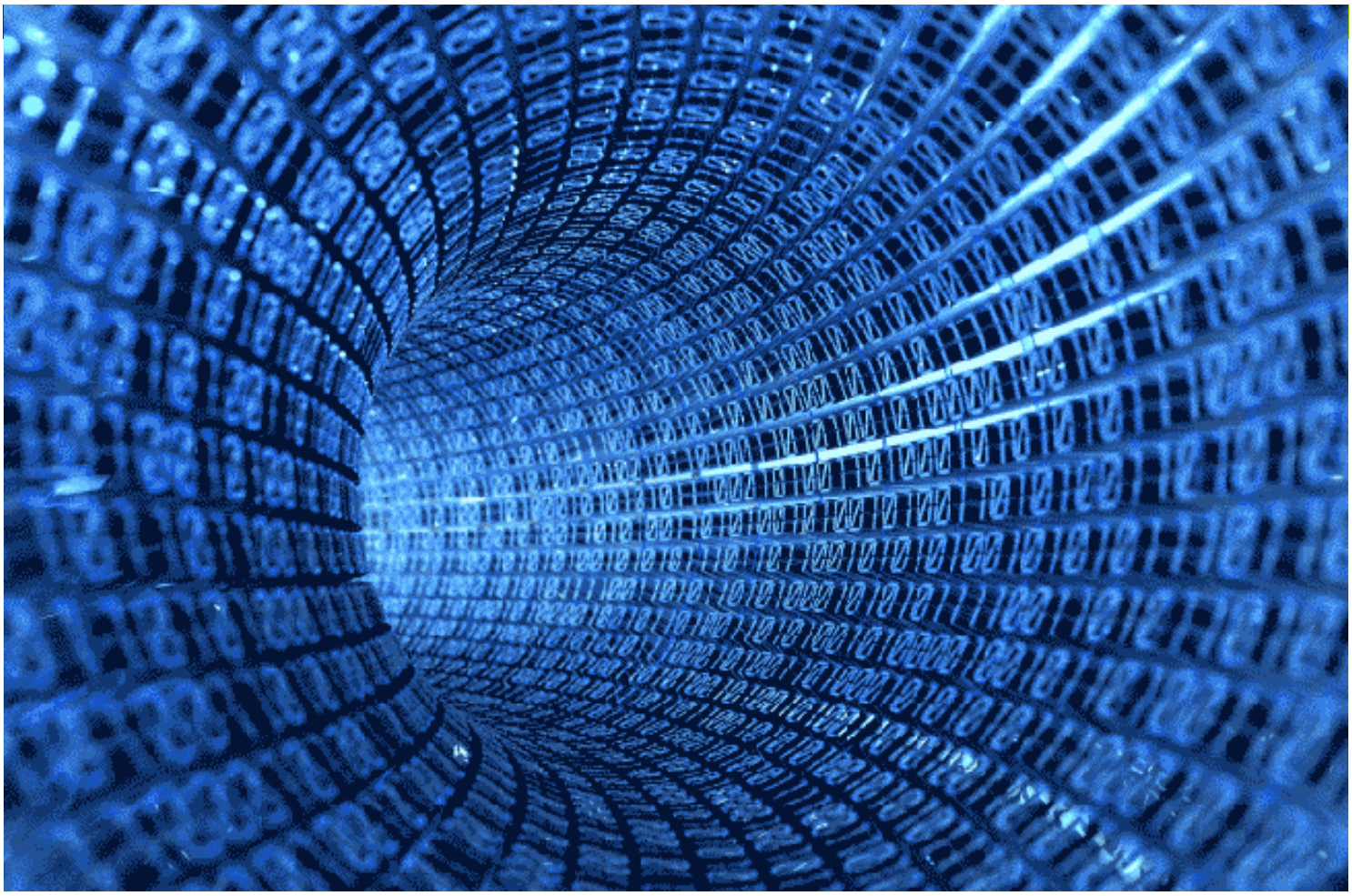
Therefore, Public Safety will have a difficult time convincing the 3GPP to address the issue of mission critical voice. If a non-standard workaround can be and is developed, it would mean that the devices used by Public Safety would not be nearly as standard as the devices being envisioned today for data and video, thus the cost of these devices would be considerably higher.

However, voice over LTE will happen. It might take longer than many people believe, and it will certainly be implemented in stages. The first voice over LTE smartphones will be available on commercial networks by the end of this year, and the first PTT LTE devices will be tested. Initially, neither of these voice services will meet all of the voice requirements of the Public Safety community. The first PTT service will probably be PTT over LTE for non-mission critical voice communications that will be bridged to existing narrowband P25 voice systems in order to provide for interoperability between narrowband voice and LTE PTT services.

For those trying to plan upgrades to or expansion of their existing narrowband voice networks, it is possible that voice over LTE, both on and off-network, will eventually be developed to provide all of the voice requirements for mission critical on and off-network services. If there is funding for research and development available from the federal government, the time frame will most likely be shortened. In either case, it will take time to first build out the nationwide broadband network, then it will take time for Public Safety to learn how to incorporate data and video into their everyday incidents and then how to integrate voice over LTE into their systems over time.

Excerpt: National Public Safety Telecommunications Council Broadband Working Group. (2011). Mission Critical Voice Communications Requirements for Public Safety. White Paper.

LTE will be able to provide some of the voice capabilities needed by the Public Safety community. The questions remaining are how long will it take to implement the rest of



SPECTRUM & CAPACITY

Excerpt: Rysavy, Peter. "Public Safety Spectrum." July 2011.

The amount of capacity in wireless networks depends on a variety of factors, but in general, mobile-broadband networks have significantly lower capacity than fixed-broadband networks. Capacity can be calculated by assessing the spectral efficiency of different wireless technologies, a value that is represented in bits per second per Hertz of spectrum (bps/Hz). While new technologies such as LTE are spectrally more efficient than prior technologies, all wireless technologies are reaching what is called the Shannon bound, a law that dictates the maximum spectral efficiency that a technology can achieve relative to noise. By knowing the radio channel size and the spectral efficiency of the wireless technology, one can estimate the aggregate capacity of a cell site. LTE in its initial deployments has a spectral efficiency value for the downlink of about 1.5 bps/Hz per sector. For the uplink, it is .65 bps/Hz.

Given the application requirements discussed in the next section, these capacity values, even for 20 MHz are quite finite. The capacity in 10 MHz, as is made clear below, is simply too limiting to provide a broadband network that can accommodate the needs of first responders.

There are multiple factors that are fueling growth in data usage including:

- Faster networks. The faster that data can be exchanged, the more likely it is that applications will take advantage of the speeds, especially since faster speeds can mean less waiting time for workers.
- More network-enabled devices. New device categories such as tablets and netbooks are expanding overall data consumption, especially because of the delivery of highquality video. Just as consumers and enterprises are adopting these new device categories, so will first responders.
- Increasing computing speeds. The faster the platform can compute, the more data an application can process in real time.
- Higher screen resolution. Greater screen resolution corresponds to higher resolution video options for users.
- Embedded modems. An increasing number of laptops and tablets come with embedded 4G modems, facilitating the use of mobile broadband service.

The question is how much bandwidth do applications actually need.

- Voice over IP - 10 thousand bits per second (kbps) to 20 kbps (both
- downlink and uplink directions.)
- General-purpose audio to record all sounds - About 100 kbps.
- Video - Ranges from 200 kbps on a small-screen device like a phone, to 1 million bits per second (Mbps) for medium resolution on a laptop, to 5 Mbps for high definition.
- Web browsing - Usually requires about 1 Mbps or higher to provide good response time.

By comparing these throughput requirements against the capacities listed in the previous section, one can see that just a handful of first responders could easily consume the capacity of a 10 MHz LTE network. LTE in 10 MHz has a downlink capacity of 7.5 Mbps. Thus, 8 downlink streams at 1 Mbps each would consume the capacity of the cell sector. On the uplink capacity is even more constrained at 3.25 Mbps where just 4 uplink streams would consume capacity. For example, these streams could be video from patrol cars at a crime scene.

Public-safety applications will increasingly demand higher bandwidth. The same innovation shown in commercial broadband will extend to public-safety broadband. In the February 2011 report "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010-2015," Cisco predicts a 92% compound annual growth rate in mobile traffic. There is no reason that such trends do not also apply to Public Safety. Examples of public-safety applications include:

- Wireless video surveillance.
- Aerial video from a helicopter over a scene fed to personnel below.
- Video-based training to remote emergency workers.
- Real-time license plate recognition.
- Testimony based on video transmitted from an emergency-services vehicle or command post.
- Sending and receiving high-resolution pictures.
- In-field biometrics (such as iris and fingerprint identification).
- Automated vehicle location and navigation.
- Medical applications such as telemedicine, patient records, and high-resolution video to enable medical services performed at a scene of an accident.

It is important to note that another aspect of some public-safety applications is that they demand bandwidth continuously. For example, a patrol car in an emergency situation may need to transmit a constant video stream.

PRIORITY VS. PREEMPTION

Excerpt: Rysavy, Peter. "Public Safety Spectrum." July 2011.

There are arguments for alternative approaches to dedicating spectrum for Public Safety, such as sharing commercially-allocated spectrum between first responders and commercial operators, with the commercial operator serving as the primary user or licensee. This is a bad idea for a multitude of reasons.

The first reason is that the needs of commercial customers and Public Safety are inherently different. Commercial networks are developed in a highly competitive environment where operators invest in a way to provide services at the lowest possible cost to customers. These low costs are a major factor in what is driving the broadband market. First responders, however, need hardened networks that are extremely reliable. This hardening includes items such as long term backup

power, redundant backhaul, diversified routing, and explosion proof sheltering, thus significantly increasing the cost of the network, and likely not making it viable from a competitive aspect for the private sector.

Sharing of spectrum also assumes that public-safety applications will obtain the bandwidth they need when they need it from the commercial entity. This assumption, however, is fraught with risk for the following reasons:

- Policies implemented by commercial operators may not sufficiently address public safety needs. Policies, such as reserving certain amounts of bandwidth for commercial customers, may result in insufficient capacity for public-safety applications in emergency situations.
- Prioritization schemes may not work correctly. In an emergency situation where there is massive demand on the network from both constituencies, it is possible that prioritization schemes will not work as planned simply because they may never have been tested under such extreme conditions.
- Users may defeat prioritization schemes. It is already common for users to hack their devices, especially smart phones, to access services not in their current service plans. These modifications could defeat the prioritization schemes at exactly the time they are most needed.

Nevertheless, if Public Safety has control of the spectrum and they wish to lease part of their network capacity to other entities, this can be feasible and even desirable for defraying costs, so long as Public Safety can specify the terms of such arrangements, can implement the appropriate preemption capabilities, and so long as the underlying network is built to address the specific requirements of Public Safety.

Excerpt: Seybold, A. M. (2011, September 1). Cell Phones and Nature. Retrieved September 13, 2011, from AndeySeybold: http://andrewseybold.com/2617-cell-phones-and-nature

The East Coast has suffered a double whammy as we all know. First was the 5.8 earthquake followed by Hurricane Irene, which was not as bad as was feared but still bad enough that the damage will take a long time to repair. Both of these events caused problems for the commercial wireless networks but in very different ways, pointing out the major differences between network overload and cell site failures.

In both of these cases there were network issues. During the earthquake the problem was simple: The networks stayed up but they were overloaded and could not process all of the requests for service. This is the same scenario that has been experienced with landline phones for years. Remember how difficult it used to be to get a dial tone on Mother's Day? Perhaps you remember when after an earthquake in California or during the wildland fires you could not get a call through to your relatives using the wired network?

While the cause of wired and wireless phone system overloads are different, the results are the same. The network is up and running but the number of people trying to make calls simply overwhelms the network. In the case of wired phones, the reason is that after your dedicated line reaches the nearest central office your call is joined with all of the other calls on a cable or microwave link. This link transfers the requests and the calls overloaded the link since all of these systems are built on the premise that not all phone users will want to make a phone call at exactly the same time. Therefore, the wired phone systems were designed to handle a normal, expected traffic load with extra capacity for peak call periods, but they were not designed for times when demand is unusually high. The lines and switches were jammed and people could not get dial tone and had to wait until the demand subsided.

For the sake of simplicity, let's assume that within each sector the maximum number of voice calls that can be handled is 100. A sector's normal traffic load might be thirty calls at the same time, peaking at sixty calls in a single cell sector during busy periods. Good cellular design dictates that reserve capacity be built into each cell sector so that others entering that sector from another have capacity on the new sector and are not disconnected as they move from sector to sector.

The sector becomes overloaded when demand for service exceeds the maximum number of calls that can be processed in that sector, in this case 100, so if there are 120 people within the sector some will not have network access. The way you gain access to the network is that your device (or the network in the case of an incoming call) sends a request on what is typically called the signally channel. This channel is not only used to request a call but also for the network to track the location of the device so it can be found during an inbound call as well as to facilitate the hand-off to the next sector when the phone is moving. In some networks this signaling channel is also used for SMS traffic, which uses some of the capacity of the signaling channel.

If there are too many devices trying to access the network within a cell sector, the signaling channel becomes overloaded and some customers' requests will not even reach the network (this is one reason priority access for public safety is not a viable option). So there are two issues, the total number of calls a sector is capable of handling, and the amount of traffic on the signaling channel. Even if more spectrum is allocated to a cell sector, while the number of calls that can be handled by that sector increases, there is still a finite number the sector is capable of processing and completing.

On the data side, even fewer data sessions per sector are normally supported. In normal usage, data bursts to and from the device will permit more customers to make use of the broadband data side of the system. However, if a number of

customers are streaming video up or down, the total number of broadband data users is diminished greatly. Even in normal times we have seen the results of cell site sector overloading. AT&T had this type of problem as the iPhone took off a few years ago and many of its customers started using a lot of data services. It is possible that one sector or multiple cell sites are completely overloaded due to demand but calls can still be made and received a few miles away where the demand is less.

What happened during the earthquake was that everyone reached for their phones at once. The networks worked perfectly during the aftermath of the quake but they were simply overloaded on both the voice and the data side. Calls could not be made or received, calls were dropped, video taken of damage could not be sent, and SMS messages did not get through. No matter how much spectrum we have or how robust the commercial operators build these networks, we will have network overloading during major events.

This is not a new problem. You might recall that during the Oklahoma bombing the radio and TV stations were telling people within the affected areas not to use their phones so the commercial systems could be used to augment the public safety channels. During the earthquake, I am not aware of a single cell site failure so the bottom line is that in this instance, the problems experienced were network overloading and this will never be solved no matter how much spectrum we throw at it and no matter how many more cell sites are built. It is not possible for anyone to build a commercial wired or wireless network that will not reach saturation at some point, due to some type of major incident. The same is true, by the way, with the Internet for all of you who plan to rely on it and store all of your data in the cloud.

One advantage to the commercial wireless networks is that the network operators can do some on-the-fly network management. Especially the newer 3G and 4G networks have tools built in that enable pro-active traffic management by changing antenna patterns to shrink the radius of a cell site, to overlap cell sectors in a given area, and to try to balance the load. However, even with all of this new technology there comes a point where a cell sector, and possibly many cell sectors, will be overloaded and this will happen over and over again. It is more severe during an event such as an earthquake because once the event is over, everyone reaches for their phones at once. During a longer incident, say a hurricane, the traffic does not usually peak as quickly and therefore the networks are generally able to handle the additional traffic.

Two different acts of nature caused incidents resulting in two different types of commercial network issues. During the earthquake, the networks stayed up but were overcrowded, a situation that will be repeated regardless of what we do, and the hurricane saw more spot outages due to power and communications links problems. In both cases these types of problems cannot be fixed by an FCC inquiry or a change in the rules, they will continue to happen. There is no such thing as a network that can withstand overcrowding or wind and flooding.

MIGRATION OF LMR TO BROADBAND

Summary: Sen Hutchison, K. B., & Sen Rockefeller, J. D. (2011). S. 911: The Public Safety Spectrum and Wireless Innovation Act of 2011. United States Senate, U.S. Senate Committee on Commerce, Science, and Transportation.

S. 911 requires the Commission to conduct a study and submit a report to the appropriate committees of Congress and to the Corporation on the spectrum used by public safety licensees or for public safety services pursuant to section 337(f) of the Communications Act of 1934 (47 U.S.C. 337). The report shall inventory the spectrum assigned to public safety use; and include the amount of spectrum allocated to public safety use; the number of licensees and amount of spectrum assigned to each licensee; a general description of technologies and systems in each band; an approximation of network coverage, as appropriate, of major systems (such as an estimation of land mobile radio coverage by population) in major metropolitan areas; and an approximate number of users of major systems, such as the number of first responders using land mobile radio, in major metro areas; assess if spectrum is adequate to meet the current and future needs for public safety services; and assess the opportunity for return of any additional spectrum to the Commission for reallocation.

IV. HOW MUCH WILL IT COST

Excerpt: Public Safety Alliance, "America's First Responders Need Your Help!" July 2011

The Federal Communications Commission's (FCC) National Broadband Plan states that the build-out of a 10-MHz broadband network will cost between $12 and $16 billion over the next ten years. The cost of building a 20-MHz network is the same as building a 10 MHz system, and could actually cost less. The FCC's plan requires the federal government to pay for the build-out.

However, if public safety were able to leverage the excess network capacity, and utilize existing public safety infrastructure when building out the network while securing partnerships with private industry partners, the actual cost to local, state, tribal and federal governments would be considerably less. A combination of leasing excess capacity, prioritized federal grant programs and revenue from other auctioned spectrum would help build and sustain the nationwide interoperable public safety broadband network, while creating a budget neutral funding model.

The recently released Congressional Budget Office (CBO) report on the estimated costs and revenues for S. 911 will provide more than $6.5 billion for deficit reduction. The CBO's estimated costs and revenues for S. 911 indicate that the FCC's auction of spectrum would generate $24.5 billion in auction revenues which would fully fund the $11.75 billion broadband network for first responders.

The CBO's analysis of S.911 reflects the sentiments of Senators Rockefeller, Hutchison, Schumer and others that this bill will help save lives, lower the national deficit and implement a final outstanding recommendation of the 9/11 Commission, without costing the American taxpayer.

Congressional Budget Office of S. 911

Excerpt: Gramp, K., Willie, S., Pickford, M., Stocking, A., & Webre, P. (July 2011). COST ESTIMATE: S. 911 Public Safety Spectrum and Wireless Innovation Act. Congressional Budget Office.

S. 911: The Public Safety Spectrum and Wireless Innovation Act of 2011 would establish a new entity, the Public Safety Broadband Corporation, to build, operate, and maintain a broadband network for public safety agencies that would be available across the country on a specific spectrum band. The bill would grant a license to the corporation to use 22 MHz spectrum nationwide: the 10 MHz "D block" spectrum (discussed above) and 12 MHz that has been allocated for public safety purposes under current law. The license would have an initial term of 10 years and would be renewable for additional 10-year terms if the FCC determines that the corporation has met the requirements set out in S. 911.

The bill would appropriate $11.75 billion to the corporation from spectrum auction receipts to build a nationwide network of wireless broadband. The corporation also would be authorized to borrow funds from the public and incur other forms of indebtedness. It would be given temporary authority to borrow funds from the Treasury through the NTIA for amounts necessary to carry out its responsibilities; this borrowing authority would terminate once certain auctions have begun. CBO expects that the corporation would borrow amounts sufficient to allow the network to be developed and operated, independent of the timing of the auctions under the bill.

S. 911 also would authorize the corporation to assess and collect several different fees in amounts sufficient to cover, but not exceed, its annual operating expenses. Specifically, the corporation would be authorized to assess:

- A subscription fee from each entity using the public safety network;
- Fees from commercial services that choose to lease the network's capacity on a secondary basis; and
- Fees from entities that access equipment or infrastructure built and maintained by the corporation.

CBO estimates that establishing the corporation would increase direct spending by $12.5 billion over the 2012-2021 period. This amount includes amounts appropriated to the corporation by S. 911 for capital expenditures and net operating losses that CBO anticipates would be generated in the first few years of the corporation's operations.

CAPITAL EXPENDITURES TO BUILD OUT THE NETWORK

CBO estimates that the corporation would spend $11.5 billion over the 2012-2021 period to build a nationwide wireless broadband network.

Based on information from the FCC and industry experts, CBO estimates that the corporation would develop a network of about 45,000 sites to serve 95 percent of the Cost of Build Out population by 2018 at an average cost of about $170,000 per site. That estimate is higher than the costs typically incurred by private firms because of the added reliability and security needed for public safety systems and the cost of independent capabilities specified in the bill. CBO estimates that meeting the goal of nationwide coverage would require several thousand additional sites to be built in rural areas at roughly double that unit cost. Because S. 911 would provide funding for the additional sites, CBO estimates that most of those sites would be operational by 2021.

NET OPERATING INCOME

The corporation's annual cash flows from operations would depend on how quickly the network is built and used. Operating costs would be largely tied to the number of sites that are built and on the administrative costs of serving public safety users. CBO based its estimate of operating costs on historical trends for wireless firms as well as FCC and industry projections of the costs associated with sites that have been built or are leased from other companies. Income from customers would depend on the network's available capacity and market conditions. For this estimate, CBO assumes that the corporation would be able to sell virtually all of its available capacity by 2021 at prices that are consistent with industry trends for retail and wholesale transactions.

Based on that information, CBO estimates that the corporation's operating costs would exceed its income by about $1 billion over the 2012-2021 period. Operating losses are typical for new entrants in the wireless market because of the lag between start-up costs and income from retail and wholesale customers. CBO estimates that the corporation would experience annual losses ranging from about $200 million to $400 million a year in the first few years of operation but would start to generate sufficient income to offset those losses by the end of the 10-year period. CBO also expects that the corporation's losses would be higher than for commercial firms because the towers located in areas with very low population densities may not generate enough income during this period to cover the added operating costs.

STATE AND LOCAL GRANTS

S. 911 would appropriate $250 million from spectrum auction receipts for matching grants to assist state, local, and tribal governments in developing effective ways to use the public safety network created by the corporation. To implement the program, the Department of Commerce would be allowed to borrow that amount from the Treasury beginning on October 1, 2011. Once auction proceeds become available, they would be deposited into a State and Local Implementation Fund and would be credited as an offset to borrowed funds and cover other program expenses, subject to the $250 million limit.

RESEARCH AND DEVELOPMENT PROGRAMS

S. 911 would appropriate up to $1.5 billion from auction receipts for two research and development (R&D) programs related to communications technologies. Funding would be provided for each of the fiscal years 2012 through 2016 in the following amounts: $100 million a year would be allocated for a new research program coordinated by the National Institute of Standards and Technology (NIST) on systems for public safety users and $200 million a year for additional research conducted by NIST, the National Science Foundation, and the Defense Advanced Research Programs Agency.

Because of the time needed to conduct auctions and issue licenses to the winning bidders, CBO estimates that there would not be any funding available for the R&D programs until fiscal year 2014. As a result, we estimate that the funding available for those initiatives would total $900 million over 2012-2021period.

TRANSFER OF THE D BLOCK SPECTRUM

Current law directs the FCC to auction commercial licenses for 10 MHz of spectrum known as the "D block" and to deposit the proceeds in the Treasury. (The D block covers spectrum between the frequencies from 758 MHz to 763 MHz and between 788 MHz to 793 MHz.) Under current law, CBO estimates that such an auction will be held by the end of 2012 and will generate receipts of $2.75 billion over the 2012-2013 period.

S. 911 would reallocate the D block from commercial to public safety uses, at no cost to those entities. CBO estimates that forgoing the offsetting receipts from the auction of the D block would increase direct spending by $2.75 billion.

V. HOW WILL IT BE FUNDED

Excerpt: Gramp, K., Willie, S., Pickford, M., Stocking, A., & Webre, P. (July 2011). COST ESTIMATE: S. 911 Public Safety Spectrum and Wireless Innovation Act. Congressional Budget Office.

S. 911 would amend existing law regarding the FCC's authority to auction licenses to use the electromagnetic spectrum. It would extend the commission's auction authority, which is currently scheduled to expire at the end of fiscal year 2012, through 2021. The FCC would be directed to auction certain frequencies by January 31, 2014, including 95 megahertz (MHz) of spectrum that is currently used by the Department of Defense (DoD) and other agencies. Other provisions would establish a statutory framework for what are known as "incentive auctions," in which private firms (primarily television station owners) would voluntarily relinquish some or all of their existing spectrum rights in exchange for a payment from the FCC. That spectrum would then be available for new licensed or unlicensed services. To implement incentive auctions, the bill would:

- Authorize the FCC to spend auction receipts to pay firms that voluntarily relinquish their licenses;
- Appropriate up to $1 billion from auction receipts to create an Incentive Relocation Fund administered by the National Technology Information Administration (NTIA). The fund would be used to pay television broadcasters who do not relinquish their licenses for costs the FCC would impose to change their channel assignment as part of the process of clearing spectrum for nonbroadcast services. The fund also would cover certain expenses incurred by cable operators and other distributors of television programming.
- Allow the FCC to spend auction receipts to compensate television broadcasters who do not relinquish their license for any modifications made by the FCC to the quality or scope of their coverage as a result of efforts to clear spectrum for nonbroadcast services; and
- Allow the FCC to make some television broadcast frequencies available for unlicensed use if the amount of spectrum awarded through competitive auctions is at least 84 MHz.

CBO estimates that enacting those provisions would reduce direct spending by $24.5 billion over the 2012-2021 period. That estimate reflects the expected value of offsetting receipts (based on the outcomes of various scenarios regarding the quantity and quality of frequencies likely to be auctioned over this period), net of direct spending to compensate existing licensees affected by the auctions.

Establishes in the US Treasury the ''State and Local Implementation Fund". The Treasury is authorized to deposit into or credited to the State and Local Implementation Fund (1) any amounts specified in section 401; and (2) any amounts borrowed by the Assistant Secretary. The Assistant Secretary is authorized to borrow from the general fund of the Treasury beginning on October 1, 2011, such sums as may be necessary, but not to exceed $250,000,000, to implement section 222. The Assistant Secretary is required to reimburse the general fund of the Treasury, without interest, for any amounts borrowed as funds are deposited into the State and Local Implementation Fund.

Summary: Sen Hutchison, K. B., & Sen Rockefeller, J. D. (2011). S. 911: The Public Safety Spectrum and Wireless Innovation Act of 2011. United States Senate, U.S. Senate Committee on Commerce, Science, and Transportation.

S. 911 establishes the "State and Local Implementation Gran Program" that is to be administered by the Assistant Secretary in consultation with the Corporation. The purpose of the grant program is to make grants to States to assist State, regional, tribal, and local jurisdictions to identify, plan, and implement the most efficient and effective way for such jurisdictions to utilize and integrate the infrastructure, equipment, and other architecture associated with the nationwide public safety interoperable broadband network to satisfy the wireless communications and data services needs of that jurisdiction, including with regards to coverage, siting, and other needs. The matching requirement for the grants is 80% of eligible costs but the Assistant Secretary can waive, in whole or in part, the requirements for good cause shown if the Assistant Secretary determines that such a waiver is in the public interest.

Six months after the establishment of the bylaws of the Corporation the Assistant Secretary, in consultation with the Corporation, shall establish requirements relating to the grant program, including (1) defining eligible cost; (2) determining the scope of eligible activities for grant funding; and (3) prioritizing grants for activities that ensure coverage in rural as well as urban areas. In carrying out the grant program, the Assistant Secretary shall require each State to certify in its application for grant funds that the State has designated a single officer or governmental body to serve as the coordinator of implementation of the grant funds.

VI. HOW WILL IT BE MANAGED

Alcatel-Lucent. (2010). Long Term Evolution (LTE) for Public Safety: Enabling Flexible Business Models. White Paper.

STATE AND LOCAL DEPLOYMENT OPTIONS

The following three deployment options each have positive and negative factors. For all options, it is important to understand the requirements, resources and risks.

- CAPEX model – All equipment and software is purchased, and ongoing support is provided through in-house personnel.
- Managed model – All equipment and software is purchased, but the ongoing support is either wholly provided by another party, or the support is shared by another party and in-house personnel.
- Hosted model – Network access is provided by another party and leased to a public safety entity for a monthly fee.

In the **CAPEX model**, the overall network is owned and managed by one or more public safety entities. These entities take full responsibility for purchasing all network elements and software, and they employ in-house personnel to build, manage, operate and maintain the network. Individual agencies may be able to remotely monitor network health.

Mission-critical networks are built with complete geographic redundancy to eliminate any single point of failure. This approach increases costs for core network equipment, beyond what is usually required for commercial networks. Initial upfront costs can be offset — and ongoing OPEX costs can be reduced — through government grants and incentives, along with any reallocated monthly per-subscriber fees (which may currently be paid to commercial broadband wireless service providers). The extent of upfront costs depends on: the scale of deployment (local or regional), whether the core network is shared among multiple areas or entities and how deployment is scheduled (gradually over years or within a shorter time period). With the CAPEX model, the public safety entity must also employ skilled personnel for network design, operations, maintenance, security and technical support, as well as program and project management. For a small deployment, these expenditures might not be economically viable.

The state and local public safety entity has full control over the network. A dedicated network in the 700 MHz band provides operational benefits, along with potential savings on margins imposed by service providers. With the proper know-how in place, a self-managed network can also offer an "a-la-carte" selection of applications and services customized to user needs in the target area, which could be local, county or another public sector. On the other hand, smaller networks would not benefit from the economies of scale a commercial operator might be able to realize. For example, commercial operators could gain efficiencies by leveraging their existing commercial resources to manage — and possibly build — the public safety network.

The CAPEX model can be a good option for local and state public safety entities that deploy their own network as long as they have "critical size." Critical size is determined by comparing the total allocated costs with the cost of an equivalent outsourced or managed service.

The managed model is a hybrid, combining elements of the CAPEX and hosted models. With the managed model, the public safety entity is responsible for ensuring that network elements are appropriately owned and deployed. But it contracts with another party to manage and/or operate the network. Leased lines connect the network to the Operations, Administration and Maintenance (OA&M) center. Individual agencies may be able to remotely monitor the health of the network.

Similar to the CAPEX model, this model requires each public safety entity to purchase all the equipment and software and contract for the required deployment services. Depending on the network architecture, these costs can vary significantly. Though in this model, cost savings are possible by contracting management functions with another party. For the highest Quality of Service (QoS), management services should go beyond traditional network monitoring and provide a performance management platform that proactively monitors for predetermined thresholds, along with preventive maintenance to ensure all network elements are running at peak efficiency. In doing so, the network is managed proactively to maintain network availability while ensuring a high degree of service uptime.

The **managed model** offers flexibility in terms of the management functions contracted. For example, a public safety entity could have another party provide end-to-end operational support, using a service-centric approach. This approach provides operational support from the core through the network to the end user. Contracting one party to provide full operational support eliminates finger pointing and the need to address multivendor management requirements.

The managed model provides a degree of control to each public safety entity. Network elements are deployed at a site chosen (and often owned) by the public safety entity. Owning

the assets allows each public safety entity to decide when to upgrade the network and implement its own security platform. By contracting with another party to provide management services, the public safety entity will have a predictable monthly fee with lower IT and administrative headcount. It will also require less investment in network management tools and training.

The **hosted model** allows each public safety entity to use network assets that are owned and managed by another party. These assets are usually shared among several similar types of customers with similar needs, creating economies of scale for both capital and operational expenses. While core infrastructure is shared, Radio Access Networks (RANs) are usually owned — and may be unique to — each individual public safety entity. The shared core provides the benefits of the platform while reducing startup costs and ongoing operations costs.

With a hosted model, the public safety entity pays a consistent, predictable periodic fee for network access. The fee is usually a function of some known factor, such as the number of end users, devices or usage. This model also eliminates the need to plan and allocate funding for network upgrades, maintenance contracts and ongoing training for operations. These expenses are all handled by the hosting provider, who is responsible for keeping the platform current, resolving all technical issues and ensuring the appropriate level of service.

A hosted model architecture, where a non-public safety entity is the host — thereby owning a portion of the core and handling OA&M activities. The hosted core may include all functions related to mobility control, bearer management, gateway selection and authentication, messaging center, device management center, subscriber databases and Quality of Service control. The public safety portion of the core consists primarily of gateways to provide external connectivity and IP addressing. Both fractional cores could be physically separate. This approach accommodates large implementations and can eventually serve multiple jurisdictions. Transport is split between public safety-owned backhaul — for example, within a given jurisdiction — and a third-party transport cloud that carries traffic (mainly signaling) toward the hosted core. Individual agencies may be able to remotely monitor the health of the network.

Summary: Sen Hutchison, K. B., & Sen Rockefeller, J. D. (2011). S. 911: The Public Safety Spectrum and Wireless Innovation Act of 2011. United States Senate, U.S. Senate Committee on Commerce, Science, and Transportation.

FEDERALLY CHARTERED INDEPENDENT NON-PROFIT CORPORATION

S. 911 assigns the license 20 MHz of spectrum to the independent Public Safety Broadband Corporation (PSBC). Term of license is 10 years. The Corporation can renew the license for 10 more years if the Corporation demonstrates that it met the duties and obligations set forth in the Act.

The Corporation will be incorporated in DC and will be subject to DC's Non-Profit Corporation Act (sec. 29–301.01 et seq., D.C. Official Code). The PSBC needs to have headquartered out of DC. Members of the initial BoD will need to incorporate the PSBC in DC. The Board will consist of:

- Non Federal Officials – Secretary of Commerce will appoint:
  - At least 3 individuals to represent the interest of the states, localities, tribes, and territories. The appointment needs to ensure geographic and regional representation and ensure rural and urban representation.
  - At least 3 individuals to represent the interests of public safety. The appointees must be individuals who have served or are currently serving as public safety professionals.
- 5 Other BoD comprised of experts in commercial cellular services, communications and network managers, financial managers, corporate leaders, and or additional state, local and public safety officials.
- Four Federal Officials
  - The Secretary of Commerce.
  - The Secretary of Homeland Security.
  - The Attorney General of the United States.
  - The Director of the Office of Management and Budget.

Each non-Federal candidate for the Board must be able to meet at least one of the following criteria:

- Expertise in public safety;
- Technical expertise regarding broadband communications, including public safety;
- Network expertise in building, deploying and operating commercial networks; and
- Financial expertise in funding and financing telecommunications networks.

The Secretary must appoint at least one individual satisfies each of the criteria listed above to serve on the Board of Directors.

Board members may not accept consulting or advisory or other compensatory fee from the Corporation. Board members may not be associated with the Corporation or any affiliated company. Non-Federal Board members also can not be officers or employees of the US Government or the District of Columbia and they must be a citizen of the United States to be a Board of Officer.

Term of Office - Federal members of the Board will serve as members of the Board for the life of life of the Corporation. Non-Federal members shall serve for 3 years. No non-Federal Board may serve more than 2 consecutive 3-year terms. Board serves until successor has taken office or the end of the calendar year in which the Board's term has expired, which ever is earlier. Term of the initial non-Federal Board members will be:

- 4 members serve for 3 years;
- 4 members serve for 2 years; and
- 3 members serve for 1 year.

Vacancies will be filled in the same manner as the original member was appointed.

Appointment of the Chair - The Secretary of Commerce will select the Chair of the Board from among the non-Federal Board. The Chair will serve for 2 years term. The Chair may not serve more than two consecutive terms.

Removal of non-Federal Board Members - The Secretary of Commerce can remove the Chair or any other non-Federal Board member for good cause. Non-Federal Board members may also be removed by a majority vote for conduct that is detrimental to the Corporation and a request from the Secretary of Commerce to remove the Chair Board to be determined by the Board to be detrimental to the Corporation.

Meetings – The meetings will scheduled in accordance with the bylaws of the Corporation but the Board is required to meet at least once a year and at the call of the Chairperson. The meetings of the Board, including any committee of the Board, shall be open to the public. The Board may, by majority vote, close any such meeting only for the time necessary to preserve the confidentiality of commercial or financial information that is privileged or confidential, to discuss personnel matters, or to discuss legal matters affecting the Corporation, including pending or potential litigation. Eight members of the Board shall constitute a quorum, including at least 6 non-Federal members of the Board. Attendance at the meetings can be in person, via telephone or videoconference.

Compensation – Members of the Board serve with without pay. Board members will be allowed to per diem allowance for travel expenses at rates authorized for an employee of an agency under subchapter I of chapter 57 of title 5, United States Code.

Corporation Staff – The Board shall appoint the CEO and other officers and employees. The Board will set the terms and rates of compensation for the CEO and other officers and employees. The CEO may appoint employees as necessary. All employees and officers serve at the pleasure of the Board. To serve as and officer of the Corporation, you must be a US citizen. No political test or qualification can be used in selecting, appointing, promoting or other personnel actions with respect to officers, agents or employees of the Corporation. The Federal Board members shall jointly approve the compensation, including benefit plans and salary ranges, for officers and employees of the Board. No officer or employee of the Corporation may receive any salary or other compensation from any sources other than the Corporation for services rendered during the period of employment. Service by any officer on boards of directors of other organizations, on committees of such boards, and in similar activities for such organizations shall be subject to annual advance approval by the Board. No officer or employee of the Board or of the Corporation shall be considered to be an officer or employee of the United States Government or of the government of the District of Columbia.

Advisory Committee – The Board is required to establish a standing public safety advisory committee. The Board can establish additional ad hoc committees, panels or councils as the Board determines necessary.

Non-profit and non-political requirements on the Corporation - The Corporation will not issue any stocks. No part of the income or assets of the Corporation shall inure to the benefit of any director, officer, employee, or any other individual associated with the Corporation, except as salary or reasonable compensation for services. The Corporation may not contribute to or otherwise support any political party or candidate for elective public office. The Corporation shall not engage in lobbying activities (as defined in section 3(7) of the Lobbying Disclosure Act of 1995 (5 U.S.C. 1602(7))).

POWERS AND AUTHORITY OF THE CORPORATION

To carry out its duties and responsibilities under the law, general powers include:

- Adopt and use a corporate seal.
- Have succession until the Corporation is dissolved by an Act of Congress.
- Regulate the way the Corporation conducts it general business.

- Exercise all powers specifically granted by the provisions of this subtitle, and such incidental powers as shall be necessary.
- Hold hearings, sit and act at such times and places, take such testimony, and receive such evidence as the Corporation considers necessary to carry out its responsibilities and duties.
- Obtain grants and funds from and make contracts with individuals, private companies, organizations, institutions, and Federal, State, regional, and local agencies.
- Accept, hold, administer, and utilize gifts, donations, and bequests of property, both real and personal, for the purposes of aiding or facilitating the work of the Corporation.
- Issue notes or bonds.
- Incur indebtedness.
- Spend funds in a manner authorized by the Board, but only for purposes that will advance or enhance public safety communications consistent with the Act.
- Establish a reserve fund.
- Expend reserve accounts.
- Take such other actions as the Corporation (through its Board) may from time to time determine necessary, appropriate, or advisable to accomplish the purposes set forth in the section.

Powers to deploy and operate a nationwide public safety interoperable broadband network include:

- Holding the license for the 20 MHz of spectrum.
- Take all actions necessary to necessary to ensure the building, deployment, and operation of a nationwide public safety interoperable broadband network in consultation with Federal, State, tribal, and local public safety entities, the Director of NIST, the Commission, and the public safety advisory committee. At a minimum the Corporation will
    - ensure nationwide standards for use and access of the network;
    - issue open, transparent, and competitive requests for proposals (RFP) to private sector entities for the purposes of building, operating, and maintaining the network;
    - encourage that such the RFPs leverage, to the maximum extent economically desirable, existing commercial wireless infrastructure to speed deployment of the network;
    - manage and oversee the implementation and execution of contracts or agreements with non-Federal entities to build, operate, and maintain the network.
- The Corporation shall ensure the safety, security, and resiliency of the network, including requirements for protecting and monitoring the network to protect against cyberattack;
- The Corporation will promote competition in the equipment market, including devices for public safety communications, by requiring that equipment for use on the network be:
    - built to open, non-proprietary, commercially available standards;
    - capable of being used by any public safety entity and by multiple vendors across all public safety broadband networks operating in the 700 MHz band; and
    - backward-compatible with existing second and third generation commercial networks to the extent that such capabilities are necessary and technically and economically reasonable.
- The Corporation will promote integration of the network with public safety answering points or their equivalent.
- The Corporation shall require deployment phases with substantial rural coverage milestones as part of each phase of the construction and deployment of the network. To the maximum extent economically desirable, such proposals shall include partnerships with existing commercial mobile providers to utilize cost-effective opportunities to speed deployment in rural areas.
- The Corporation can obtain grants from and make contracts with individuals, private companies, and Federal, State, regional, and local agencies to deploy and operate a nationwide public safety interoperable broadband network.
- The Corporation can hire or accept voluntary services of consultants, experts, advisory boards, and panels to deploy and operate a nationwide public safety interoperable broadband network.
- The Corporation can receive payment for use of the network capacity licensed to the Corporation; and network infrastructure constructed, owned, or operated by the Corporation; and take such other actions as may be necessary to accomplish the purposes set forth in this subsection.

Other duties and responsibilities of the Corporation include:

- Network Policy: Establishing the network policies by developing the RFPs with appropriate timetables for construction, coverage areas, service levels, performance criteria, and other similar in the construction of such networks; the technical and operational requirements for the network; the practices, procedures, and standards for the management and operation of such network; the terms of service for the use of the network; the ongoing compliance review and monitoring of the management, operation, use and training of network operators and users.
- Existing Infrastructure: The Corporation has the authority to enter into agreements to utilize, to the maximum extent economically desirable, existing commercial or other communications infrastructure; and Federal, State, tribal, or local infrastructure.

- Maintenance and Operation of the Network: The Corporation shall ensure the maintenance, operation, and improvement of the nationwide public safety interoperable broadband network.
- Roaming on Commercial Networks - The Corporation shall negotiate and enter into, as it determines appropriate, roaming agreements with commercial network providers to allow the nationwide public safety interoperable broadband network to roam onto commercial networks and gain prioritization of public safety communications over such networks in times of an emergency.
- Network Infrastructure and Device - The Director of NIST, in consultation with the Corporation and the Commission, shall ensure the development of a list of certified devices and components meeting appropriate protocols and standards for public safety entities and commercial vendors to adhere to, if such entities or vendors seek to have access to, use of, or compatibility with the nationwide public safety interoperable broadband network.
- Standards Setting - The Director of NIST, in consultation with the Corporation, the Commission, and the public safety advisory committee, shall represent the interests of public safety users of the nationwide public safety interoperable broadband network before any proceeding, negotiation, or other matter in which a standards organization, standards body, standards development organization, or any other recognized standards-setting entity regarding the development of standards relating to interoperability.
- Foreign Governments - The Corporation shall not have the authority to negotiate or enter into any agreements with a foreign government on behalf of the United States.
- U.S. Mail - The Corporation may use the United States mails in the same manner and under the same conditions as the departments and agencies of the United States.

CONSULTATION WITH STATE AND LOCAL GOVERNMENTS

In the development of RFPs and carrying out the duties and responsibilities established under the Act, the Corporation shall consult with regional, State, tribal, and local jurisdictions regarding the distribution and expenditure of any amounts required to carry out the policies established above, including: construction of an Evolved Packet Core and any Radio Access Network build out; placement of towers; coverage areas of the network, adequacy of hardening, security, reliability, and resiliency requirements; assignment of priority to local users; assignment of priority and selection of entities seeking access to or use of the nationwide public safety interoperable broadband network; and training needs of local users. The consultation shall occur between the Corporation and the single officer or governmental body designated by each State to certify in its application for grant funds.

S. 911 authorizes the Corporation to collect fees for network use, lease of network capacity, and lease of network equipment and infrastructure.

- Network User Fee – The Corporation is authorized to collect a user or subscription fee from each entity, including any public safety entity or secondary user, that seeks access to or use of the nationwide public safety interoperable broadband network.
- Network Capacity Lease Fee – The Corporation is authorized to collect a fee from any entity that seeks to enter into a covered leasing agreement. The secondary user may access to network capacity on a secondary basis for non-public safety services; and the spectrum allocated to such entity to be used for commercial transmissions along the dark fiber of the long-haul network of such entity.
- Network Equipment and Infrastructure Lease Fee – The Corporation is authorized to collect a fee from any entity that seeks access to or use of any equipment or infrastructure, including antennas or towers, constructed or otherwise owned by the Corporation.
- Fee Amount - The total amount of the fees assessed for each fiscal year shall be sufficient, and shall not exceed the amount necessary, to recoup the total expenses of the Corporation in carrying out its duties and responsibilities of the Corporation for the fiscal year involved.
- Reinvestment of Funds - The Corporation shall reinvest amounts received from the assessment of fees in the nationwide public safety interoperable broadband network by using such funds only for constructing, maintaining, or improving the network.

S. 911 also requires the Comptroller General of the United

The Public Safety Alliance has requested that S. 911 be amended to require "coordination" with state and local government instead of "consultation". The PSA believes that agency coordination across jurisdictions (local, tribal, state, and federal) and close oversight of construction, operation, and funding are essential to building out the broadband network, which is why the PSA supports language in S. 911 that establishes the governance structure of a new independent nonprofit Corporation. The PSA strongly believes, however, that public safety must hold majority representation on the Board of Directors of the new Corporation. This framework must ensure there is a requirement for state and local coordination with the new Corporation but this coordination requirement must not impede the build out of the network. The governance of the new Corporation must be transparent and held accountable to build out the nationwide network and ensure interoperability. Chief Jeff Johnson, Answers to Questions for the Record for House Energy and Commerce Subcommittee on Communications and Technology Hearing titled "Creating an Interoperable Public Safety Network."

States to conduct annual audits of the Corporation. The audit report is required to be submitted to appropriate committees of Congress; the President; and the Corporation.

The Corporation is required to submit and annual report to the appropriate committees of Congress. The report is required to include a comprehensive and detailed report of the operations, activities, financial condition, and accomplishments of the Corporation; and such recommendations or proposals for legislative or administrative action as the Corporation deems appropriate. The directors, officers, employees, and agents of the Corporation shall be available to testify before the appropriate committees of the Congress with respect to the report; the report of any audit made by the Comptroller General; or any other matter that such committees may determine appropriate.

S. 911 authorizes the Commission to adopt rules, if necessary in the public interest, to improve the ability of public safety networks to roam onto commercial networks and to gain priority access to commercial networks in an emergency if the public safety entity equipment is technically compatible with the commercial network; the commercial network is reasonably compensated; and such access does not preempt or otherwise terminate or degrade all existing voice conversations or data sessions.

S. 911 Prohibits the Corporation from offering commercial telecommunications services to directly to consumers. The section however does not prohibit the Corporation and a secondary user from entering into a covered leasing agreement. The Corporation is not limited from collecting lease fees related to network equipment and infrastructure.

VII. COST-BENEFIT ANALYSIS OF ALLOCATION

Excerpt: Ford, G. S., & Spiwak, L. J. (2011, March). Public Safety or Commercial Use? A Cost/Benefit Framework for the D Block. PHOENIX CENTER POLICY BULLETIN (26).

Preliminary analysis suggests that the 10 MHz D Block plausibly provides at least $3.4 billion more in social benefits if assigned to public safety rather than to commercial use. The lost auction revenue, we observe that the loss of auction revenues today is more than offset by the gain of higher auction revenues and lower public safety network deployment cost in the future. Thus, an auction of the D Block adds, rather than relieves, stress to the public budget.

Perhaps the most daunting, yet relevant, question regards the social benefits of "public safety." Such benefits are real but difficult to quantify and, absent immediate crisis, prone to be undervalued. If we faced another event like 9-11 or Hurricane Katrina, we believe the 20 MHz would be allocated to public safety immediately and the network fully funded in a week's time. Fortunately, we are not presently victims of such a crisis and, though the lack of crisis makes the spectrum allocation decision a more difficult one, this is a burden we welcome. For the moment, we choose to set aside the quantification of the benefits of an additional 10 MHz of spectrum for public safety, looking instead at the cost side of equation.

Spectrum is not homogeneous. Not only is the 700 MHz spectrum highly valuable because its technical properties are well-suited for mobile communications, including broadband Internet services, but for the public safety community the D Block has added value because it is contiguous to the PSB, which is already allocated to the public safety community. A contiguous block of 20 MHz of spectrum is substantially more valuable than 20 MHz of nonadjacent spectrum. As noted above, a 10 MHz block of contiguous spectrum in the 700 MHz band is worth about $2 to $6 billion more than a non-contiguous block of the same size.

While this value differential is estimated based on commercial use, much of this premium is based on the lower cost of deploying network for contiguous spectrum, which would likewise apply to public safety. Evidence suggests that the cost of the public safety network using 20 MHz of spectrum is probably about $10 billion. Andrew Seybold, a highly regarded wireless industry expert, suggests that expanding a 10 MHz public safety network to 20 MHz adds about 15% to 25% to network deployment costs. By this standard, the incremental cost of the additional 10 MHz is about $1.5 to $2.5 billion. Alternately, adding a non-contiguous block of 10 MHz of spectrum to the public safety network would cost about $5 to $7.5 billion in deployment costs. Assignment of the D Block to public safety, therefore, is likely to reduce the cost of the public safety network by around $4 billion in network deployment costs alone. Operational costs are likely to be lower as well, perhaps adding billions more to the savings. Moreover, the cost to deploy the 700 MHz band is much lower than other bands (some estimates are 70% lower than other bands). Thus, depending on what additional spectrum is provided to the public safety community if they do not receive the current 10 MHz block, the ultimate deployment costs could be substantially higher (though this differential may also apply to the commercial licensee). We leave a more sophisticated assessment of such costs to others, and assume here that the cost difference is $4 billion.

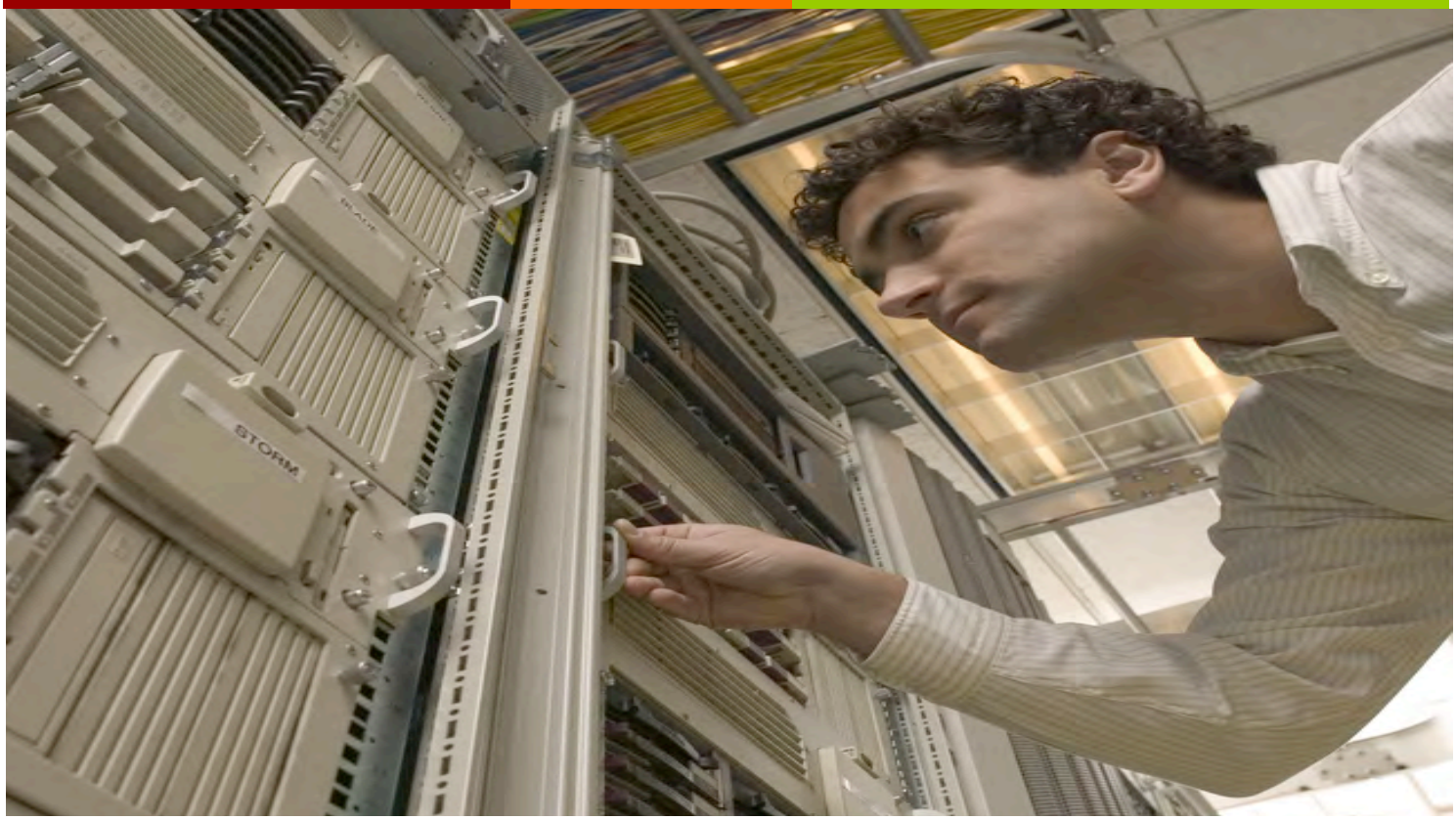
While we have not addressed the benefits of public safety's use of the additional 10 MHz of spectrum, which could be quite large, we can see that the contiguous spectrum premium of $4 billion is itself sufficient to offset the value of commercial assignment of an additional 10 MHz ($0.6 billion).

Even if the 10 MHz provided zero benefit in terms of enhanced public safety, then assignment of the D Block to public safety produces $3.4 billion in additional social value over and above the commercial value of the same block.

Notably, much of this value spread arises from the unique opportunity to create significant value by allocating a contiguous block of spectrum to public safety, and then doing so in the future for commercial use. This value is foregone by commercial allocation of the D Block today. While some may contest our estimates, it is necessary to account for the economic value arising from contiguous spectrum.

VIII. JOB CREATION (100,000 NEW JOBS)

Excerpt: Shapiro, Robert J. and Aparna Mathur. "The Contributions of Information and Communication Technologies To American Growth, Productivity, Jobs and Prosperity." September 2011. Telecommunications



The $10 billion proposal to fund the development and initial deployment of a nationwide wireless broadband data and communications network for public safety agencies would lead to the creation of an estimated 100,000 new jobs in Information and Communication Technologies (ICT) industries and, over time, produce indirect or spillover benefits of an estimated $4 billion to $8 billion per year.

Based on the current use of labor and capital by ICT companies and prevailing wages, nearly $8 billion of the initial funding would go to salaries, sufficient to produce some 74,000 new ICT jobs with average compensation of $107,229 per-worker. In addition, the remaining, nearly $3 billion in new capital investments would support some 20,000 additional jobs.

Analysts calculate that the new network and its technologies could increase the productivity of police and fire agencies by at last 1 percentage point per year, producing direct efficiency savings of nearly $2 billion per year. The indirect benefits from a nationwide public safety network could total another $2 billion to $6 billion per-year.

IX. WHY PUBLIC SAFETY NEEDS MORE THAN 10 MHZ

Excerpt: Rysavy, Peter. "Public Safety Spectrum." July 2011.

While commercial operators can design their networks for typical densities of mobile users, emergency situations can result in needing to support extremely high densities of public safety workers. For this reason alone, the public-safety network has to have as high a capacity as possible. The network must have at least 20 MHz of spectrum. Anything less could lead to catastrophic consequences due to applications performing unreliably or failing completely.

The consequence of insufficient spectrum is restricted capacity, which combined with high demand, causes network congestion. For applications, this means sluggish behavior or outright failures.

Consequences of such congestion are not just slower performance but also application failures. Most communications protocols implement timeouts on their operations, including Transmission Control Protocol (TCP) itself, the packet-transport protocol used in the Internet to provide reliable end-to-end delivery. With large delays or dropped packets, communications protocols attempt to deliver data reliably, but at some level of congestion, they can no longer cope properly, and applications will either indicate a failure, or worse yet, require an application or full-system restart.

Beyond needing 20 MHz just to satisfy bandwidth requirements, there are compelling reasons for providing Public Safety 20 MHz of contiguous spectrum.

- LTE is spectrally more efficient operating in 20 MHz channels than 10 MHz channels. In other words, the network can deliver more bits per second using a 10 MHz radio channel (10 MHz down, 10 MHz up) than in two 5 MHz radio channels.
- Using non-contiguous radio channels will significantly increase the cost of the radio access network due to the need for additional radios and antennas.
- Adding spectrum later in a non-contiguous manner will result in devices in the field likely not being able to take advantage of the new spectrum.

X. WHAT HAPPENS IF D BLOCK IS NOT ALLOCATED

Excerpt: Ford, G. S., & Spiwak, L. J. (May 2011). Re-Auction of the D Block: A Review of the Arguments. PHOENIX CENTER FOR ADVANCED LEGAL & ECONOMIC PUBLIC POLICY STUDIES.Industry Association. SONECOM.

Many proponents of a D Block re-auction focus exclusively on the potential auction revenues from the block. Others appear to believe the auction will somehow fund the entire (or at least a good chunk of the) public safety network. In these tough financial times, it is difficult to criticize anyone looking for revenues or cost savings. However, it is essential to consider the full financial effects of the allocation options, not simply those implications favoring one option or another.

First, the claimed $3 billion in revenue from a D Block re-auction is too rosy an expectation. Statistical analysis of historical auctions indicates that a 10 MHz block of spectrum in the 700 MHz band must be unencumbered to produce $3 billion in revenues. Yet, the FCC's National Broadband Plan envisions a number of significant encumbrances on any reauction of the D Block which have substantially reduced auction revenues in the past. (In 2008, the D Block failed to secure a minimum bid at auction of $1.3 billion due to onerous encumbrances, creating the stalemate among lawmakers and policymakers we are faced with today over this block of spectrum.)

Re-auction of the D Block will increase government spending on the public safety network and reduce future auction revenues by far more than the re-auction may generate in revenues.

Second, the re-auction of the D Block will under no circumstances come close to fully funding a public safety network. A nationwide public safety network is expected to cost about $10 to $13 billion. Even if a re-auction of the D Block did bring in $3 billion of revenues, it offsets only about one quarter of the public safety network's cost. The D Block re-auction offers no other mechanism by which to generate funds for the remaining network construction and operating costs.

Finally, we discuss the potential broader adverse market effects of a D Block re-auction. The evidence indicates that the public safety community needs a full 20 MHz of spectrum. If the D Block is assigned to commercial use, then an additional 10 MHz for public safety must be obtained from either future spectrum assignments or the capacity-equivalent thereof obtained via burdensome public safety

encumbrances on commercial spectrum. This alternate block of spectrum will not be contiguous to the Public Safety Broadband ("PSB") Block, which has the effect of increasing the deployment cost of the public safety network by an estimated $4 billion relative to the D Block assignment.

A commercial assignment of the D Block also has the potential of frustrating the creation of contiguous blocks of spectrum for future auctions, thereby substantially reducing auction revenues. Moreover, filling the public safety spectrum shortage with public safety obligations on all commercial providers could substantially reduce future auction revenues.

Based on an econometric analysis of the more recent spectrum auctions in the United States, if the FCC auctioned the D Block on a truly unencumbered basis, then we could expect the auction to generate revenues in the range $1.3 to $3.3 billion. However, the re-auction of the D Block is not unencumbered. The Commission has made clear that it intends to impose costly requirements on any re-auction of the D Block.

While the agency hopes for a "voluntary" public-private partnership, it nevertheless hedges, advancing a set of rules by which the D Block will be auctioned. These rules include the following:

- D Block licensee(s) must use a nationally standardized air interface [to] ensure that the D block will be technically capable of supporting roaming and priority access by public safety users of the neighboring public safety broadband block;
- D Block licensee(s) are required to provide such roaming and priority access to public safety users;
- D Block licensee(s) must develop and offer devices that operate both on the D Block and the neighboring public safety broadband block; and
- D Block licensee(s) should be subject to commercially reasonable build out requirements.

A network suitable for public safety also requires both higher technical standards and a larger footprint than does a strictly commercial network. And, logically, with such increased requirements comes higher network deployment costs, and, in turn, with higher deployment costs comes a lower auction value for the spectrum.

Former FCC Chairman Reed Hundt, who was serving as the President of potential D Block bidder Frontline Communications, conceded "the costs necessary to reach only a few additional users would entail a vastly disproportionate additional cost." Likewise, Verizon testified that the build out requirements were too "costly" and Qualcomm testified that the build out requirements were "too onerous", going so far as to note that these requirements were "far more expensive than any of the current [commercial] networks."
The new D Block licensee would be required to take on cost-increasing mandates including: (1) the use of a Commission-selected air interface; (2) the mandate to develop and offer devices that operate both on the D Block and the PSB Block; and (3) the requirement to build out the network on the agency's timetable. All of these requirements could increase deployment costs, thereby reducing the auction value of the D Block.
Public safety obligations of the first auction attempt reduced the value of the spectrum by 86% and, as discussed above, the FCC's reauction plan embraces similar encumbrances.

A reauction of the D Block could produce less than $1 billion in revenue and is unlikely to exceed $2 billion in the best plausible scenario.

XI. CONCLUSION

Allocating the D Block to public safety for the build-out of a nationwide, interoperable and mission critical-grade public safety broadband network will fundamentally alter the way first, second and situational responders plan, respond and react to disasters of all proportions. For the first time in decades, it will put leading edge technology into the hands of those individuals who are called on every day to put their lives on the line for the safety and security of the American public.

This paradigm shift has not gone unnoticed in the minds of scholars, public safety professionals, legislators, corporations specializing in public safety communications products and services, who have all written prodigiously on this subject. This report is comprised of selected sections of these manuscripts. Our belief is that the passages will help highlight key points in order to give the reader a granular, and ultimately more comprehensive understanding of the issue at hand. In order to give context to the selected passages, each of the papers are reproduced in their entirety, which can be found in the appendix of this binder. A number of other supporting materials not highlighted in this packet which speak to the need for additional spectrum for the public safety community can also be found in the appendix.

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APPENDIX

Go to www.psafirst.org to download the full document and appendices.

Appendix A – Studies

Appendix B – Letters of Support

Appendix C – Public Safety Spectrum Holdings

Appendix D – FCC Filings

Appendix E – Bill Language

Appendix F – Commentary and Policy Statements

Appendix G – Testimony

Appendix H – Public Safety Statistics

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