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September 10, 2010

EX PARTE NOTICE

Electronic Filing

Ms. Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, SW, Room TW-A325
Washington, D.C. 20554

Re: *700 MHz Interoperable Broadband Public Safety Network*
WT Docket No. 06-150, PS Docket No. 06-229,
GN Docket Nos. 09-47, 09-51, 09-137, RM Docket No. 11592

Dear Ms. Dortch:

I am submitting this document for inclusion in the above captioned dockets as my response to the August 24, 2010 filing of a white paper authored by Roberson and Associates, LLC, under contract to Deutsche Telecom's T-Mobile USA, Inc. entitled: *Technical Analysis of the Proposed 700 MHz D-Block Auction.* Unlike that white paper, my response is not a for-hire response. Further, neither Andrew Seybold, Inc. nor myself individually has received or is to receive funding for this paper from any organization, governmental agency, corporation, or individual.

It is interesting to note that T-Mobile USA (wholly owned by Deutsche Telecom, the largest telecom company in Europe), which did not take part in the 700-MHz spectrum auctions and has shown no interest in working with the Public Safety community, has contracted for this paper to attempt to prove that the D Block should be auctioned. Some would say that this last-minute attempt to derail the momentum of the Public Safety community with Congress and the Executive Branch is disingenuous given the vast amount of AWS spectrum T-Mobile USA has now and that will be available for auction in the future.

Though the stated premise and conclusion of the referenced white paper is that the allocation of 10 MegaHertz (MHz) of spectrum in the D Block is sufficient for Public Safety, upon careful examination, the reader will recognize that it only further demonstrates how this allocation is entirely insufficient.

If it is true that the limited D Block allocation is sufficient, readers must ask themselves why the authors would go to such great lengths describing how portions of the recently allocated, channelized 700-MHz band should be "repurposed" as broadband, and how the limited D Block allocation could be supplemented by the already heavily deployed 4.9-GHz local-area spectrum.

The T-Mobile paper fails to recognize that the channelized 700-MHz spectrum, though approved in 1997, was only released for use in 2008 with the transition to high-definition television. Considering the hundreds, even thousands of hours of deliberations and studies prepared by the FCC, NPSTC, NIST, APCO, and the vendor community itself regarding this allocation, I am hard pressed to believe that the authors could make a reasonable case for reversing the FCC's decision to channelize this spectrum. At a minimum, this would, of necessity, involve reconsidering and redesigning nearly every element of the FCC's own 700-MHz band plan adopted in its Second Report and Order[1] and would set Public Safety voice interoperability back decades.

The authors make the bold and inaccurate assumption that the 4.9-GHz spectrum is pristine and available on a nationwide basis to supplement any shortfall that would result from the 10-MHz D Block assignment. However, they ignore the guidance recently provided by the FCC[2] for the use of this spectrum and the countless hours that FCC-designated "Regional Planning Committees" have spent devising and coordinating plans for the use of this spectrum. The authors fail to recognize that in many areas this spectrum is already in use for communications with thousands of devices already deployed for traffic control, camera backhaul, and aircraft video relay. Nor do they address the fact that while this spectrum is licensed to Public Safety, multiple entities (i.e., city, county, state) may have concurrent authority to operate within the same geographic area. Furthermore, the authors fail to address the issue of how long it would take to deploy the supplemental equipment in this spectrum during routine emergencies, the fact that it would require Public Safety to manage the use of multiple devices with multiple and different airlinks, and that this would add significantly to the backhaul infrastructure cost of the overall systems.

Even if these other portions of spectrum could be "repurposed," the white paper does not attempt to address the costs and disruption that would ensue. I fail to understand how the authors could conclude that the 10-MHz D Block allocation is sufficient.

Some of the terms used in the paper are vague and therefore subject to question. For example, throughout the paper, there is the term "dense" as in, "*The capacity provided by a **dense** 10 MHz LTE network using the 700 MHz Public Safety spectrum.*" Any broadband system can be made ***dense*** and therefore provide increased capacity in a given area if the system makes use of macro, pico, micro, and inbuilding femto cells and/or distributed antenna systems (DAS). However, in this paper, there is no discussion of how these may be deployed or at what cost. The term ***dense*** is left undefined in both the cover letter and the body of the paper; therefore, the validity of the conclusions based on its use must be questioned.

Additionally, in Section 2.2.4 of the document, the authors state: "*Early measurements of LTE field trial implementations have been reported in open literature. The figure on slide 12 of LTE Field Trial depicts LTE downlink spectral efficiency measured independently by 6 leading Operators in field trials incorporating multiple LTE base sites. The normalized average cell capacity for a 20MHz system is 40 Mbps. It is reasonable to extrapolate that a 5 MHz system will have a normalized average cell capacity of 10 Mbps or less. This is significantly higher than what the FCC assumed (7.5 Mbps) or the Motorola predictions on expected performance (8.7 Mbps in Motorola LTE Performance). Further optimization of system performance has the potential to increase cell capacity even further."*

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[1] *See* Service Rules for the 698-746, 747-762 and 777-792 Bands; Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band, WT Docket No. 06-150, PS Docket No. 06-229, *Second Report and Order*, 22 FCC Rcd 15289, 15406 ¶ 322 (*Second Report and Order*).
[2] *See* FCC 09-29 Adopted on April 9, 2009 styled as REPORT AND ORDER AND FURTHER NOTICE OF PROPOSED RULEMAKING at ¶9

This statement deals with theory and is not based on real-world measurements of data capacity and throughput. I have provided additional detail in the following response; however, it is important to note that according to the FCC's own study, even with wired access to the Internet, users are experiencing data speeds of about 50% of what was expected.[3] Verizon Wireless, which is further along in its deployment of LTE and is deploying a 10X10 MHz LTE network, is projecting downlink speeds of 5 to 12 Mbps and uplink speeds of 2 to 5 Mbps.[4] If we use the authors' assumption that these data speeds can be "*extrapolated*," this will result in a 5X5 MHz system having downlink speeds of between 2.5 and 6 Mbps and uplink speeds of 1 to 2.5 Mbps. On this issue alone, the entire premise of the T-Mobile white paper is in question.

The T-Mobile paper also fails to adequately address the topic of Interference Risks. Statements include, "*Any potential for adjacent channel interference between the commercial D Block and the PSBL spectrum can be readily avoided if both systems are based on the LTE standard and use similar system design guidelines with comparable cell sizes. LTE, like most modern broadband technologies, is designed to allow networks to operate on adjacent spectrum without causing harmful interference.*"

However, the authors did not address the issue we raised in our previous response[5] to the FCC's white paper on capacity.[6] In our filing we agreed with the statement that **IF** all the PSBL and D Block sites were co-located, interference could be minimized. However, we also noted that according to LTE experts at a number of companies, there currently is no FCC requirement for a commercial service on the D Block to co-locate with Public Safety and that the service provider(s) would be adding micro, pico, and femto cells that would generate interference.

It is for these reasons and more I will demonstrate in the following response that the T-Mobile USA white paper actually supports the full allocation of the D Block to Public Safety. The bottom line is that the Public Safety community needs more contiguous spectrum, and the D Block is that spectrum.

Public Safety broadband is important, and re-allocating the D Block directly to Public Safety is the right course of action. It needs to be accomplished swiftly.

Respectfully submitted,

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[3] http://www.fcc.gov/Daily_Releases/Daily_Business/2010/db0813/DOC-300902A1.pdf
[4] https://www.lte.vzw.com/AboutLTE/VerizonWirelessLTENetwork/tabid/6003/Default.aspx
[5] Andrew Seybold: Comments on the FCC White Paper, submitted to the FCC June 23, 2010
[6] The Public Safety Nationwide Interoperable Broadband Network: A New Model for Capacity, Performance, and Cost, issued in June of 2010

Response to Roberson and Associates, LLC white paper, *Technical Analysis of the Proposed 700 MHz D-Block Auction*, dated August 23, 2010, contracted for by T-Mobile USA, Inc.

Summary

Section 1 Capacity for Public Safety

In this section of the white paper submitted by T-Mobile USA, Inc., the authors attempt to point out how a combination of the 10 MHz of spectrum already allocated to the Public Safety Broadband Licensee (PSBL) and the 50 MHz of spectrum available as licensed low-power broadband spectrum in the 4.9-GHz band can be combined to provide Public Safety with enough spectrum for commercial broadband system requirements. However, even with the spectrum they are discussing, they couch their words by saying, "*The capacity and throughput provided by a 5+5 MHz LTE network in the 700 MHz Public Safety Broadband spectrum is **sufficient on a system and sector-cell basis to meet immediate Public Safety broadband (non-voice) spectrum needs for day-to-day and incident scene scenarios**, as long as the network is designed as a high cell-density (low-site) network**, and** the 50MHz of 4.9 GHz Public Safety broadband spectrum is used in a coordinated manner."*

In other words, from the very beginning of the T-Mobile white paper, the authors are actually saying that 10 MHz of 700-MHz broadband spectrum will NOT be enough unless augmented with the 50 MHz of 4.9-GHz broadband spectrum already assigned to Public Safety. However, the 4.9-GHz spectrum is ill suited for wide-area coverage and should be compared to Wi-Fi local-area systems and not part of a nationwide interoperable broadband system. Further, this spectrum does not penetrate buildings and is already in use in most major cities providing point-to-point links for fixed camera backhaul and other fixed, point-to-point uses as recommended by the FCC's own Capacity study.[7]

As a point of reference, searching the FCC's Universal Licensing System (ULS),[8] there are currently 2,028 licenses for use of this spectrum across the United States. A sampling of the license holders includes the City of New York (multiple agencies), Dallas, Los Angeles, San Francisco, State of California, Philadelphia, Denver, the State of Maryland, Las Vegas, San Diego, the states of Colorado and Washington, and scores of others. Most of the licenses are for the entire 50 MHz of available spectrum and most of them have been valid and in use for a number of years. The assumption that this spectrum is unused, and therefore can be used in conjunction with the PSBL broadband spectrum, is not correct.

The authors fail to discern that it is precisely in these well-populated areas of the nation where the added capacity provided by the D Block will be most needed to meet the routine daily capacity requirements of Public Safety first responder operations. As an example, Silver Springs, MD was the site of a recent hostage[9] drama that was carried by many media outlets. On multiple cable channels, one could observe that streaming video was being employed to broadcast the event to viewers. This area of Montgomery County, MD, as well as other portions of the National Capital Region, are also in close proximity to many locations that already use Public Safety systems that have been deployed on the 4.9-

[7] http://fcc.gov/pshs/docs/releases/DOC-298799A1.pdf
[8] http://wireless.fcc.gov/uls/index.htm?job=home
[9] Discovery Channel Building Hostage Situation in Silver Springs, MD on September 1, 2010

GHz spectrum. The Maryland Department of Transportation also uses this spectrum to relay highway video of the busy roadways of the area. One cannot assume that the 4.9-GHz band would be available to support such a high-demand area.

I am also concerned with the use of the term "immediate." Do the authors define immediate as this year, two years, three years from now or more? Data usage has grown on commercial networks in the order of 5000% in only the past three years. Demand will follow the same curve as the commercial broadband sector as new applications and devices become available for Public Safety, which they quickly will as these systems are built and put into operation. Today, Public Safety's data access using commercial networks or lower-speed systems on the Public Safety narrowband channels is limited to in-vehicle laptop computers. This will also change quickly as the networks come online and handheld devices are made available. Therefore, I believe that data usage models will increase exponentially beginning with the first year of network availability.

The authors restrict this use to only data, excluding any voice component that might be added in the future. This is in contradiction with other sections of the T-Mobile paper and with the FCC's statement that it believes broadband voice will play an important role in Public Safety interoperability going forward.[10] This is the first occurrence of their use of the term "**high**-cell density" for which they provide no definition or criteria to explain their use of this nebulous term. The Public Safety community has embraced the FCC's recommendation that the system will include at least 44,800 cell sites and be built to commercial standards. However, the authors did not address how "dense" a system of this nature will have to be to provide the implied capacity. Instead, they assume that loading will be uniform across multiple cell sites and sectors and provide a chart that allows the reader to make assumptions about capacity (Section 2.2.2).

Later in the same section, they continue, "*Specifically, high-quality video can be provided by the wide area LTE network over a broad geographic area.*" This does not address the requirements for high-quality video within an incident's immediate area for use around the scene, or the ability to capture details of the incident and have the video transmitted to the Incident Commander, Emergency Command Center(s), and others. My research in working with Public Safety on the use of broadband and video over the past three years indicates that each video stream will, in fact, be transmitted within the confines of an incident, multiple times to a command vehicle, the Incident Commander, and others involved in the ongoing incident, as well as from the command vehicle or command post back to the Emergency Operations Center.

For example, in a hostage situation, it would be vital for the law enforcement sniper with the most advantageous view of the scene to have a high-resolution camera attached to his or her riflescope.[11] This video, at high resolution, would need to be transmitted to the command vehicle on the scene where it would be further distributed back to the command center, the swat team commander, and also to the Incident Commander. In reality, several snipers, all in different locations, would be feeding video to the command post and the command post would choose which video to send on to the Incident Commanders and swat team leaders. In such an incident, most of these participants are within a few hundred meters of each other. Thus this video would not be a single 1.2 or 2.3 Mbps stream, it would require multiple high-bandwidth channels within the same cell sector.

[10] http://fcc.gov/pshs/docs/releases/DOC-298799A1.pdf
[11] http://www.castfiresolutions.com/

According to the authors, this type of distribution could be handled over the 4.9-GHz spectrum for on-the-scene video. However, it is not clear if the authors are aware of how heavily the 4.9-GHz channels are already being used for camera backhaul, helicopter and fixed wing video feeds, and other uses (see Section 1 above). Nor is it clear whether they understand that this spectrum, while licensed to Public Safety, does not require any type of frequency coordination, which means other agencies responding to an incident could cause or be affected by interference during the incidents. It would take additional effort and different types of devices, and would add considerable cost to deploy 4.9 GHz in conjunction with the 700-MHz broadband channels. Finally, the authors fail to address the interconnection and backhaul requirements to make such a sub-system work.

As a point in fact, a sampling of 200 of the 2,028 existing licenses for use of the 4.9-GHz band shows that all are licensed for all 50 MHz, which includes all eighteen channels. Further, it is not clear whether the authors recognize that of these eighteen allocated channels,[12] ten are for 1-MHz blocks of spectrum while only eight are for 3 or 5-MHz blocks of spectrum. Power limits for this band are for low power. For a single channel, the high power peak is limited to 20 dBm, and even when combining channels for 10 MHz of bandwidth, the high power peak is limited to 30 dBm. In other words, these channels are for low power and generally used for point-to-point camera backhaul, not on-the-scene data communications.

The authors also suggest the use of "*vehicular mounted 700 MHz pico-cells*," which are expensive and require backhaul to the core of the network, yet there is no information given on how this backhaul would be provided, how long it would take to put it in place, or how much it would add to the cost or technological complexity of the network. This also assumes that there are personnel on the scene who know how to put these picocells in operation and how to connect them to the necessary backhaul, and that they have the time during the early stages of an incident to set them up.

This complex technological approach obviates the straightforward cost issues that the FCC and others within Public Safety have envisioned over recent years. The basic 700-MHz eNodeB components will be used universally by Public Safety and commercial network operators. Thousands of these devices will be deployed resulting in cost savings to taxpayers. However, the scheme envisioned by the authors to aggregate 700-MHz LTE and 4.9-GHz specialized systems will be non-standard and will result in higher deployment costs. This commercial vision negatively affects the taxpayers who will ultimately fund the Public Safety broadband systems.

Next is the contention that since the Public Safety voice channels on VHF and UHF spectrum are in the process of undergoing narrowbanding, and with the reconfiguration of the 800-MHz band, that these "*prompt the discussion of a future repurposing of a portion of the 700 MHz Public Safety narrowband spectrum for broadband use. This would provide the additional bandwidth necessary to accommodate dispatch voice service in an integrated and interoperable fashion with broadband applications. Already requested by some Public Safety agencies, the combination of the 10 MHz of 700 MHz Public Safety broadband spectrum with a portion of the currently allocated 700 MHz narrowband spectrum would allow a seamlessly integrated voice, data, and video Public Safety broadband network to be deployed, and would increase the maximum per user throughput and overall capacity achievable within the dedicated Public Safety network.*"

This statement indicates a lack of understanding of the current needs of Public Safety and its growing use of 700-MHz land mobile mission-critical voice systems, and once again acknowledges that the 10

[12] *See* 47 CFR §90.1213

MHz of spectrum that has already been allocated to Public Safety is not enough to meet its day-to-day requirements. As a matter of fact, the T-Mobile white paper spends a great deal of time providing options to increase the bandwidth capabilities for Public Safety and very little time proving the assumption that 10 MHz of Public Safety spectrum is sufficient for its daily needs. Therefore it is my contention that the T-Mobile white paper supports the case for reallocating the D Block to Public Safety.

The channelized 700-MHz voice channels have only been available for a little over a year and Regional Planning Committees have already fully allocated them in the most dense and critical markets in their 12.5-KHz configurations. Notwithstanding the fact that the FCC clarified its stance on requiring systems to further narrowband to 6.25-KHz channels,[13] in a recent conversation with Admiral Barnett, Chief of the FCC's Public Safety and Homeland Security Bureau, he expressed the logical and appropriate concern about requiring a further move to 6.25-KHz channel widths telling me he was not convinced that this is a sound idea.

Again according to the FCC ULS,[14] 445 licenses have been issued to Public Safety in this band. This breaks down as follows: 126 SG or conventional systems, 53 SL or state (includes a number of statewide and agency-specific statewide licenses), and 266 SY or trunked radio systems. Further, the Regional Planning Districts have more than double that number in the frequency coordination process. These systems will provide for voice interoperability, which had not been unavailable to the Public Safety community until this spectrum was released.

Contrary to the impression given in the T-Mobile paper, neither LTE nor any broadband technology has been demonstrated to be capable of meeting the requirements of Public Safety for voice communications. The T-Mobile paper contradicts itself on this point as well. First it states, "*The packet-based air interface and architecture of LTE, and the use of Voice over Internet Protocol (VoIP), provide the opportunity for the design and deployment of a truly integrated and interoperable voice, data, and broadband (video) capable Public Safety network,*" but then it goes on to state, "*Since there are still 40 channels of narrowband conventional voice channels available immediately adjacent to the broadband channels, Public Safety user equipment could be designed to operate on the 20 MHz integrated voice, data, and video network when in range of the LTE network, but be able to switch when necessary into the "talkaround" mode for direct unit-to-unit communications when utilizing the LTE network is unfeasible*." You will also notice that in this statement the authors refer to a full 20 MHz of broadband spectrum, NOT the 10 MHz that is available today—one more point that demonstrates that the authors agree with Public Safety that 10 MHz of broadband spectrum is not sufficient.

Since LTE and other fourth-generation (4G) wireless technologies will in the future include "multi-cast" (one-to-many) capabilities in their standards, it is assumed by most that broadband will be able to provide needed mission-critical voice as well as data services. In reality, Public Safety's requirements are far different from those envisioned by the standards bodies for multi-casting. Most cities are divided into districts and dispatch channels are assigned on a per-district basis. In the larger metro areas, this means that from 2 to 20 channels are needed for one-to-many dispatch for normal district operation, and that there is then the additional need to provide multiple citywide channels for coordination. Commercial multi-casting standards are being developed, but they do not include the capabilities needed to meet Public Safety's requirements.[15]

[13] *See* 47 CFR §90.535(d)
[14] FCC ULS
[15] 2.4.2 Potential Long-Term Future Roadmap for the 700 MHz Band

Since LTE and other commercial standards are developed for worldwide adoption for commercial wireless networks that serve more than 5 billion customers today, and since these network operators have not expressed any desire to permit their customers to have direct customer-to-customer communications bypassing the network (or a cell site), it is not likely that LTE or any broadband technology will be modified to permit the types of one-to-many communications that are vital to the Public Safety community as well as federal agencies such as the FBI, Secret Service, and the military.

Therefore, the authors' statement that when outside of the LTE footprint, their proposal provides for 40 narrowband channels (1 MHz) is not valid. Not only is it not possible to provide "talkaround" or one-to-one voice communications without the use of a cell site in the LTE standard, they have suggested that only 40 channels of narrowband voice for this purpose is enough for Public Safety. This is not true. Each agency, and each specialized response group within an agency, needs access to many narrowband voice channels on a daily basis. Thus the authors' contention that these 40 voice channels are enough and that they will only be needed outside of LTE coverage is not valid.

The idea put forth in the T-Mobile white paper that the PSBL 10 MHz of spectrum has the capacity to serve Public Safety for its "immediate needs," coupled with the belief that additional capacity can be achieved for broadband use by reallocating most of the narrowband Public Safety Spectrum for broadband usage, defeats Public Safety's goal, which is to end up with both a fully interoperable broadband network and a common set of mission-critical voice channels using the narrowband spectrum already licensed for narrowband use. Today's voice channels are spread out over numerous portions of the spectrum requiring agencies to make use of multiple radios to provide interoperable voice. The 700-MHz narrowband spectrum will provide a much higher level of voice interoperability than can be achieved in any other way. Therefore, it does not make sense to turn this resource into additional broadband spectrum, especially when the D Block could be reallocated for Public Safety broadband use.

Reallocating the D Block to Public Safety and leaving the narrowband mission-critical voice channels in place will result in many Public Safety agencies achieving both voice and data interoperability over time. At some future time, the FCC could study the possibility of regaining some of the VHF and UHF narrowband spectrum currently being used by Public Safety.

The assumption that LTE can be implemented to, "*selectively inhibit service requests from classes of users during periods of heavy use so that the access channel can be prioritized to ensure access for high priority Public Safety users,*" is correct. However, this does not address the issue of existing customers grabbing a connection at the first sign of an incident and holding onto that connection. Further, this statement leads the reader to believe this can simply be an innate feature of the system. In fact, there is no basis for this assumption. There have been no demonstrations of such a concept, and like IPAWS,[16] someone (or some entity) would have to make decisions on a case-by-case basis of when to implement such a feature and then execute the plan if this happens. Historically, this does happen with consumer users and the press, so having priority access to the access channel does NOT mean access to a connection on the network. What it does mean is that IF and WHEN a connection is dropped, the bandwidth that was being used for the dropped connection will be given to a higher priority user. There is also the possibility that the customer who grabs a connection early will use that connection to send video from the scene of the incident. This would result in less bandwidth for any priority users even if

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[16] http://www.fema.gov/emergency/ipaws/systemenhancements.shtm

they are allocated a connection, and even with the LTE capability to dynamically limit bandwidth by class of user.

Commercial networks are required by FCC law to periodically report on the number of dropped calls. However, in order for a call to be considered dropped, it is assumed that the user was able to access the network to attempt to set up the call. These measurements do not take into account the number of users who were not able to access the network since their calls could not be handled or dropped. Public Safety systems cannot afford to have their calls dropped or blocked from being completed in the first place. This is one of the major differences between what commercial networks can provide and what a Public Safety managed network is expected to provide.

Section 3: Interference

Discussions with many members of the 3GPP[17] standards body, as well as a number of LTE infrastructure vendors, indicate that the only way to truly mitigate interference between the D Block and the PSBL broadband spectrum is to ensure that ALL sites for both networks are co-located. This is not currently a requirement of the FCC-proposed D Block auction. Further, since at least 21 Public Safety systems are in the process of being deployed under the PSBL waiver process approved by the FCC, by the time the D Block commercial networks are ready to deploy, a number of these systems will already be operational with sites chosen based on the coverage requirements of the various localities.

As mentioned, because 10 MHz of spectrum is not enough for any commercial operator to be able to offer LTE services within the major metro areas, the auction winner(s) would have to build additional microcells and picocells and make extensive use of femtocells, all of which will have the potential to interfere with the PSBL spectrum. Reallocating the D Block to Public Safety would ensure that there is no likelihood of interference between the two services and would help ensure mission-critical status for the Public Safety network.

The only real way to mitigate the interference issue is to build a common D Block and PSBL network making use of all 20 MHz of available spectrum. It should be noted that another difference between commercial networks and Public Safety networks is in the way interference is treated and the effect it has on overall system performance. In the commercial world, networks are designed based on the total aggregated throughput of cell sectors; areas or pockets of interference are not of much importance. However, for a Public Safety network, pockets of interference will mean that sessions will not be completed in these areas, or existing sessions will be dropped as the device is moved into areas of interference. This is not acceptable in the design of a mission-critical network.

Unfortunately, there is already an issue with interference in the 800-MHz portion of the spectrum. Rebanding between Nextel and Public Safety channels was necessitated because Public Safety units, when in proximity to Nextel cell sites, were unable to communicate due to interference. The resultant rebanding of this band, which was supposed to have been accomplished within three years, is still a work in progress and has proven to be detrimental to the Public Safety agencies that use this portion of the spectrum for mission-critical communications.

The authors of the paper negate the mention of this ongoing interference issue stating that the 800-MHz spectrum is channelized, not broadband, and that the channels for both Public Safety and Nextel

[17] http://www.3gpp.org/specifications

are interleaved and thus subject to interference. However, the issue in the case of the 800-MHz interference was related more to receiver front-end overload. Since the Public Safety devices for use in the PSBL spectrum will also be capable of operating in the D Block, their receivers will also be susceptible to some type of front-end overload when in proximity to a separate D Block network. As pointed out earlier, any commercial D Block operator will have to build more microcell, picocell, and femtocell sites in order to provide the level of capacity they will need, and proximity by Public Safety to these sites will cause interference that is unacceptable for mission-critical Public Safety networks. This is only one more reason the D Block should be reallocated to Public Safety. Built as a single 20-MHz network (10X10 MHz), these interference issues will be completely mitigated.

Main Paper

1.0 Introduction

Please refer to my comments in my filing on the subject of the FCC's white paper on capacity for the Public Safety broadband system.[18]

2. 0 Public Safety Capacity and Throughput

Section 2.1 Summary of FCC Whitepaper

The conclusions reached in the FCC white paper have been questioned by the Public Safety Alliance,[19] NPSTC,[20] me,[21] and others. This paper was published in June 2010 and there have been numerous filings questioning the conclusions. To date, there has been no response from the FCC or the authors of the FCC capacity white paper to counter our arguments.

2.2 Meeting the Broadband and Real-Time Video Capacity Needs of Public Safety

While the authors contend in this section that in a 10X10-MHz LTE system there is 7.5 to 10 Mbps for the downlink and 3.5 to 5 Mbps for the uplink, the paper does not include a discussion of the fact that LTE uses three different modulation schemes for downlink data rates and two for uplinks. The three specified for downlinks are QPSK (Quadrature Phase-Shift Keying), 16-QAM (Quadrature Amplitude Modulation), and 64-QAM. There are a number of parameters that can be set in a network to determine which of these data rates to use. Typically, users closest to the center of the cell are assigned the fastest downlink rate of 64-QAM, those in the middle have the mid-data rate of 16-QAM, and those at the cell edge experience the slowest data rate, QPSK. However, networks will be optimized and managed differently. For example, a commercial network operator may elect to forgo the fastest downlink speed in order to provide average speeds for more users within a cell sector. It is clear that with the flexibility of LTE and the data rates available, commercial networks and Public Safety broadband networks could be set for vastly different parameters, which could have a negative impact on Public Safety when required to share bandwidth on a commercial network.

Nor have I seen any discussion about the 3GPP test procedures used by the commercial industry not corresponding to real-world tests when considering bandwidth availability for Public Safety. The standard 3GPP tests for system capacity are based on series of 19 cell sites, each with 3 cell sectors for a total of 57 sectors. Interference is assumed to be constant across all sectors and the testing makes use of Full Buffer UDP traffic. However, when measuring capacity for video especially, and with Quality of Service implemented as it will have to be in both commercial and Public Safety broadband networks, different parameters are needed for the purpose of calculating bandwidth and cell sector capacity.

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[18] http://fjallfoss.fcc.gov/ecfs/document/view?id=7020512618
[19] http://fjallfoss.fcc.gov/ecfs/comment/view?id=6015659049
[20] http://fjallfoss.fcc.gov/ecfs/comment/view?id=6015658870
[21] http://fjallfoss.fcc.gov/ecfs/document/view?id=7020512618

Where QoS is invoked, the cell sector capacity turns out to be between 50% and 75% of the capacity as measured by the 3GPP full buffer tests.[22] This would mean that each cell sector's available capacity will be as much as 50% less for real-world network operation. If we start with the authors' assumption that in a 5X5-MHz cell sector the total available capacity is between 7.5 and 10 Mbps for the downlink and 3.5 to 5 Mbps for uplink, and we factor in the reduction in this capacity when QoS has been invoked, the actual per-sector capacity in a 10-MHz system at 75% reduces the capacity to between 5.625 and 7.5 Mbps for the downlink and 2.625 and 3.75 Mbps at most. At 50%, the numbers equate to cell sector capacities of between 3.75 and 5 Mbps for the downlink and 1.75 and 2.5 Mbps for the uplink. If we use these numbers for our capacity requirements against the data requirements, the reason Public Safety needs the D Block reallocated for its use becomes clear.

Further, starting with the Verizon Wireless projected data rates for its 10X10-MHz network[23] of 5-12 Mbps for the downlink and 2-5 Mbps for the uplink, and then using the same method prescribed by the authors in section 2.2.4, "*Early measurements of LTE field trial implementations have been reported in open literature.31 The figure on slide 12 of LTE Field Trial depicts LTE downlink spectral efficiency measured independently by 6 leading Operators in field trials incorporating multiple LTE base sites. The normalized average cell capacity for a 20MHz system is 40 Mbps. It is reasonable to extrapolate that a 5 MHz system will have a normalized average cell capacity of 10 Mbps or less. This is significantly higher than what the FCC assumed (7.5 Mbps) or the Motorola predictions on expected performance (8.7 Mbps in Motorola LTE Performance). Further optimization of system performance has the potential to increase cell capacity even further.*"

So if I now use the Verizon numbers and "extrapolate" them, it is reasonable to believe that in 5X5 MHz these numbers will be halved to a range of 3.75 to 5 Mbps for the downlink and between 1.75 and 2.5 Mbps for the uplink. If I then take 75% of these numbers based on QoS video data rates and not the 100% rate assumed by the authors for the standard 3GPP tests based on full buffers, I end up with a usable speed range of 2.81 to 3.75 Mbps and an uplink range of from 1.31 to 1.88 Mbps, which is a long way from the numbers the authors used to calculate the number of video streams that will be available for Public Safety use in a 5X5 network.

Further, according to a paper published by the IEEE[24] that simulated the downlink LTE video (1 Mbps with QoS for a 10X10-MHz system with reasonable site spacing), the network will only support four 1-Mbps video streams per sector. If I then extrapolate this to a 5X5 system, there are only two 1-Mbps video streams available per cell sector. This represents a 3.6 times overestimate of QoS capacity by the authors of the T-Mobile white paper.

2.2.1 Video Bit Rate Required for Public Safety

I had previously commented on the low data rates that the FCC white paper considers to be adequate for use by the Public Safety community and was pleased to see that in the T-Mobile paper a more realistic 1.2 Mbps rate has been chosen for purposes of comparison. However, as I will show in the next section of my reply, a single video stream may be required to be re-transmitted to multiple vehicles and

[22] Buffered via QoS cell sector capacity reference

[23] https://www.lte.vzw.com/AboutLTE/VerizonWirelessLTENetwork/tabid/6003/Default.aspx

[24] Streaming Video Capabilities of the LTE Air-interface, Communications (ICC), 2010 IEEE International Conference on 23-27 May 2010, Talukdar, A.; Cudak, M.; Ghosh, A.

individuals at in incident. Therefore, the total number of video streams required at a single incident must be taken into account.

2.2.2 Geographic Extent of the Incident: Number of Video Streams Able to be provided

The authors have included a chart that depicts their assessment of the size of an incident and thus the number of cell sectors that will be available for Public Safety during an incident. Using these cell sector sizes and based on the total uplink and downlink capacity of each cell sector, they determine exactly how many 1.2-Mbps video streams can be accommodated for incidents confined to ½, 1, 2, and 4 square mile areas.

However, they do not factor in capacity degradation that will occur because of the overlapping cells. Like the FCC's capacity white paper, it appears as though this paper also assumes no degradation to bandwidth and capacity because of interference. Yet with any system where cells using the same spectrum overlap, there will be some degradation due to increased interference. (LTE is being deployed with a cell reuse of 1 to 1, meaning that each cell sector is using the same portion of the spectrum.)

I contend that many incidents, especially in major urban areas, will be confined to smaller areas than the one-half square mile they have chosen for the smallest incident size. It is also my contention that even in dense urban areas, many incidents will be confined to an area that is covered by a single cell sector or at most, two cell sectors. The chart below, extracted from the T-Mobile white paper, mixes meters for cell size with square miles for incidents, which is somewhat confusing to this reader.

		Potential Number of RF Sectors Serving an Incident				Potential Number of 1.2 Mbps Downlink Streams				Potential Number of 1.2 Mbps Uplink Streams			
		Incident Area (sq. miles)				Incident Area (sq. miles)				Incident Area (sq. miles)			
Cell Size (radius, meters)	RF Sector Area (sq. miles)	0.5	1	2	4	0.5	1	2	4	0.5	1	2	4
500	0.10	4	9	19	39	25	56	118	243	11	26	55	113
750	0.23	2	4	8	17	12	25	50	106	5	11	23	49
1000	0.41	1	2	4	9	6	12	25	56	2	5	11	26
1500	0.92	1	1	2	4	6	6	12	25	2	2	5	11

Table: Variation in Number of Downlink and Uplink Video Streams as a Function of Incident Scene Area and Cell Size (3 Sectors per Cell)

The other issue that is not addressed is the fact that each video feed will need to be sent multiple times. For example, in the hostage situation described above, which will be confined to a smaller radius than 1/2 square mile, several snipers might have video running from their vantage points. This video, at 1.2 Mbps for example, would need to be transmitted to the command vehicle at the scene. From there it would need to be re-transmitted to the Emergency Control Center, to the Incident Commander on the scene, and to at least the swat commander. Thus this one video stream will be transmitted on the uplink four times. LTE does not currently support multi-cast, so each individual re-transmission of the video stream would require its own 1.2 Mbps of bandwidth. In this case, with a single sniper's camera transmitting the video, load on the cell sector would be four times 1.2 Mbps or 4.8 Mbps, which exceeds the available uplink in a 10-MHz cell sector.

Further, in a real-world scenario, several snipers would be transmitting their video feeds to the command vehicle and the command vehicle would be transmitting the video thought to be most important out to the Incident Commander, the swat commander, and perhaps two or more feeds up to the Emergency Operations Center. The video required for this one incident could quickly consume all of the bandwidth available at the scene and leave no bandwidth available for other uses such as downloading and sharing floor plans, maps of the area, and other data that might be required during the incident.

If I use the numbers generally recognized as industry standards for LTE using 2X2 MIMO (dual antennas), the aggregate sector throughput (i.e., spectral efficiency) should be on the order of 1.3 bps/Hz. This has been supported by many studies and demonstrations.[25] Unless the authors are calculating their throughput based on more antennas (4X4 MIMO), I do not see how they can support their claims for throughput speeds that work out to 2 bps/Hz. Therefore, I consider the above chart to be an unrealistic assessment of the video streams available for a given incident by a factor of two or more.

All of the scenarios I have been designing for real-world testing are confined to one, two, or at most three cell sectors within a metro area. It should be noted that to date all we have available to us are theoretical calculations, which vary from expert to expert and from company to company. It is not feasible to believe that even a dense Public Safety broadband network will be able to provide the same amount of capacity evenly throughout a major metro area. Commercial operators are able to plan their cell density based on known population patterns, heavy traffic locations, and around major venues. Public Safety does not have the same luxury since incidents can and do happen not only in the densest sections of an area, but in industrial and residential sections as well. The metrics for the deployment of these two very different types of networks will be different and many of the incidents that occur on a daily basis will take place within an area served by only one or two cell sectors, and in some cases, underserved by commercial operators.

2.2.3 Role of Pico-Cells and 4.9 GHZ

This section begins with the following statement: *"The challenge of providing greater capacity levels for high-quality video for compact incident scenes can be met in two ways. As described in the FCC Whitepaper, Cell Sites on Wheels or "Mobile Pico-Cells" can be rapidly deployed to augment capacity when it is known that an incident has occurred in an area where there are large cell sites. The 700 MHz mobile pico-cell solution (with wireless backhaul) is particularly suited to bringing additional sectors (and additional capacity) to bear on an in-building incident where 700 MHz propagation characteristics provide in-building RF penetration."*

There are a number of issues with these assumptions, the first being that incidents are time critical. Many incidents can and are prevented from becoming larger incidents within the first 10 to 20 minutes or ½ hour of the alert. It is during this time when the demand for voice and data services will stress the networks. Those first on the scene will assess the incident and request additional assistance if deemed necessary, then request information such as floor plans, begin sending video of the scene back to the Emergency Operations Center, and request access to other data as needed. Unless each vehicle in a fleet

[25] http://www.rysavy.com/Articles/2010_01_Rysavy_Neutrality.pdf and http://www.rysavy.com/Articles/2010_02_Rysavy_Mobile_Broadband_Capacity_Constraints.pdf

is equipped with a picocell and/or a 4.9-GHz router, the delivery of cell sites on wheels or mobile picocells will take too long.

Further, the authors reference “wireless backhaul” but do not indicate exactly what type of backhaul they have in mind. If they plan on using 4.9-GHz broadband for backhaul, there are the issues I have already pointed out. First, the spectrum is already heavily in use, and second, using 4.9 GHz for backhaul will require setting up a point-to-point link. And since 4.9 GHz is a line-of-sight technology, it is not practical in urban canyons or other locations where there is not a clear visual path to the other end of the link. Satellite backhaul setup is time consuming and introduces system latency, which is unacceptable during incidents. Using the same LTE spectrum that is being used for the picocell as backhaul is not an option, either. Therefore I am at a loss to understand how the deployment of these picocells would work and of what benefit they would be to first responders.

These two types of cell site capacity enhancement are good tools for long-running incidents that will require personnel in place for a long period of time. Historically, commercial network operators deploy Cells On Wheels (COWs) to assist Public Safety’s efforts and to reduce congestion for their own customers, but these take days to be brought in and set up, as acknowledged by the authors of the T-Mobile white paper. In most cases, this type of added capacity is suitable only for large-scale and long-running incidents. Each of these cells on wheels requires access to the back-end of the network using satellite, fiber, or microwave to connect the cell. Without this connectivity, the portable cell is of no use. There are not many places in a metro area where back-end connections can be provided on a temporary basis, and by the time the device is in place and the connection to the network has been established, most incidents will be over.

Next in the T-Mobile white paper is the idea of using routers on the licensed 4.9-GHz, Wi-Fi-like short-range communications spectrum. As previously noted, in many areas of the nation, this spectrum is already in heavy use providing point-to-point links for video cameras and as wireless transport for cameras mounted on fixed-wing planes and helicopters and is not available for this type of incident use. Further, in order for these access points to be useful, they need access to backhaul services in order to transport the video back to the Emergency Command Center as well as on to the Incident Commander and others at the scene. It appears as though the only way to backhaul this video and data will be to use the 700-MHz broadband network, thus requiring capacity on not one but two networks and not, as the authors contend, adding to the amount of capacity at the scene of an incident.

Their assumption that 4.9 GHz can also be used for backhaul from an incident does not take into account the fact that many incidents will occur in urban canyons and that in order for 4.9-GHz point-to-point links to be effective, there needs to be line of sight between the two ends. It would also take time and would require someone with experience in establishing these links to be in the field at a given incident. This is not a task that could be assigned to any of the personnel who will be on the incident scene, nor will an Incident Commander have the luxury of assigning one of his field personnel the task of establishing this link at the scene. All of the personnel assigned to the incident will be consumed with their own tasks of saving lives and property.

2.2.4 Throughput for Video at the Cell Edge

The T-Mobile paper tries to provide us with reassurance that edge-of-cell data rates can be increased to provide additional data speeds and capacity at cell edges. In theory, their logic is sound, but in the practical world of Public Safety, the conceptual aspects of their solutions will not provide increased data performance at the cell edges. One of the recommendations is to make use of better antennas for mobile and portable devices to help increase cell access and coverage. This will help in a number of circumstances, but it will also cause problems for the commercial operators when Public Safety units are deployed onto commercial spectrum networks that are designed to operate with devices that do not have external antennas.

When the authors state that the use of external antennas will help with throughput at the cell edges, they do not address the fact that usually when at the edge of a cell sector, the user is actually at the edge of two cell sectors. In this case, the use of external antennas will only intensify the interference problems since the device will be trying to communicate with one cell sector while being interfered with by the other.

In this section, the authors also make the following statement that appears as footnote 27: *Internal antennas, commonly employed in cell phones held by hand next to the ear, have a nominal radiation efficiency of 8-12%, while external antennas commonly employed in Public Safety handheld devices have nominal radiation efficiency when held near the mouth of 30-40%. Using nominal radiation efficiencies of 10% for cellphone, and 35% for a Public Safety radio, the radiation efficiency advantage for a Public Safety device is therefore 10 x log (35/10) = 5.4 dB. This performance can be considered representative of the differences between commercial and Public Safety devices.*

The math and the assumptions may be correct, but this example does not take into account that many Public Safety personnel wear their mobile devices on their belts or in a pocket in their turn-out gear to protect them from the weather and make use of a remote speaker/microphone combination for communications. While it is true that some of these speaker/microphones include external antennas that are connected to the radio, many do not. Therefore, the advantage of an external antenna is minimized by the location of the handled radio. I would venture a guess that in real-world testing the use of an external antenna in this manner merely puts the radio on a par with a cell phone that is held up to the ear when used by a consumer.

The use of picocells, as discussed above, requires access to backhaul of some sort and costly mobile relays, which are mobile mounted devices that will receive a signal from a handheld device and rebroadcast it onto the network. While this mode of operation is supported within the LTE specification, I know of no commercial network operator planning to deploy this type of device. If the D Block is being used by commercial network operators, this type of device can and will result in interference to the commercial network and possibly the Public Safety network as well.

The use of picocells has already been discussed and, once again, the issue with these devices is that they must be connected in some way to the network. During routine or major incidents, this will be a time-consuming task that cannot be performed by those responding to the incident. It would require someone from the city's communications department to respond to any incident in which bandwidth was constrained and to set up one of these picocells, and it could not be done within the short timeframe of an incident.

The use of Distributed Antenna Systems (DAS) is a viable solution, and as pointed out by the authors, while their use does not increase the available bandwidth, these systems do provide coverage in areas where there is no cell coverage. Distributed antenna systems are permanently installed, very costly, and deployed by commercial networks to provide better inbuilding coverage. They are installed where there is a known need for inbuilding capacity, and in the case of Public Safety, there is no way to predetermine where incidents will occur.

Their inclusion in this section of the use of beam-forming antennas and how they can be used to provide additional capacity and coverage is partially correct. However, there are a number of issues with the deployment of these “smart” antennas. First, of course, is the need to locate more antennas on each cell site, a task that has already become burdensome due to zoning requirements and the negative reaction from the general public about cell site location and placement. These systems have been proven to work well for targeted devices, but they have also proven to be ineffectual for multiple, simultaneous, streaming data requirements.

The authors’ final statement in this section reads as follows: “*Early measurements of LTE field trials implementations have been reported in the open literature. The figure on slide 12 of LTE Field Trial depicts LTE downlink spectral efficiency measured independently by 6 leading Operators in field trials incorporating multiple LTE base sites. The normalized average cell will have a normalized average cell capacity of 10 Mbps. This is significantly higher than what the FCC assumed (7.5 Mbps) or the Motorola predictions on expected performance (8.7 Mbps in Motorola LTE Performance). Further optimization of system performance has the potential to increase cell capacity even further.”*

This statement is ambiguous since it refers to cell capacity and does not specify if this is the total capacity of the entire cell (all three sectors) or if it is per cell sector. Further, it deals with theory and is not based on real-world measurements of data capacity and throughput. According to the FCC’s own study, even with wired access to the Internet, users were experiencing data speeds of about 50% of what they expected.[26] Verizon Wireless, which is further along in its deployment of LTE and is deploying a 10X10-MHz LTE network, is projecting downlink speeds of between 5 and 12 Mbps and uplink speeds from 2 to 5 Mbps.[27] Using the same assumptions as the authors chose to use above, this would translate into a 5X5 LTE network with downlink speeds from 2.5 to 6 Mbps and upload speeds from 1.25 Mbps to 3 Mbps, which is a long way from either the FCC or T-Mobile white paper’s estimates and is more in alignment with the Motorola projection.[28] If these data speeds are indeed correct, then the entire T-Mobile white paper is in question based on the data rates assumed by the authors.

Further, when these data rates are recalculated using the Quality of Service (QoS) model above, the total available capacity per cell sector based on 75% of the full buffer rate will be 4.5 Mbps for the downlink and 2.25 Mbps for the uplink. If the reality turns out to be on the low end of the QoS data rate scale, the per-sector capacity will be 3 Mbps for the downlink and 1.5 Mbps for the uplink, neither of which is sufficient for incidents that occur within a single cell sector.

Section 2.3 Dynamically Moving Public Safety Devices form Public Safety Networks to Commercial Networks

This section discusses the ability for Public Safety devices to seamlessly move onto commercial networks. However, it stops short of saying exactly how this will be accomplished and does not address a Public Safety device that moves out of its home area into a mutual aid situation where the commercial network might not even understand that the unit or units are designated as priority access customers.

[26] http://www.fcc.gov/Daily_Releases/Daily_Business/2010/db0813/DOC-300902A1.pdf
[27] https://www.lte.vzw.com/AboutLTE/VerizonWirelessLTENetwork/tabid/6003/Default.aspx
[28] http://fjallfoss.fcc.gov/ecfs/document/view?id=7020396248

Section 2.4 Long-Term Roadmap for 700 MHz Public Safety Spectrum

It is not clear to me what the authors are saying in this section of their report. However, it appears as though they are saying that today's LTE technology will be able to satisfy the voice requirements now served by channelized narrowband voice channels. This is not the case. Neither LTE nor any other broadband technology has demonstrated the ability to provide one-to-many multi-cast voice and/or data communications. While multi-casting is included in the next release of the 3GPP LTE standard, it is not clear to me or the LTE experts I have consulted that the standard will provide for the types of one-to-many dispatch capabilities required by Public Safety.

Most major cities have one or more citywide one-to-many channels for citywide operations, but day-to-day dispatch systems divide the city into districts and each district has its own primary and sometimes secondary dispatch channel. In the major cities, this equates to having, for example, three citywide channels and another 12-15 channels that are used on a per-district basis for one-to-many dispatch. I can find no reference anywhere in the 3GPP specifications that discusses multi-dispatch to multi-device voice or data services.

Another vital form of voice communications is peer-to-multi-peer communications without the use of a cell site or network infrastructure. This type of communications, referred to as tactical or simplex communications, is a vital part of Public Safety's voice requirements.[29] There is nothing in the 3GPP specifications that addresses this requirement now or well into the future. LTE specifications are, by and large, driven by commercial network operators' requirements. Since these operators have no reason to permit peer-to-peer or peer-to-multi-peer communications, it is unlikely that LTE or any other broadband technology will incorporate this feature in the specifications. This is a vital requirement for Public Safety systems and MUST be available now and in the future.

The authors' answer is to set aside 40 channels in the 700-MHz narrowband spectrum, leaving these for use when direct communications is required. In the FCC's 700-MHz Band Plan for Narrowband Spectrum,[30] they have set aside narrowband channels for nationwide calling, state licensed systems, and interoperability channels. There are more than 40 of these channels designated by the FCC for specific use.

Section 2.4.1 Assessment of Public Safety Narrowband Voice Spectrum and Capacity

This section deals with the amount of voice spectrum available to Public Safety today and into the future. The chart in this section is a prelude to their assumptions later in the T-Mobile report that the narrowband Public Safety spectrum in the 700-MHz band could be repurposed for broadband services. I have a number of issues with this prelude to their further comments. First, the interoperability issue for voice communications has been created over a thirty-year period by previous FCCs that instead of finding sufficient contiguous spectrum for Public Safety's voice needs, continued to provide small slices of spectrum in an assortment of frequency bands. According the chart, today's spectrum allocations include spectrum in the following segments:

25-50 MHz — should read 30-50 MHz for accuracy

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[29] http://fjallfoss.fcc.gov/ecfs/document/view?id=7020550832

[30] http://www.fcc.gov/pshs/docs/public-safety-spectrum/700mhz-chart-segments.pdf

138-144/148-174 MHz —some of this spectrum is assigned to Federal agencies, NOT Public Safety
220-222 MHz — this spectrum is available in only one small portion of a county in upstate New York to mitigate interference with Canadian radio systems
450-470 MHz
806-821/851-866
821-824/866-69
806-824/851-869 — After rebanding (reconfiguration), interesting that it is counted twice in the chart

As can be seen by this list of spectrum assignments, Public Safety systems are spread out over a broad range of small spectrum slices. The result of this is that to be able to provide interoperable voice, multiple radios are needed in Public Safety vehicles or dispatch centers, or dispatch centers must install equipment capable of tying multiple channels together when needed, which is not spectrally efficient and decreases the number of units that can be served on a given set of channels.

It is not unusual for cities and counties to have spectrum allocated in the 150-MHz band for fire services and additional spectrum in the 450-MHz band (for example) allocated for the police and sheriff. To solve the interoperability problem between police and fire organizations, two separate radios are required in each vehicle or more expensive and difficult-to-use dual-band radios can be used. The 700-MHz narrowband voice spectrum will solve a number of these voice interoperability issues going forward.

Many Public Safety agencies are moving forward with plans to implement 700-MHz narrowband voice systems and are or will be including the channels set aside for nationwide, regional, state, and local interoperability use. The solution proposed in the T-Mobile white paper is to remove most of the 700-MHz narrowband channels and replace them with broadband-capable spectrum. This single move would set Public Safety voice interoperability back decades and would preclude voice interoperability from ever becoming a reality. The public, Public Safety, and the FCC would be better served by concentrating on providing enough broadband spectrum for Public Safety by reallocating the D Block and then concentrating on not only building out the 700-MHz broadband systems that are needed, but also encouraging more Public Safety agencies to plan a migration path to the 700-MHz narrowband spectrum as well. With today's technology, it would be easy and cost-effective to build devices for Public Safety that include 20 MHz of broadband spectrum as well as all of the 700 and 800-MHz channelized narrowband spectrum. Over time, this might enable the FCC to reclaim some of the Public Safety channelized spectrum in lower bands and would result in a truly interoperable broadband and narrowband set of communications capabilities, which has been Public Safety's goal for many years.

One final point regarding this section is that 6.25-KHz channels will be achieved by employing a TDMA technology that provides two separate voice paths in a 12.5-KHz channel, not by channel splitting and doubling the number of channels. This type of voice communications will be reliant on base stations or cell sites and will not provide the type of peer-to-to-multi-peer communications required and being used on a daily basis at Public Safety incidents. In the recent major wildfires in the Santa Barbara area, Los Angeles Area, and in San Diego, multiple peer-to-multi-peer (simplex) channels were pressed into service in addition to command channels. During one of the major Santa Barbara fires, the total number of radio channels in use topped 100. Most were used for on-scene ground coordination by various sub-groups assigned to different locations around the fire. This does not include channels used by police, sheriff, and EMS personnel in and around the incident.

The T-Mobile white paper would limit the number of 700-MHz narrowband channels to 40, which in reality is not enough to serve a major metro area for all Public Safety services, let alone provide enough channels for major incidents such as hurricanes, earthquakes, and wildland fires. Further, their vision for these channels is for use only when units are outside of the LTE footprint, however, as previously stated, LTE cannot support simplex, tactical, or talkaround (in Internet speak: peer-to-multi-peer) without the use of a cell site.

2.4.2 Potential Long-Term Future Roadmap for the 700 MHz Band

It is a mystery to me how those who do not understand the voice requirements for Public Safety can state that, "*The packet-based air interface and architecture of LTE, and the use of Voice over Internet Protocol (VoIP), provide the opportunity for the design and deployment of a truly integrated and interoperable voice, data, and broadband (video) capable Public Safety network.*"

There is no doubt that in an ideal world, one common, IP-based, standard radio interface-based network could provide the best of all worlds for the first responder community. However, this is not reality today and it won't be reality well into the future. Once again, I would like to reference a report I submitted to the FCC on July 7, 2010, entitled "Incident Communications."[31] In this document, I explained in non-technical terms the types of day-to-day voice communications used by Public Safety and why I do not believe LTE or any broadband technology can meet the requirements. I will include one section of this article in this report for reference:

> "Consider this scenario: You are in a large shopping mall with your family and you each go in different directions, agreeing to meet later at the food court. You are in a store and you find a bargain that you want your spouse to see before you buy the item. You pull out your cell phone only to find that you do not have cell phone coverage in the mall, so you can't call your spouse's cell phone to ask him or her to meet you at the store. Your son or daughter is walking in the mall and sees someone fall down the stairs. He or she reaches for his or her cell phone to call 911, and again, finds there is no cell phone coverage, so the call cannot be made.
>
> The problem in both cases is that you are out of cell site coverage, and without a cell site, your phone does not work. It is simply a great piece of technology that is useless when you are not in range of at least one cell site. To you this is an inconvenience, but for the person who fell down the stairs and is injured, the delay in getting assistance could be the difference between living and dying. This is not acceptable in the world of Public Safety communications where those on a scene need to be able to communicate, especially with each other, no matter where they are and regardless of the conditions.
>
> There is a type of voice communications that enables Public Safety personnel to communicate among themselves even when they are out of range of a cell site or a tower site, and it is vital to the way in which Public Safety personnel on the scene of an incident operate. Using the same mall as an example, once the fire department and EMS personnel arrive, they switch their radios off of the dispatch channel to a channel that provides the ability for them to talk to each other over short distances. These voice transmissions are heard by all personnel at the incident. (To be clear, fire and EMS personnel can talk to each other, and the police, usually on another one or more channels, can talk to each other.)

[31] http://fjallfoss.fcc.gov/ecfs/document/view?id=7020550832

This capability provides good communications between those on the scene, and if they need to contact their dispatcher they can contact someone in their vehicle outside the mall, who in turn can relay the request for additional assistance to the dispatcher. Further, if a fire fighter is on the second floor of a burning building and sees that the roof is about to collapse, he or she can make a call that will be heard by all personnel in the building, alerting them to the danger. And if the person making the call is in danger, they can provide assistance. Again, this type of communications is vital to Public Safety and it is used every day at many different times."

Section 3: Use of D-Block Commercial Networks by Public Safety

Before I get into the specifics for this section of the T-Mobile white paper, I would like to ask T-Mobile, on the record, if the D Block is auctioned and T-Mobile wins part or all of it, will T-Mobile pledge, in writing, to the following:

T-Mobile will provide Public Safety with full pre-emptive access that is absolute and will cause commercial customers to lose their connection if need be so Public Safety has full access to the D Block network 24X7 during any and all incidents in which Public Safety needs access to the D Block spectrum. Further, would T-Mobile ensure that signaling channel overload would not block Public Safety priority access?

Without that level of assurance, LTE's priority access is only "best effort" and will not provide the Public Safety community with full and complete priority access to a commercial network. Further, the FCC's NBP document states that priority access will be on a priority basis but does not specify if that access will be on a pre-emptive basis. Public Safety personnel cannot be in a position where priority access means they are first in a queue (if they can get to the queue) and have to wait for a commercial user to drop a connection before a "priority" connection can be established. Any delay in access to broadband services during an incident could jeopardize additional lives and property.

If I were a commercial network operator, I would not want the responsibility, or the possibility, of my network denying service to Public Safety units during an emergency. The final statement in this section says, "*Analysis of the priority and access methods in the LTE standard as shown below, however, reveals that there are no technical impediments to providing Public Safety users immediate access to commercial networks during periods when the network is at capacity. With an appropriate FCC regulatory framework that would require sharing of spectrum during times of emergency, a robust system that serves both Public Safety and commercial Users can be realized."*

However, there are no FCC rules in place today that address this issue. So far, we have only seen vague statements about the intent of priority access in the NBP and FCC white papers. It is not reasonable to ask the Public Safety community to sign onto a priority access scheme without the rules being finalized and published for review by both commercial operators and the Public Safety community.

As it now stands, there are no requirements on a D Block auction winner to share infrastructure, sites, or other system resources. To expect Public Safety to agree to the idea of a network partnership without any firm rules in place for doing so does not make sense. Further, it would not be prudent for any entity to bid on the D Block spectrum without knowing in advance what its obligations are to the Public Safety community. This is the same question I have asked several times regarding the existing 700-MHz spectrum holders. Can the FCC now go back and impose new restrictions on the use of their spectrum and the availability of that spectrum for their customers? So far, I have not received an answer to these inquires.

Section 3.1. Basic LTE Quality of Service (Priority) Mechanisms

In the first paragraph of this section, the authors state that LTE packet streams can be slowed or delayed "on-the-fly" to accommodate higher priority streams during emergencies. They go on to cite others who have compared their experiences with 2G circuit-switched systems where traffic, once started, cannot be interrupted. However, the issues that have been raised by Public Safety have not been about circuit-switched 2G networks, they have been about 3G packet-based systems presently in operation in the United States and the rest of the world. These systems do not make use of circuit switches and while they are not capable of Quality of Service, they are able to offer some levels of priority access. It is these networks that have been criticized for their inability to provide full priority for Public Safety, and which, on a daily basis, are not usable by Public Safety in many cities even during routine incidents because of the increased traffic from others on the network.

In their descriptions of their mechanisms for priority access, the authors' comments are somewhat vague. For example, they state, "*Access barring (or cell access restriction) is performed during Connection establishment and provides a means to control the load originated by UE-originated traffic. At times of an emergency incident,* ***the mechanism can be invoked*** *to control what types of devices may access the network: for example, only Public Safety devices with access classes 11-15 may be allowed, preventing commercial users from blocking the access channel. Access class restrictions might also be needed to limit the number of possible UEs using the Random Access Channel (RACH).*

The mechanism can be invoked… Does this mean automatically or that someone sitting in a network operations center has to agree to invoke it? This is simply another attempt to assure Public Safety that its mission-critical communications will be treated as mission-critical but not providing information about how this system will actually work.

According to the table included in this section of the report, the Quality of Service (QoS) level is determined based on the type of usage on the network. Network signaling IMS has top priority, followed by conversational voice, and then others. This appears to me to mean that even during emergencies, if the network is offering VoIP services, VoIP will have priority over Public Safety data services. This is simply not acceptable to the Public Safety community, especially since consumer voice traffic will be high during times of emergencies.

My take on this section of the report is that there are a lot of variables, all of which will impact the type of priority access. Nowhere do I see listed a pre-emptive method of priority that will be higher than voice services or that could be invoked to free up bandwidth in a fully loaded cell sector. Nor do I see whether this priority will be automatic or will require intervention with Public Safety having to request it. If intervention is required, the delays could have a negative impact on the resolution of the incident, which is not acceptable.

Section 3.2 Additional Mechanisms for Giving Priority to Public Safety Users on Commercial LTE networks

Section 3.2.1 Policy and Charging Rules Function (PCRF)

This section goes into great detail about additional functionality within LTE and the back-end systems, which theoretically can benefit Public Safety. Once again, it is not clear if these rules can be set up within a network so they are instantaneously available for Public Safety or if they need to be invoked only when requested by Public Safety.

There is a big difference between Public Safety having automatic priority access to a commercial network during an incident and someone within the Public Safety organization having to request that these rules be implemented. In the case of Public Safety having to request access, serious delays in system access will occur and they will be detrimental to the activities at an ongoing incident. Further, network operators need to be able to maintain total control of their networks, which seems to put them at odds with the Public Safety community's requirements. Once again, these issues could be solved easily with the reallocation of the D Block to Public Safety's control.

Reiterating a point I have made several times, the T-Mobile white paper, as well as the FCC's own white paper, indicates that Public Safety will only have to roam onto the commercial network(s) during times of "emergencies" or larger incidents. It is my belief and that of a number of LTE vendors and Public Safety officials that if the D Block is auctioned for use by commercial operators, Public Safety, at least in the top 100 markets, will require access to the commercial networks on a daily basis or even multiple times per day. I have been creating real-world tests with the assistance of a number of police, fire, and EMS organizations around the country that indicate that in major metro areas, incidents that are classified as routine require a response of up to 50 to 75 police officers, another 30 to 50 fire and EMS personnel, and other agencies. Most of these daily incidents will use video and high amounts of data to and from the scene, and that data usage will be heaviest at the onset of the incident with video requirements building as the incident escalates. Normal police and fire activities surrounding the incident will continue, further taxing the broadband network for routine dispatch, license plate verification, and all of the other functions that will quickly become routine once the networks are placed into service.

3.2.3 Ensuring Control Channel Capacity for Public Safety Users

This section starts out with the statement, "*When an emergency incident occurs and Public Safety users are seeking to roam onto a commercial network, it is required not only to limit the low priority users from accessing the affected base stations, but also to ensure that all Public Safety users who want to gain access and establish radio connection through the base station are able to do so."* The phrase "it is required" would lead one to believe that the FCC has already set priority access rules for Public Safety roaming, but this is not the case.

This is indicative of one of the major issues Public Safety has to contend with. The Public Safety community is being asked to have faith in the fact that LTE priority will serve its needs during emergencies, but there are no agreements from existing or potential network operators that these safeguards would actually be implemented. Nor are there any real-world tests that demonstrate exactly how the LTE priority system will operate or whether the commercial network operators will permit or be required to permit full pre-emptive priority access on an automatic, when-needed basis.

Later in this section of the T-Mobile white paper is the following statement, *"The possibility of Collisions can be greatly reduced among Public Safety users if at times of emergency situation, the PRACH region is increased suitably (while PUSCH is decreased by the corresponding amount) so that the collision probability among Public Safety users attempting to get successfully past the RACH process is kept below a design threshold."* The choice of words for this section does nothing to instill confidence that collisions will not occur; the possibility that collisions can be greatly reduced does not mean they won't happen. There is mention of a "design threshold" to control collision probability, but no indication that it could or would be set for 99.999% reliability.

Also in this section, there is the statement that, *"It is worth noting that in the example cited for earlier systems, in which Public Safety users were (unsuccessfully) trying to access a commercial network (2G/3G); those networks were unaware or unable to adjust themselves for an emergency situation."* This statement and its implications are confusing. It seems to imply that in times of emergency, Public Safety personnel should be concerned with access to a radio channel and take steps to ensure that they are able to "adjust themselves" to an emergency situation. Those in the field involved in an incident need a communications tool that is mission-critical in nature. They have neither the time nor the training to be concerned with how they must "adjust" their behavior in order to ensure access to a communications link that is vital to their safety and the incident. I would not expect commercial network users to understand how to "adjust" to blocked and dropped calls or to know which steps to take to minimize such occurrences. It certainly cannot be expected that first responders will be any more knowledgeable about the inner workings of a network.

Section 3.3 An Approach for Roaming and Priority Access between Dedicated Public Safety and Commercial Broadband Networks.

The first paragraph of this section of the T-Mobile white paper indicates to me that the authors are not fully conversant with the concept of Public Safety incidents. In this paragraph, the emphasis is "*dependent on the severity of the emergency crisis.*" Every incident is considered severe until it is under control. One of the most feared of all police responses is to a domestic dispute that could start out as a verbal discussion between the police officer and the parties involved but could quickly escalate to a situation where one of the parties decides to take physical action against the officer, or brandish a knife or other weapon. If this incident is in, for example, an apartment complex, it could escalate well beyond a domestic dispute and involve many more people. In short, there is no way to predetermine how severe an emergency situation is or may become, and the severity can change in a very short period of time. Therefore, ALL emergencies must be treated as severe from the very beginning of the incident.

The scenario or list of actions that could be taken to provide priority access for Public Safety all seem to require network personnel intervention to change the network settings to enable these features. This is unrealistic in the world of Public Safety. Having to place a call to a network operations center and REQUEST priority access during an incident is not feasible. Who makes the call? Who has the authorization to ask for (demand?) that access be provided? How long does this process take? During an incident that is escalating, those on the ground are preoccupied with the incident, and while communications is of vital importance, they will not be focused on having someone make the call and request access, nor will they have time to wait while priority access is granted. Again, there are too many "ifs" involved in providing 99.999% reliability that the needed bandwidth will be forthcoming.

3.4 Prior Implementations of Priority Access without Preemption-Voice

I find it interesting that the authors chose to use GETS as a prime example of non-preemptive priority access. GETS is underutilized today because most of the time, the person initiating the GETS call is blocked from network access because the network's signaling channel is overloaded. GETS ONLY works AFTER the initiating party gains access. Further on in this section, the authors also refer to WPS but then state that "*WPS calls do not preempt calls in progress nor will WPS users monopolize all available cellular resources.*" Because Public Safety does not have complete and preemptive access to GETS and WPS, is it no wonder that GETS and WPS are little-used resources within the Public Safety community.

3.5 Necessity for Additional Work—Packet and Broadband Networks

The above sections do not prove that the Public Safety community will have priority access, only that it will have "priority completion," which is very different from priority access. If the connection cannot be established for any reason, there is no priority availability for that connection.

As many before it, this section talks about future regulations that could be put into place to provide an unknown level of priority access. Those in favor of putting the D Block up for auction are asking the Public Safety community to endorse this idea based on "faith and promises" rather than demonstrated capabilities and a set of rules that would ensure the type of priority access that is needed. In my discussions with multiple LTE infrastructure companies, not one has stated that it can guarantee priority access for first responders even with all of the various capabilities, including QoS, that are built into LTE.

Finally, there has been no indication from the commercial operators, or more importantly, from those who want to step up at the D Block auction, what level of priority access they are proposing, how it will work, if it will require human intervention on an incident-by-incident basis, and how it will handle units that may be called in from outlying areas for mutual aid. It is unreasonable to expect the Public Safety community, which is charged with protecting life and property on a 24X7 basis, to accept the vagueness that surrounds the entire subject of priority access.

This is one of many reasons I strongly advocate the reallocation of the D Block to Public Safety. The results can be almost the same, except that network control would reside within the Public Safety community and not within the commercial community. It has been proven many times over that Public Safety needs all 20 MHz of contiguous spectrum, and that re-allocating the 700-MHz narrowband channels is a move backward for both voice and data nationwide interoperability.

4. Interference

4.1 Introduction

If the statements in the introduction are true ("*the LTE physical layer specification has been designed to allow different networks to operate in adjacent spectrum with no guard band.*") then why, after the FCC started receiving comments and inquiries about the possibility of interference between the two systems, did the FCC file[32] a request for input on the need for a guard band between the D Block and the PSBL spectrum?

[32] http://urgentcomm.com/policy_and_law/news/fcc-guard-band-comments-20100520/

4.2 Previous Comments Filed

The authors in this section of the T-Mobile white paper claim that previous filings regarding interference issues were based on “worst case” scenarios. Public Safety MUST design and build its communications infrastructure for worst-case scenarios. The T-Mobile white paper makes it appear as though the only way to mitigate interference is for the D Block owner(s) and Public Safety to work hand-in-hand when deploying their networks. This is not realistic. Because 10 MHz of spectrum is not sufficient for Public Safety, it won’t be sufficient for a commercial network operator either. Therefore, the D Block operator(s) will most likely have to use more macrocells, microcells, picocells, and femtocells than will Public Safety, and in order to build the capacity they need, they will have to exceed the 44,800 sites that Public Safety agrees should be built.

If this is the case and the best way to avoid interference is to co-locate the systems and/or to plan and implement them together, a level of partnership that goes beyond anything that is practical would be required. It would seem that any time the D Block operator wanted to add a site, it would have to sit down with the Public Safety system manager and determine the best location for the next site and vice versa. In my estimation, this type of plan is not workable.

If the D Block and Public Safety sites were to be co-located and one or more sites were disabled by weather or on purpose, Public Safety would not only lose its own network, it would lose its back-up network as well. In practice, I believe that if the Public Safety network is built to Public Safety standards, there is more probability that the commercial D Block network will be off the air and the Public Safety system will remain operational. In either event, additional spectrum would not be available to Public Safety when it was most needed.

4.3 Analysis of Previous Comments

As mentioned, the authors’ statement that the example given for interference is based on a worst-case scenario is exactly how a network for mission-critical communications should be designed. The picture included in this section to “prove” that Public Safety and commercial networks can co-exist is, I believe, simply a red herring. It shows a cell site and a 4.9-GHz Public Safety system co-existing. The difference in frequencies between a cell site and 4.9 GHz is huge while the difference between a D Block cell and a PSBL cell is that they operate in adjacent spectrum. Therefore, the use of this site as an example of Public Safety and commercial sites being able to co-exist is not valid.

Further, with any communications technology, out-of-band emissions are generated and while they must be below levels specified by the FCC, a handheld device in proximity to a cell site (macro, micro, pico, or femto) that is on adjacent spectrum will suffer interference, especially since the FCC’s vision is that all Public Safety devices will be capable of operation on both the PSBL spectrum and the D Block. If the two networks were built using only macrocell sites, this interference could be minimized but would still potentially cause interference problems between users of the two systems. If, as I believe, the commercial network is constructed with additional site density to increase capacity, this interference will be experienced by the Public Safety users more often and in many different areas, especially in high-density areas. Therefore, I reject the authors’ view that the allegations of unacceptable interference are unsupported.

To further this analysis, when the FCC was discussing the release of the spectrum known as the AWS-2 and AWS-3 bands that are adjacent to T-Mobile's AWS-1 spectrum, T-Mobile continued to file comments even after an FCC interference study theoretically showed that there would be no harmful interference between the T-Mobile system and the system to be built in the ASW-2 and ASW-3 spectrum. While the technologies in this case were different, the issue was the same. No matter how carefully the systems are designed, adjacent spectrum users can and do interfere with each other. For the same reasons I then supported T-Mobile's contentions about the potential for interference,[33] I now support Public Safety's contention that there can and will be interference between the two systems.

4.3.2 Effect of Duplexer Filter

This is an interesting section of the T-Mobile white paper. The authors go to great lengths to arrive at a conclusion that without studying the channel rejection capabilities of LTE receivers (there have been no studies to date), it will be necessary to ascertain the adjacent band and adjacent channel rejection capabilities of LTE receivers before such a determination can be made. This misses the point that if the D Block is sold to commercial operators and they are to provide priority access roaming, Public Safety devices will be designed from the start with the ability to transmit and receive in both of these bands. If Public Safety devices are built to include both bands, their ability to "reject" interference from the D Block will be severely limited, making interference between the two networks even more likely.

4.3.3 Current 800 MHz Band Interference Experience

I read this section with interest and for the most part its assumptions are correct. However, the authors seem to believe that the D Block and Public Safety sites will be co-located or at least located close to each other so the signal strength received by the Public Safety receiver will be at about the same level as any signal from the D Block. I do not believe it is prudent to build a network based on assumptions such as this and all of us should learn a lesson from the 800-MHz band interference issues that still have not been completely resolved and try to avoid any probability of interference to Public Safety field units. It is incumbent on the technology experts to base their judgment on the worst-case scenario in order to protect the Public Safety community's vital communications links.

4.3.4 D Block Interference to GPS

I defer in this part of the discussion to those who are more deeply steeped in the knowledge required to make such determinations. Until we have equipment designed and in testing, we will not know to what extent this could be a problem for either the D Block user or the combined D Block and PSBL user.

Conclusions

I and numerous other professionals both in Public Safety and within the LTE industry have reviewed the T-Mobile white paper in depth, and my response is based on my own findings as well as the advice and guidance of those who work within Public Safety and the LTE segment of the wireless industry.

The T-Mobile paper was a "for hire" project and the outcome of the findings was pre-determined by the company paying for the paper. This is to be expected, however, it does raise some questions, and as pointed out, there were many sections where the authors' assumptions and conclusion were in error.

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[33] http://andrewseybold.com/static/public/commentary/commentary217.html

It was also obvious to me that the authors, while knowledgeable in their chosen field of expertise, did not exhibit any understanding of the real-world issues that confront first responders on a daily basis, how incidents are handled, and the small areas in which multiple first responders work during routine incidents. It is also clear to me that the term “emergency” is used by the authors to refer to major events that take place over a considerable amount of time rather than the Public Safety definition that every incident is or has the potential to become an emergency.

As an example, what if a citizen found a briefcase on the seat of a subway train, thought it was suspicious, and called 911? The first officer on the scene was also uncomfortable with the object and escalated the call to the next level. Those responding at this point escalated the call further by calling in both the hazmat team and the bomb squad. These first responders arrived at the scene and used their robots, cameras, and other devices only to find that the briefcase contained some file folders and someone’s lunch and had been left in the subway by mistake. Would the authors and/or T-Mobile refer to this incident as an emergency? To Public Safety, this IS an emergency and this type of event happens many times a day in many different parts of the nation and around the world. Each time our first responders are called into service, it is or could be an emergency situation and their communication capabilities MUST be mission-critical and able to provide them with the resources they need.

Having reviewed and commented now on both the FCC’s own white paper on capacity requirements for Public Safety and this recent T-Mobile paper, I am more convinced than ever that those trying so hard to make what they believe and hope will be the right decisions are doing so without fully understanding the needs of the Public Safety community or realizing that for the past few years, criminals, as well as citizens and teenagers they protect and serve, have better communications capabilities than the first responder community.

In fact, this may be one of the key issues. Because everyone has the technology available, they take it for granted that Public Safety can use the same technology across the same networks. The reality is quite different. Public Safety communications must work when all else fails, it must be available in a split second, and it must be rock solid. There can be no dropped calls, no blocked video connections, and no having to change location to be able to communicate. They need the capabilities now, regardless of where they are.

I am more convinced than ever that the way to provide Public Safety with the communications tools it needs is to reallocate the D Block and combine it with the PSBL spectrum. This would leave the 700-MHz narrowband voice channels in place and provide in a single portion of the spectrum what Public Safety has never had—interoperable voice and data communications across every city, town, and rural area in America, implemented in such a way that these interoperable communications channels are built to its standards and available for everyone who needs them from local through federal jurisdictions.

As an added benefit of reallocating the D Block to Public Safety and keeping the 700-MHz narrowband channels available, I strongly believe that in areas where Public Safety does not require the full, day-to-day usage of the entire 20 MHz of spectrum (rural America), that in conjunction with rural power companies, railroads, educational institutions, medical providers, and others, this network can serve not only Public Safety, but all of these organizations PLUS homes and businesses in rural America that have no access to broadband services today. And I believe this can be accomplished in a shorter period of time and with fewer federal dollars than any other solution being investigated by the federal government today.

Congress and the FCC have an opportunity to get this right. If they do not take full advantage now, the opportunity will be gone forever and during the next bridge collapse, Katrina, earthquake, or whatever we have to face, Public Safety will still not have the tools to communicate effectively between agencies and departments using both voice and data services. They also need these same tools on a day-to-day basis—a lost bag in Times Square could be just that, or it could be a dirty bomb. Those responsible for protecting us are entitled to the highest level of communications available. Reallocating the D Block and leaving the 700-MHz narrowband channels in place will provide Public Safety with the communications links it needs and deserves.

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