MOTOROLA

Marlene H. Dortch, Secretary
Federal Communications Commission
Office of the Secretary
445 12th Street, SW
Washington, DC 20554

July 2, 2010

Re: PS Docket 06-229
WT Docket 06-150

Dear Ms. Dortch:

Pursuant to Section 1.1206(b)(2) of the Commission's Rules, Motorola submits this written ex parte filing in the above captioned proceeding.

On June 15, the Commission released a staff white paper titled *The Public Safety Nationwide Interoperable Broadband Network: A New Model for Capacity, Performance and Cost* ("staff white paper"). The staff white paper purports to show that:

1) The 10 MHz of dedicated broadband spectrum allocated to Public Safety in the 700 MHz band for broadband communications provides more than the required capacity for day to day communications and scenarios the staff selected to analyze; and

2) For the worst emergencies even access to another 10 MHz of spectrum would be insufficient.

The staff white paper then concludes that in these situations, priority access and roaming on the 700 MHz commercial networks is the solution.

Motorola respectfully disagrees with the staff's analysis and conclusions in this white paper. As addressed in the attachment, many of the assumptions used in this paper apply to commercial systems and consumer requirements but are inapplicable to Public Safety broadband operational requirements. In addition to covering issues specifically pertinent to the staff white paper, additional implications for Public Safety of the staff's recommended plan are addressed herein.

Pursuant to the Commission's Rules, one copy of this notice is being filed electronically with the Commission. If you require any additional information please contact the undersigned at (202) 371-6900.

Respectfully submitted,

/s/ *Rob Kubik*
Robert D. Kubik, Ph.D.
Director, Telecom Relations Global

**The staff's capacity analysis suggests that 10 MHz (5+5 MHz) of dedicated spectrum provides the required capacity and the required performance for serious emergency scenarios. Is this analysis correct?**

No. Public Safety agencies do not get to predict or choose where an incident will occur. They must respond wherever the need occurs within their jurisdiction. Therefore, as Public Safety systems deploy new broadband technology, the systems must be designed to meet anticipated requirements throughout the jurisdiction or region for which the system is designed, whether the incident occurs at the center of a cell or on the cell edge. The staff's analysis is based on average sector capacity which may be applicable to consumer based deployments, but does not accurately model the network performance required for mission critical broadband Public Safety operations. These Public Safety broadband operations must be highly reliable and available even on the cell edge, to the extent possible. The cell edge capacity of any technology, especially single frequency reuse, self-interference based technologies, exhibits much less user and sector capacity on the edge of a cell. For example, based on 3GPP requirements, the average per user throughput in a sector is approximately 3 times that of the edge throughput per user.

| **Performance based on 3GPP TR 36.913 V9.0.0 (EUTRA Advanced Requirements)** | | | | | | |
|---|---|---|---|---|---|---|
| **Communications Direction** | **Antenna Config. (TxR)** | **Average Spectrum Efficiency (Sector bits/Hz.)** | **Cell Edge Throughput (per UE bits/Hz.)** | **Average to Edge Ratio (per UE)** | **5+5 MHz Average Sector Throughput (kb/s)** | **5+5 MHz Cell Edge UE Throughput (kb/s)** |
| Uplink | 1x2 | 1.2 | 0.04 | 3.0 | 6000 | 200 |
| Uplink | 2x4 | 2.0 | 0.07 | 2.9 | 10000 | 350 |
| Downlink | 2x2 | 2.4 | 0.07 | 3.4 | 12000 | 350 |
| Downlink | 4x2 | 2.6 | 0.09 | 2.9 | 13000 | 450 |
| Downlink | 4x4 | 3.7 | 0.12 | 3.1 | 18500 | 600 |

Therefore, the staff white paper overstates the capacity that would be available to agencies when an incident occurs at a cell edge. The capacity available at the point of an incident is what is relevant, not the average capacity throughout a cell. The staff white paper also seems to believe that any capacity problem can be solved just by adding more cell sites. This appears to ignore the many practical tradeoffs of adding cell sites such as increased need for backhaul links and spectrum, zoning, and cost, especially for Public Safety grade facilities.

Additionally, the staff's analysis does not accurately reflect the capacity demand. A successful solution must fully comprehend and address the needs of the Public Safety community as defined by that community. Motorola's customer research indicates the Public Safety community will require 400-1200 kb/s for tactical decision making. We have used state of the art video codec's to ensure efficient operation and have done trade-off analyses with customers who project that they will need these higher rates and the resulting higher quality video to allow for tactical operations. For example, the video could need to show whether a suspect is holding a bomb…or a baby.

The staff's white paper significantly reduces the anticipated required video data rate down to 256 - 512 kb/s while relying on the Project Safecom document.[1] While the report suggest that 256 – 512 kb/s may be sufficient for the video system under certain prescribed constraints, the report has most all items as either "Under Study" or "Not Specified" for the video acquisition and video display systems. One should not draw a formal conclusion from this previous unfinished work. We suggest that the Project SAFECOM video performance subject be revisited and evaluated by the Public Safety community and industry before any hard conclusions can come to consensus.

The staff use of average sector capacity, coupled with low-rate, low quality video, skews the analysis. Assumptions more applicable to Public Safety operational requirements should be used when predicting capacity and spectrum requirements for a mission critical broadband environment.

## Why does Public Safety need the D block spectrum?

It is contradictory to predict that Public Safety will be limited in its broadband requirements while at the same time accepting that consumer requirements for broadband will soar. To the contrary, Public Safety has identified a host of applications for broadband. Public Safety agencies will be able to utilize the data applications in place today with faster, more responsive performance, increasing their utility and benefit. Also, sufficient broadband capacity can offer access to a whole array of advanced, multimedia applications that take advantage of key enablers including:

- Bi-directional, vehicular and portable video
- Location aware real-time services
- Mobile office, in-field productivity
- Multimedia command & control
- Dynamic mapping, weather & traffic flows
- Content-rich lookups to complex databases
- Biometric data

The Public Safety broadband network can provide greater efficiencies in day-to-day Public Safety operations, management of emergency incidents and major events, as well as providing the critical support needed for catastrophic incidents. Failure to reallocate the D block to Public Safety will limit its ability to get the full use of these applications.

Given the likely increased Public Safety data consumption, Public Safety agencies that are constrained on their own network will face increasing data roaming costs to support capacity requirements on a commercial network. We note that one major carrier recently adjusted its rate plan to effectively eliminate its unlimited tier in an effort to moderate demand from users with greater airtime requirements.

[1] Public Safety Statement of Requirements for Communications and Interoperability, (Project Safecom Document) Volume II Version 1.2 2008.

## How will the staff's plan impact multi-agency interoperability?

Broadband has been promoted as a solution for Public Safety interoperability by Congress, the Commission, the Public Safety community and industry. Public Safety operations require multi-agency coordination. Even a fairly routine incident may call in over 100 responders and over 50 vehicles – all requiring coordinated, interoperable communications. More expansive incidents like the 2007 Minneapolis I-35 bridge collapse had over 128 agencies and over 1200 first responders involved in the rescue operations.[2]

Public Safety communications capacity requirements have exceeded every spectrum allocation made throughout the years. Even with improvements in technology and efficiency and sharing of systems among multiple jurisdictions, growing requirements have exceeded the spectrum capacity available. Unfortunately, continuing the same history by providing Public Safety the minimum allocation possible at the outset of broadband deployment negatively impacts the ability to ensure effective interoperability across all levels of government. Refusing to reallocate the D block to Public Safety will result in the need for future Public Safety broadband allocations that ultimately have to be sourced from another spectrum band, further hampering interoperability and significantly increasing the cost for deployment, as well as ongoing operations and maintenance.

## Will reallocating the D block to Public Safety increase the cost of the network and associated devices and evaporate the benefits of aligning to the broader commercial LTE market?

No. Public Safety will benefit from a healthy, commercial market-driven ecosystem at 700 MHz. Verizon Wireless, AT&T and other carriers have committed to using LTE for their 700 MHz deployments.[3] In fact, LTE will be the dominant commercial platform across the overwhelming majority of the commercial 700 MHz allocation. Critical mass has been achieved and the commercial eco-system at 700 MHz will not be affected by a decision to reallocate the D block. From a base transceiver (eNodeB) standpoint, we already see vendors in the process of offering Band Class 14 equipment to the Public Safety Communications Research test bed, so those investments have already been made. Also, regardless of whether the D block is reallocated, roaming across other 700 MHz commercial systems as the Commission's National Broadband Plan recommends would require devices to cover one or more commercial 700 MHz LTE band classes.

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[2] Statement of Minneapolis Deputy Police Chief Rob Allen, *Subject to Debate- A Newsletter of the Police Executive Research Forum*, Vol 24, No.3, March 2010 at page 3.

[3] "Analyst Angle: A market perspective on LTE's rollout", *RCR Wireless News*, June 30, 2010 (http://www.rcrwireless.com/apps/pbcs.dll/article?AID=/20100630/OPINION/100639995/-1, visited June 30, 2010)

## Can roaming onto carrier networks eliminate the need to dedicate the D block to Public Safety?

No. The staff's white paper positions priority access and roaming onto commercial networks as the solution, in lieu of providing Public Safety sufficient dedicated spectrum. However, large scale incidents requiring Public Safety to utilize commercial spectrum under the staff's plan, are the very same times that such incidents dramatically increase commercial networks demand and make them congested and least available to other users.

Public Safety has first hand knowledge of the need to control its communications networks. Many disaster situations have shown that commercial systems get clogged with drastic increase in demand, just as Public Safety systems do. Even priority access (without pre-emption) on a clogged commercial system does not guarantee Public Safety access to the capacity it will need.[4]

Furthermore, commercial systems are necessarily built to meet the needs of consumers, not the higher levels of reliability, availability, in-building coverage, and user feature flexibility inherent in dedicated Public Safety networks. For the worst emergencies, most commercial networks will not be available since their hardening and reliability is often less than that of the typical dedicated Public Safety system. Even the staff's previous proposals that envisioned additional hardening for commercial networks did not apply to all commercial systems. Therefore, depending on where the emergency occurs, Public Safety may or may not have service from roaming.

A Public Safety responder handing over to the commercial network looking for capacity may discover that the sites are down or overloaded and experience dropped service connections. There is no device visibility to the status of other networks and no guarantee that capacity will be available when switching between networks.[5]

In times when commercial networks are available, roaming onto a commercial carrier with priority access will offer a significant back-up capability. However, the costs of roaming, priority access, and data usage have not been factored into the staff's cost model. With overly-limited Public Safety spectrum, these costs will be considerable in daily emergency situations as well as major incidents.

Additionally, commercial LTE prioritization policy as defined in the 3GPP standard cannot distinguish between Public Safety incidents.[6] There is no ability to distinguish between a firefighter responding to a cat in a tree one day or a 4 alarm fire the next day.

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[4] For examples, see "700 MHz Broadband Public Safety Applications And Spectrum Requirements", submitted February 23, 2010 by the City of New York, and the Police Executive Research Forum paper, "Subject to Debate", March 2010.

[5] 3GPP TS 23.401 General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access (Release 9) V9.5.0.

[6] 3GPP TS 23.203 Policy and Charging Control Architecture (Release 9) V9.5.0

## What is "pre-emption" and why is this important to Public Safety?

"Pre-emption" is the ability to immediately drop active communications of low priority users off of the network during emergency incidents to direct necessary capacity to critical public safety user communications. This is an important feature that is built into the foundation of Public Safety mission critical voice communication systems.

Priority access alone without pre-emption, as the FCC staff has suggested, would not guarantee immediate access to public safety users. It only puts that a public safety user's request at the head of the queue waiting for available bandwidth to free up. The higher priority public safety user would not be allocated bandwidth if the non-priority users were active in guaranteed bit rate sessions, as are used for real-time video and voice communications. For example, citizens at the scene of an emergency who are streaming video from their smartphones to their friends, or in phone calls with their friends, could tie up the commercial bandwidth and prevent public safety access until a citizen ended his/her session and made the bandwidth available. Priority access alone is therefore unacceptable for time sensitive public safety communications, and pre-emptive access would be required.

## Can Public Safety rely on commercial carriers to provide pre-emption capabilities during critical incidents?

While providing pre-emption on a commercial network would be necessary for Public Safety operations, doing so would not be viewed as a positive experience by consumers booted off the network during an emergency. Also, requiring pre-emption on all commercial networks would essentially change the terms of operation under which operators have acquired spectrum in the previous 700 MHz band auction. A further policy challenge is deciding the priority level of next generation 911 calls by citizens with respect to the priority of communications from Public Safety users. Next generation 911 calls may involve high bandwidth video sessions.

## What is the impact to the public of removing the D block from the auction?

First, dedicating spectrum to further empower Public Safety with broadband tools benefits the entire public community being served by police officers, firefighters and emergency medical personnel. Without adequate safety and homeland security, the entire U.S. economy and way of life suffers. Second, removing the 10 MHz of the D block from the auction would be only a 2% impact on the 500 MHz the Commission has targeted for overall commercial broadband operations.

In contrast reallocating the D block to Public Safety can effectively double the capacity guaranteed to be available to protect public life and property and help ensure homeland security by reducing Public Safety's reliance on commercial networks that are often inadequately designed to meet Public Safety's operational needs.

Furthermore, removing the D block from auction does not prevent Congress from appropriating funding for Public Safety broadband deployment. The Administration and the Commission are promoting making 500 MHz of spectrum available for commercial broadband. Should Congress choose to support Public Safety through auction revenues, doing so should be accomplishable even if the D block is reallocated and not auctioned. In unveiling the Administration's proposal, Larry Summers, Director of the National Economic Council advised that Public Safety would have first claim to revenue generated by the spectrum auctions.[7]

## How do we know what quality of video is really required for Public Safety operations?

The Department of Homeland Security has established the working group Video Quality in Public Safety (VQiPS) to determine standards around video presentation in various Public Safety use cases.[8] While the industry awaits the analysis and outcomes from the working group, Public Safety agencies along with leading technology vendors have identified requirements for higher video quality and data rates. For example, New York's DoITT (Department of Information Technology and Telecommunications) has specified requirements for 1-2 Mbps cameras supporting mobile operations:

> The system shall be able to support full motion video (30 frames per second) or data transmission speeds in excess of 2 Mbps at anytime to any one user regardless of any other network activity.[9]

## Will increasing advancements in video technology allow us to transmit higher quality video using less spectrum in the near future?

On the one hand, video encoding and compression advancements anticipated in the next decade will shrink the transmit size of a given video stream by increasing the optimization of rate control, motion estimation, and adaptive noise reductions. There will also be some improvements in the LTE technology over time. However, at the same time, the number of users and traffic on both the Public Safety and the commercial networks will continue to grow. In addition, as history on both Public Safety and commercial networks has shown, valuable new applications will come to market that need more and more bandwidth to serve each user. Public Safety and the Commission all anticipate that Public Safety will need more bandwidth to accommodate this trend. This analysis is wholly consistent with the Commission's and the administration's desire to find an additional 500 MHz for commercial broadband networks.

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[7] See "White House Backs Spectrum Reallocation, Voluntary Actions" Communications Daily, June 29, 2010 at page 2.

[8] See http://www.safecomprogram.gov/SAFECOM/currentprojects/videoquality/, visited July 1, 2010.

[9] City of New York, Department of Information Technology and Telecommunication, Request for Proposal, Citywide Mobile Wireless Network, March 24, 2004.

Commercial demand for more spectrum is being driven by the amount of bandwidth required for each user, an increasing number of broadband users and a broader set of users, including machine to machine, at the same time efficiencies in bandwidth delivery improve. The same is true for Public Safety services.

Today, Motorola's analysis shows that 10 MHz alone will not support expected Public Safety video applications for real-time incident scene decision-making.[10] Thorough analysis and modeling by Public Safety agencies and leading vendors have considered the state-of-the-art, best-in-class techniques for video encoding and compression to determine the baseline capacity needs from the broadband network. Public Safety's bandwidth constraints will only worsen over time.

## Can Public Safety use delayed video or image grabs to alleviate the capacity concerns?

Delayed video is video that is transmitted at a lower rate (bits per second) than the rate at which it was captured (seemingly because of a limitation in the network's transmission capacity or in an attempt to take advantage of non-real-time compression techniques). Transmitting video in this way causes two problems. First, the video seen on the receiving end will not be real-time, so Public Safety decision making suffers.

Second, since the outgoing bits move more slowly than the incoming bits, the camera's buffer will fill and it will have to stop recording until it catches up. Video transmission that is not real-time and has large holes endangers the response by influencing decisions based on misinformation regarding the current state of the situation. Image grabs (i.e. transmitted pictures) present the same problem, but are even more limiting. For example, assessing whether an incident is escalating (decision: send more resources) or calming down (decision: do not send any more resources or switch to clean-up resources) would be severely impaired. Decisions made and actions taken can determine the extent of lost lives and damage. The most effective Public Safety response will require real-time, situational awareness of the incident as it unfolds.

## Will auctioning the D block to a commercial operator result in interference and coverage holes for Public Safety?

Yes. Interference based coverage holes will result in unexpected and unpredictable dropped calls for emergency responders.

- Coverage holes appear due to adjacent channel interference between D block Base Sites and Public Safety Base Sites.

[10] Motorola Ex Parte presentation, WT Docket 06-150 and PS Docket 06-229, April 12, 2010.

- The coverage holes may appear anywhere across the broadband coverage area as RF shadowing and multipath phenomenon create unpredictable coverage gaps where a user connection would become suddenly terminated.
- The probability of a coverage hole appearing increases when the Public Safety user travels toward the coverage edge of a Public Safety Base Site and arrives in proximity to a D block site.
- As the D block commercial operator builds out their network to increase coverage in "hot spots" or indoor locations using microcells or picocells; the probability of a coverage gap will increase.
- Coexistence analysis methods used for purposes of commercial carrier spectrum allocations, and which the staff has relied upon, are focused on overall sector throughput reduction measurements and not on specific areas of coverage outage and capacity degradations, which is necessary for determining the impact to mission critical public safety communications. [11]
- Users traveling within 80 meters of a D block site increase their probability of a sudden communications outage by over 20% and a capacity degradation of over 50%.[12]

Public Safety cannot predict or plan where an incident will occur. If an incident occurs at the location of a coverage hole, the impact is significant, even though the "average" impact throughout a cell or sector may be viewed as low.

In short, disassociating the D block from the Public Safety broadband spectrum will result in interference scenarios similar to those experienced by Public Safety in the 800 MHz band. The plan to resolve the 800 MHz interference is currently in its 6th year with no end in sight and is likely to cost the industry more than $4 billion to complete.

The only practical solutions to mitigating this potential interference are spectrum guard bands or co-located base stations facilities between Public Safety and the D block networks. Assuming the guard bands would come from the commercial spectrum allocations, this would disadvantage D block licensees from a competitive business perspective. Any required co-location of commercial and Public Safety base sites effectively prohibits public safety from competitive partnerships with other 700 MHz carriers, and introduces substantial issues with coordinating the timing of deployments between public safety needs in a given region and the commercial D block operator's budgets and operating plans.

### Can filters be used to suppress the interference between the D block and the Public Safety PSST spectrum?

No. The major interference scenario is D block base site transmitter power coming into public safety handsets in their adjacent spectrum. Practical duplexer filters that can fit into a handset form factor are not narrow enough to significantly attenuate the adjacent D block signal. A

[11] Motorola Ex Parte presentation, WT Docket 06-150 and PS Docket 06-229, April 12, 2010.

[12] Motorola Ex Parte presentation, WT Docket 06-150 and PS Docket 06-229, April 12, 2010.

forced guard band and/or reduced power allowance on the D block may help reduce the extent of this interference. Further, any guard band between the D block and Public Safety would essentially reduce the D block to only 3+3 MHz of spectrum if compliance with the LTE standard is maintained because the next channel size below a 5+5 MHz channel in the standard is 3+3 MHz .[13]

## How does the staff's plan impact competition and fair play among commercial carriers?

The staff's plan eliminates competition and hampers fair play, to the disadvantage of both Public Safety and commercial carriers. There are only two foreseeable options (as challenged as they are in other ways) to manage the interference between the Public Safety block and the D block. In a any given area, 1) the D block winner implements a guard band and is reduced to a 3 MHz channel, i.e., the next size down from 5 MHz in the LTE standard; or 2) the Public Safety and D block site deployments must be collocated and coordinated such that Public Safety will have no option but to work exclusively with the D block winner in that area.

Under option 1, the D block winner is obviously disadvantaged from a business perspective. In option 2, Public Safety agencies will be disadvantaged because their freedom of choice is removed and the D block winner becomes a sole-source partner for life. Public Safety will be forced to the terms and conditions of an adjacent neighbor motivated by consumer services. Maintenance and service upgrades of shared equipment will be dictated by the priorities of the D block winner, a profit-motivated consumer-focused business that knows it has a captive audience.

Further, the commercial auction regions chosen by the Commission may not align with practical regional areas for Public Safety broadband systems, requiring Public Safety to coordinate with multiple D block winners.

Commercial carriers outside the D block are disadvantaged by being kept from effectively competing on a level playing field to win new Public Safety LTE business. Additionally, all existing Public Safety subscriptions are likely to churn to the D block winner.

## How do differences in LTE systems and Public Safety voice systems impact the need for spectrum?

The staff has made a point in its white paper to note that broadband systems differ from current land mobile radio (LMR) technology. LTE broadband systems will greatly improve data communications for Public Safety by offering data rates unattainable on current public safety voice networks. In addition, as noted above, the choice of LTE for broadband public safety

[13] TS 36.101 V9.4.0 E-UTRA Users Equipment (UE) radio transmission and reception (Release 9)

systems can help leverage equipment economies of scale as two major commercial operators have already chosen to deploy LTE in their 700 MHz band segments.

However, the real issue at hand is not the differences in current LMR voice system and LTE systems, but the fact that Public Safety's broadband capacity needs will expand similar to those already accepted by the Commission for commercial networks and general consumers. Whether commercial operators/consumers or Public Safety agencies, systems must be designed to meet a combination of needs, not just capacity. Therefore, the spectrum available is the key parameter that affects the capacity available, as the Commission staff has readily accepted for commercial/consumer requirements but seems to reject for Public Safety.

### The staff white paper claims that Public Safety already has per-user spectrum allocations that are 25 times that of a commercial provider. Is this correct?

The staff states that in a comparison of users per MHz of spectrum that the ratio of commercial users per MHz is 25 times that of Public Safety users per MHz. Unfortunately, the staff uses an "apples-to-oranges" comparison that is irrelevant at best. The real issue is not just the number of users, but also the amount of usage and type of usage compared to operational requirements.

Even if one assumes the comparison were relevant, the ratio is only about one tenth of that the staff claims.[14] Out of the 97 MHz of Public Safety spectrum the staff considered in its calculation, 50 MHz comes from the 4.9 GHz band which the white paper clearly recognizes is well-suited only for "fixed" deployments. For mobile broadband capability, Public Safety today only has the 10 MHz allocation at 700 MHz. If one takes out the 50 MHz of spectrum the staff states is better for fixed deployments and adds in the 500 MHz of additional spectrum the staff will allocate for commercial use, the number is closer to 2.7 times.[15] Again, even this number is irrelevant. With the growth in broadband applications, it is not unreasonable to believe that a Public Safety user's capacity demand at an emergency will be greater than that of the average consumer user.

### The staff has suggested that it will give Public Safety additional spectrum sometime later, why isn't that good enough?

The fact that the D block is directly adjacent to the Public Safety band allows Public Safety to build one network, double its capacity, solve the interference issue, eliminate dropped calls and allow Public Safety to keep up with advancing requirements. Having the two bands combined to serve one network significantly reduces the cost and complexity of the network equipment and devices compared to having the spectrum split across two non-adjacent bands. Additionally, by combining the two bands, Public Safety could utilize the entire 10 MHz where having the D

[14] Staff white paper, page 3.

[15] Staff white paper, page 10.

block separated will necessitate wasting spectrum to carve out a guard band between D block and Public Safety.

This approach repeats the history of providing Public Safety with additional spectrum allocations in differing bands that are not easy to integrate and thus frustrate Public Safety interoperability. This is precisely what the 700 MHz allocations were intended to address.