Public Technology Institute

700 MHz “D” Block: Public Safety Application Needs Assessment

White Paper January 2010

Commissioned by

PSFA

Public Safety Foundation of America

700 MHz "D" Block

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Preface

In November 2009, the Public Technology Institute (PTI) was commissioned by the Public Safety Foundation of America to develop a briefing paper on critical application needs for public safety pertaining to the "D" block of the 700 MHz spectrum. PTI, a 501 (c) 3 nonprofit organization has been serving the technology needs of local governments for over 37 years and is one of the most respected organizations of its kind.

Special Thanks

PTI is indebted to Dr. Andrew Afflerbach, Ph.D., P.E., who is one of the most recognized engineers in the country when it comes to public safety system engineering. Dr. Afflerbach serves as the Director of Engineering for Columbia Telecommunications Corporation (CTC) and was most generous in sharing data from a recent CTC Report titled ***An Engineering Assessment of Select Technical Issues Raised in the Re-location of the D Block Spectrum*****,** which he authored, submitted in June 2008, prepared for the National Association of Telecommunication Officers & Advisors, National League of Cities, National Association of Counties, and the U.S. Conference of Mayors.

Also contributing to this paper is the City of Houston, the City of Phoenix and the endorsement of PTI's Public Safety Council.

About the Author

This paper was prepared and coordinated by Dr. Alan R. Shark, who serves as PTI's executive director. Dr. Shark was previously the CEO of the American Mobile Telecommunications Association (AMTA) for over 13 years and during his tenure served on the board of the Land Mobile Communications Council (LMCC). Dr. Shark is a fellow of the Radio Club of America and is a fellow of the National Academy of Public Administration. Dr. Shark is also on the faculty of Rutgers University for Public Affairs and Administration where he serves as an Assistant Professor.

About PTI

Public Technology Institute (PTI) is a national, not-for-profit member-supported organization based in Washington, D.C.

As the only technology organization created by and for cities and counties, PTI works with a core network of leading local government officials—the PTI membership—to identify opportunities for technology research, to share solutions and recognize member achievements, and to develop best practices that address the technology management, governance, and policy issues that impact local government.

Officials from PTI member governments participate in Councils and Forums that address specific technology areas. Through partnerships with industry, federal agencies and other governmental organizations, PTI shares the results of its activities and the expertise of its members with the broader audience of the more than 30,000 U.S. cities and counties.

About PSFA

The PSFA, a 501(c)(3) charitable organization, was established in January 2002 by the Association of Public-Safety Communications Officials International (APCO). The mission of PSFA is to engender cooperation among public and private groups to provide financial and technical support to the public safety communications community.

Funding for the PSFA has been provided by a variety of sources, including donations from corporations, APCO members and staff and the Wireless E-911: PSAP Readiness Fund, a non-profit organization established by Nextel Communications and dedicated to supporting the timely implementation of wireless E-911.

Executive Summary

When and how the 700 MHz D Block is ultimately allocated 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. When compared to the 4.9 GHz public safety frequency allocation, the 700 MHZ band is far superior to that of the 4.9 GHz band because of the line-of-sight requirements and dramatically greater call density needs.

Public safety must not only plan for existing applications, it must also plan for the unanticipated crisis. Public safety has been plagued until now with inefficiencies of interoperable network operations, lack of quality and efficient broadband spectrum, and a lack of equipment, due largely to the uncertainties of the marketplace.

Public-safety-grade service demands special requirements that simply cannot be found in commercial systems. Commercial providers do not offer hardened network operations centers or hardened towers/repeaters, power surge capabilities, or quality-of-service outside of major Interstates and other high-density population centers.

This can be summed up with six factors as to why commercial grade networks are inadequate for public safety needs.

1. Coverage: Commercial networks are designed to be where the customers are, not necessarily where emergencies will occur. Not only are large land areas left un-served, but commercial systems are vulnerable to “dead zones” within service areas (e.g., inside buildings, in gaps between cell sites, areas blocked by terrain)

2. Reliability: Commercial networks generally lack the same degree of redundancy, power backups, hardened sites, and other controls necessary to limit outage times and the impact of outages.

3. Service restoration: A public-safety-controlled network will restore service much faster than a network controlled by a third party. The end user is not beholden to the network provider; it’s the other way around.

4. Capacity control: especially important during emergencies. Without absolute priority and control, critical communication could be sidelined by commercial service demands. With recent advances in commercial priority management, the system is still under the operational control of the commercial provider, and the technologies have as yet to be proven in times of an emergency.

5. Security: less of an issue than in the past, because of encryption, but still a concern as commercial systems are open to system-wide cyber attacks from its massive customer base.

6. Control: users of commercial networks have no say in future network upgrades, software changes, network management, etc, all of which have an impact on the service quality and cost.

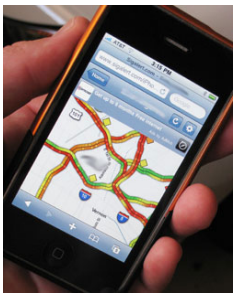
This Assessment highlights 13 out of over 25 distinct applications aimed to demonstrate the need for a larger universal broadband spectrum designated for public safety. A review of these applications should make it clear that these applications are not only real and necessary – they are bandwidth-intensive. According to what is referred to as Cooper's Law, "every 30 months the amount of information that can be transmitted over a given amount of radio spectrum doubles." (Marty Cooper, inventor of the hand-held cellular telephone).

This document also demonstrates rather conclusively that the 700 MHz D-Block and Public Safety Broadband License (PSBL) should be combined as a complete block, because of the mission-critical requirements and applications that have been highlighted.

Finally, this assessment briefly addresses the benefits to the public by way of improved safety and crime prevention, as well as more cost-saving efficiencies. It addresses the ability to better fight crime and terrorism, and the benefit of D block spectrum to the economy, as well as protecting our society against unknown threats.

Section One – Defining Application Needs Today

Critical Broadband Applications for Public Safety



The evolution of wireless communications continues at a maddening 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 significance to the public safety universe is enormous, as often the first to a scene, be it a natural disaster, a car accident, a fire, or crime incident is the public. They are sending or downloading (or attempting to) photos and videos, and often as not, public safety systems are unable to fully take advantage of this new technology. However, as capable as some of these consumer devices are, there have been rising complaints regarding dropped calls, serious delays in text messages, and other network slowdowns caused by overtaxed or underbuilt networks in many key locations.

Consumer systems are quite different from public safety systems in that they are more market-oriented, whereas the public seems willing to accept inconsistent services in return for new and "cool" devices. In times of emergency, consumer devices become overwhelmed, and entire systems have been known to crash. Power outages also present a tremendous liability - consumer networks lack the adequate power back-ups that they may have once enjoyed with landline systems. Furthermore, the devices are not built to withstand the demanding public safety requirements, and thus the general public is fortunate to have a device lasting more than two years.

CIOs, CTOs, and public safety technologists were asked to articulate the many public safety applications that are either being deployed today or are being contemplated for the very near future. Of all the applications listed, everyone agreed that the Public Safety Broadband Spectrum (10 MHz) combined with the D-Block Spectrum (10 MHz) offers the most logical and necessary home for these new applications. The three reasons most often cited are:

1. 700 MHz has exceptionally good propagation characteristics when compared to alternative frequency bands.

2. The combined public safety broadband spectrum and the “D” block contain the desired bandwidth for important applications, especially video-related.

3. The size of the full block makes multi-usage systems possible and provides great economy of scale.

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 spectrum block, with appropriate rules and standards. Current systems that may operate on 700 MHz, 800 MHz, general pool, 800 MHz vacated spectrum, and NPSPAC are subject to a hodge-podge of situational-specific FCC rules, which make it very unlikely to be able to operate as a unified network.

Mobile Crime Scene Units

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.

Mobile Incident Command Centers

When natural disasters, major structural fires, hazmat incidents, hostage situations, or terrorism incidents strike, a mobile command center is required to coordinate and establish a mobile command system. The command center 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), incident ID authentication.

Automated License Plate Readers

This relatively new 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

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 and graphical display

Streaming video and graphic display requires its own category, as either separate or combined they 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.

Mobile Geospatial information systems

Leading city, county, and state agencies are increasingly relying on 3D geographical 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.

Wireless Video Surveillance

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

Multi-Modal Biometrics Monitoring Devices

Major cities and counties are looking to purchase multi-mode biometrics monitoring devices that are either fixed or mobile. Fixed units are designed to be deployed in or around major transportation hubs as well as in high-risk government buildings and structures, and landmarks. Mobile units are designed to be deployed at planned incidents such as parades, festivals, etc, and to warn of potential threat. Mobile units may also be deployed when an incident may be about to occur or has already occurred, and precise measurements are needed to ascertain site safety for first responders and the general public.

Fire Electronic Command Boards

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.

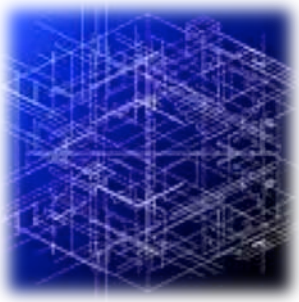
Emergency Medical Services AVL and Telemetry

Cities and counties have turned to AVL and telemetry systems to better coordinate their dispatch of first-responder units through improved tracking and system status management. ALS and BLS 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.

Facial Recognition/Video Analytics

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. Video analytics scans for visual anomalies, thus helping to track, guard, and monitor buildings, sites and events for suspicious behavior.

Floor plans, drawings, 3D graphical displays



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.

Patient tracking & video information systems

Emergency services and hospital and clinic facilities can benefit from deploying wireless systems that track patients at every stage of admittance, where staff can also view not only the tracking but also have the ability to access what procedures, meds, and other medical record information has been prescribed. As importantly, there is a critical need for incident commanders to track resources functioning at a common incident at any given instant.

Section Two: Efficiencies of 20 MHZ

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 spectrum block, with appropriate rules and standards. Current systems that may operate on 700 MHz, 800 MHz, general pool, 800 MHz vacated spectrum, and NPSPAC are subject to a hodge-podge of situationally-specific FCC rules, which make it very unlikely to be able to operate as a unified network.

Of all the applications listed, there is overwhelming consensus among the public safety community the combination of “D” block and the public safety broadband block offers the most logical and necessary home for these new applications. The three reasons most often cited are:

1. 700 MHz has exceptionally good propagation characteristics when compared to alternative frequency bands.

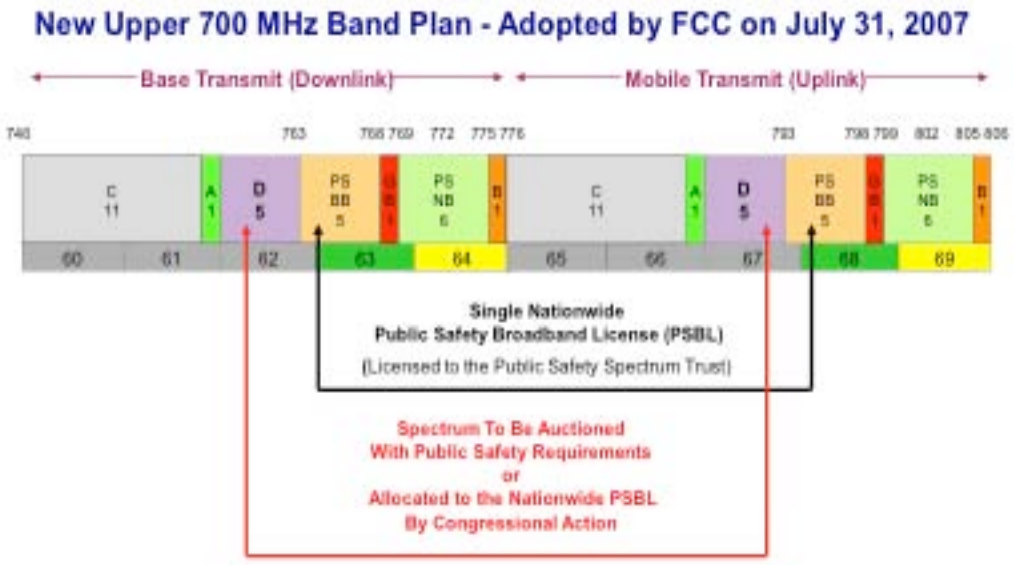
2. The additional “D” block will allow for the desired bandwidth to carry bandwidth intensive applications, especially video-related,

3. The additional “D” block will provide the capacity necessary during worst-case scenarios as an alternative to a more costly infrastructure.

With advances in technology, especially device processing power, and the need for quick reaction by emergency personnel near-total situational awareness at the resource unit level will be paramount. This is possible today through the utilization of cost-effective wireless technologies which make use of smart radio resources sharing techniques with appropriate quality of service (i.e. for user experience and priority mechanisms) and the right amount of spectrum. As demonstrated by a recent filing by New York City agencies to the FCC, given the kind of applications envisaged in the near to medium term and the number of first responders that are likely to intervene in a major event, the amount of broadband spectrum currently allocated to public safety will be insufficient to meet the needs of responders. In particular, the authors of the NYC Report note “It is clear from our analysis that in scenarios where 20 MHz of spectrum is available to public safety the system will be “stressed” during periods where important characteristics of a network need to exist above and beyond what is available commercially”.

Furthermore, while not reflected in the previous section on foreseen applications, it is becoming apparent that in the years to come there may be a desire to provide more spectrally-efficient voice services either as an alternative to current LMR or as a backup to the latter; more so if there is a desire by first responders to carry a single single-mode (rather than multi-mode) device. As reflected in the NYC analysis, the provision of such voice services would stress a broadband system further unless additional bandwidth is available.

The size of the full block makes multi-usage systems possible and provides great economy of scale. Given some the frustrations stemming from significant delays in broadcast migration and a failed auction for the D Block, some have concluded that new methods should be devised to allocate spectrum. However, based on numerous reviews of public safety communications planning, a single block is not only economically necessary, it is required for sound spectrum management implementation.



PTI, as well as most authoritative experts in spectrum management, believes that keeping the D Block and the public safety broadband block together is advisable from a technical standpoint. That spectrum combination should enable a more efficient use of spectrum and other technical resources.

The following is taken verbatim, with permission, from ***An Engineering Assessment of Select Technical Issues Raised in the Re-location of the D Block Spectrum*** authored by Dr. Andrew Afflerbach, Ph.D. P.E., of Columbia Telecommunications Corporation (CTC) submitted in June 2008, prepared for the National Association of Telecommunication Officers & Advisors, National League of Cities, National Association of Counties, and the U.S. Conference of Mayors. In this engineering assessment, Dr. Afflerbach states several reasons why this is a technical benefit to keep the D Block intact:

a. It's a significant advantage to *commercial* D Block customers—they will be receiving services from a public-safety-grade network that is clearly superior to other commercial networks, because it was designed to meet first-responder needs.

b. Operating a single network in the spectrum will enable a greater body of users to benefit from the antennas, radios, towers, and backhaul systems that will need to be

built. If there were separate commercial and public safety networks in the 22 MHz of spectrum, the infrastructure would cost twice as much to operate. Efficiency arises from the sharing, by commercial and public safety networks, of a single platform with a single set of antenna structures, base stations, backhaul, management systems, and RF designers.

If a service provider must build a new network to activate a separate channel band, the cost of the activation may be millions or tens of millions of dollars in a single metropolitan area. Carrier broadband wireless architectures may require base stations every 1.5 kilometers. Individual base station costs vary widely, depending on environment and the needs of a particular area, but are on the order of magnitude of $100,000, plus ongoing lease fees. Backhaul costs are significant, with $50,000 to $150,000 required to build a mile of fiber optic cable, or thousands or tens of thousands of dollars per month required to lease comparable capacity from a service provider.

c. A joint build-out will result in less impact to the public rights-of-way, because fewer towers, antennas, microwave infrastructure, and/or fiber infrastructure would need to be constructed.

d. Larger spectrum blocks enable operation with large channel bandwidths and high power—making it possible for devices to attain a given speed with fewer towers, each serving a larger area. This type of operation is particularly suitable for blanketing a larger geographic area, as would be necessary to cover rural areas.

e. Larger blocks of spectrum increase the flexibility for serving areas near international borders. King County, WA, for example, has noted the extreme difficulty of operating a wireless network in a major U.S. metropolitan area (Seattle) that adjoins a major Canadian metropolitan area (Vancouver)—and in which each of these networks must share spectrum with the other.

f. If, instead, two adjacent, non-coordinated networks operate in the aggregate 22 MHz, the spectrum allocation will require a guard band between the two allocations, which are currently not separated by a guard band, on the assumption that the two blocks will be operated as a whole. Adding a guard band will entail decreasing the allocation of spectrum to the D Block. A greater loss of spectrum use will result, because of the need for guard bands and mitigation of RF interference among the many individual providers/bands.

Section Three: The Value to Public Safety and the Citizens Served

This assessment would not be complete without mentioning the benefits to the public by way of improved safety and crime prevention, as well as more cost-saving efficiencies. In light of the Oklahoma City bombing and the World Trade Center disasters the public is demanding better protection and security everywhere. During the past several years the public safety communities have rallied together and have responded to citizen needs in no less than three ways.

1. First, the public safety community has deployed new video surveillance systems, bio-monitoring devices, and improved communications systems aimed at not only improving internal communications but to address citizen needs for information in a direct and timely manner.

2. Second, many of the applications mentioned in this assessment address the need for greater speed in responding to disasters – be it man-made or natural.

3. Third, a majority of the applications highlighted are designed to actually save both lives and monies. Wireless applications can reduce the need for more personnel and improve upon efficiencies of scale through shared networks, realizing efficiencies through more intelligent deployments and improved field operations.

While all these efficiencies and benefits are being realized, the public safety community remains committed to retaining the good will they enjoy through continued vigilance in adopting new technologies that protect our citizens against known and unknown threats.

Additional Resources

- An Engineering Assessment of Select Technical Issues Raised in the Re-auction of the D Block Spectrum Prepared for National Association of Telecommunications Officers and Advisors National League of Cities National Association of Counties U.S. Conference of Mayors, Prepared by Andrew Afflerbach, Ph.D., P.E. Director of Engineering (June 2008) (http://www.broadband.gov/docs/ws_pshs/pshs_afflerbach_report.pdf)
- Comments of the City of New York in the Matter of Additional Comment Sought on Public Safety, Homeland Security, and Cybersecurity Elements of National Broadband Plan, FCC's NBP Public Notice # 8. (http://fjallfoss.fcc.gov/ecfs2/document/view?id=7020348894)
- Federal Strategic Spectrum Plan (March 2008) (http://www.ntia.doc.gov/reports/2008/FederalStrategicSpectrumPlan2008.pdf)

Source Material in FCC Dockets

- APCO Comments in response to NBP Public Notice #14 (12/1/09), FCC GN Docket Nos. 09-47, 09-51 and 09-137
- NENA Comments in response to NBP Public Notice #14 (12/1/09), FCC GN Docket Nos. 09-47, 09-51 and 09-137
- Public Safety Spectrum Trust Comments in response to NBP Public Notice #14 (12/1/09), FCC GN Docket Nos. 09-47, 09-51 and 09-137
- City of New York Comments in response to NBP Public Notice #8 (11/17/09), FCC GN Docket Nos. 09-47, 09-51 and 09-137
- Alcatel-Lucent Comment in PS Docket 06-229 (11/17/09)
- Qualcomm Comments in response to NBP Public Notice #8 (11/12/09), FCC GN Docket Nos. 09-47, 09-51 and 09-137
- NENA Comments in response to NBP Public Notice #8 (11/12/09), FCC GN Docket Nos. 09-47, 09-51 and 09-137
- Motorola Comments in response to NBP Public Notice #8 (11/12/09), FCC GN Docket Nos. 09-47, 09-51 and 09-137
- APCO Comments in response to NBP Public Notice #8 (11/12/09), FCC GN Docket Nos. 09-47, 09-51 and 09-137
- Public Safety Spectrum Trust Comments in response to NBP Public Notice #8 (11/12/09), FCC GN Docket Nos. 09-47, 09-51 and 09-137
- Waukesha County Department of Emergency Preparedness Comments in response to NBP Public Notice #8 (11/12/09), FCC GN Docket Nos. 09-47, 09-51 and 09-137
- APCO Comments in PS Docket 06-229 (9/22/09)
- Public Safety Spectrum Trust ex parte submission of Broadband Task Force Report in PS Docket 06-229 (12/15/09)
- Northrop Grumman Information Technology ex parte submission in PS Docket 06-229 (11/13/09)
- Motorola ex parte submission in PS Docket 06-229 (10/28/09)