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December 7, 2011

*Via Electronic Filing*

Marlene H. Dortch
Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, DC 20554

Re: WT Docket Nos. 96-86 and 06-150 and PS Docket No. 06-229
Notice of Written *Ex Parte* Presentation

Dear Ms. Dortch:

On December 5, 2011, Andrew Rein of Access Spectrum, LLC, Kathleen Wallman of Wallman Consulting, LLC (an advisor to Xanadoo Company), Paul Nagle of Capitol Decisions, Inc., Paul Kolodzy of Kolodzy Consulting, Coleman Bazelon and Giulia McHenry of the Brattle Group, and I met with John Leibovitz and Robert Alderfer of the Wireless Telecommunications Bureau. During the meeting, we discussed technical issues relating to our proposal to combine the Upper 700 MHz A Block and Upper 700 MHz D Block spectrum as part of any legislation that would reallocate the D Block to public safety services. The proposal would provide public safety significantly more spectral capacity, which in turn would a) increase the amount of spectrum public safety can lease, and/or b) reduce the amount of public funds needed to deploy and operate the public safety network. We also discussed the points made in the attached paper.

Pursuant to section 1.1206(b)(2) of the Commission's rules, 47 C.F.R. § 1.1206(b)(2), this letter and the attachment are being submitted for inclusion in the public record in the above-referenced proceedings.

Sincerely,

/s/ *Charles W. Logan*
Charles W. Logan
*Counsel to Access Spectrum*

Attachment

cc: John Leibovitz
Robert Alderfer

# IMPLEMENTING PUBLIC SAFETY BROADBAND SPECTRUM ENHANCEMENTS

## Introduction

If the Upper 700 MHz D Block is reallocated to Public Safety, the new Public Safety Broadband Spectrum (D Block + Public Safety Broadband Block) combined with the Upper 700 MHz A Block could produce dramatic benefits for Public Safety. Inevitably, combining the A Block with the new Public Safety Broadband Spectrum would require attention to certain implementation details. However, as detailed in this paper, the combination is relatively simple to accomplish and the benefits of combining the A Block with the Public Safety Broadband Spectrum greatly outweigh the costs of doing so.[1]

It already has been shown that the combination of the A Block with the Public Safety Broadband Spectrum would create a more efficient and usable spectrum configuration that would clearly provide additional spectrum for Public Safety to lease to commercial entities (thus generating additional revenues to help offset Public Safety network operating costs). In addition, some of the benefits and cost savings that could be achieved by the A Block combination have not been quantified given the lack of a straightforward way to calculate them. Nevertheless, these benefits must be considered in conjunction with implementation requirements. For example, additional spectrum leasing opportunities would result in more devices making use of this 700 MHz network. The resulting economies of scale could be expected to further reduce Public Safety handset costs and drive technological innovation to the benefit of maintaining state-of-the-art Public Safety networks nationwide. Further spectral efficiencies and related benefits would be achieved if certain contingencies were to occur, such as the selection of Verizon Wireless – the current 700 MHz C Block licensee – as a Public Safety network partner. It is against this backdrop of substantial benefits that the relatively simple implementation requirements must be assessed.[2]

This follow-up analysis addresses the primary implementation concerns expressed by the FCC. Specifically, the analysis discusses the potential for interference to GPS systems, revises the analysis of the overall incremental capacity provided by the A Block, and explains why carrier aggregation is unnecessary under the revised implementation plan described herein. As we will show below, if the D Block is reallocated to Public Safety use, the addition of the A Block spectrum would provide Public Safety with additional spectrum capacity of 16 percent, which is worth ~$2.1 billion in incremental spectrum leasing revenues over ten years.

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[1] Proceeding to allocate the D Block to Public Safety without the A Block will irreversibly forgo substantial benefits for Public Safety, including but not limited to those detailed by the paper, "Employing the Upper 700 MHz A Block to Reduce Construction and Operating Costs for the Public Safety Broadband Network," and would waste a unique opportunity. There is a narrow window of time within which action must be taken to combine the A Block with the Public Safety Broadband Spectrum. Failure to do so will result in the more intensive use of the A Block spectrum for other purposes (*e.g.*, smart grid applications for critical infrastructure entities, control channel for commercial applications, etc.) rendering the A Block unavailable for Public Safety use and limiting the full utilization of the Public Safety Broadband Spectrum.

[2] Although utilization of the A Block within the proposed band plan would require action from the 3GPP, there currently is not a completed band plan for Band Class 14 (D Block + Public Safety Broadband), thus additional 3GPP action would be required regardless. Since Public Safety and its commercial partner(s) are going to be driving 3GPP's next steps, it will be easy for them to ensure that the A Block is included in 3GPP's actions.

## GPS Interference

The GPS L1 band is located at 1562.42 – 1587.42 MHz. The mobile transmit frequencies of the A Block are located at 787 – 788 MHz. The center 1 MHz of the L1 band (1574.92 – 1575.92 MHz) is used for narrowband commercial and consumer systems and the second harmonic of the 787.46 – 787.96 MHz frequencies (frequencies that are part of the A Block) falls into this center 1 MHz.[3]

The potential for GPS interference can occur in two ways: (1) the mobile A Block transmitter creates an interfering signal at the amplifier which is coupled into the antenna in which the GPS receiver is receiving its signal; or (2) the mobile A Block transmitter creates an interfering signal at the amplifier that is coupled into the antenna and transmitted to nearby receivers. While these issues could cause difficulties to public safety users,[4] there are simple, real-world workarounds to address the potential for interference to GPS operations.

- First, devices could use specialized notch filters in addition to the duplex filters to limit this interference. In the event Public Safety devices were to employ these filters, there would be a very limited concern.[5]
- Second, in the event these notch filters were not used, GPS applications are designed to accommodate latency and outages. Thus, one solution would be to switch off GPS receivers (or let them "coast") during transmission in the 787.46 – 787.96 MHz frequencies.
- Third, since the capacity of the uplink is generally not the limiting factor, the signal power used in those carriers in the specific 500 kHz could be limited (*e.g.*, maximum 5dBm). This is equivalent to what Band 13 (C Block) did for uplink signals to protect Public Safety narrowband receivers. Doing this would decrease the second harmonic by 45 dB – that is, the second harmonic would not be a source of harmful interference to GPS systems.

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[3] Nearly all power amplifiers generate power at harmonic frequencies, in addition to the power at the fundamental frequency. Wireless transmitters are, of course, designed to limit the power at harmonic frequencies. However, they are not generally optimized since the harmonic signals may not cause interference. Signal output at harmonic frequencies can, in some circumstances, cause interference to communications operating in those frequencies.

[4] Both cases start with the device operating at peak power, 27.5 dBm. The subsequent analysis assumes that all of the transmitted power is contained in the 787.46 – 787.96 MHz band (a controllable event and highly unlikely event). Current power amplifier modules (PAMs) provide 47 dBc reduction for second harmonic signals. This can be improved if necessary. Therefore, a -19.5 dBm signal in the 1500 MHz band is generated and passed through the duplex filter. Band 13 duplex filters provide 46 dB of rejection to the antenna and 74 dB of Tx/Rx isolation to the receiver. Therefore, the antenna port will get a signal of -65.5 dBm/MHz. The receiver will get a signal of -93.3 dBm/MHz. Line-of-sight propagation with realistic losses (6dB) would have an additional loss of 52 dB at 3 meters bringing the transmitted GPS signal to -117 dBm/MHz. The sensitivity limit for GPS is typically -147 dBm per 3GPP standard.

[5] The insertion loss of the notch filters should not be a concern in urban and suburban capacity deployments. In rural deployments, use of this portion of the band could be limited for uplink. The capacity of such rural deployments is limited most likely for the downlink data rates. The additional expense related to the inclusion of notch filters would be minimal – a cost of approximately $6.6 million for five million devices (or approximately $1.31 per filter), *See* Avago Press Release, "Avago Technologies Introduces the Industry's First GPS Front-End Modules that Integrates an FBAR Pre-Filter with a Low Noise Amplifier" (Nov. 9, 2009), *available at*: <http://www.avagotech.com/pages/en/press/alm_1912>. – although there may be additional discounts for purchasing in volumes of greater than 10,000 filters. Further, the additional spectral capacity derived from the inclusion of the A Block will drive many more devices deployed in the band and the resultant economies of scale would dwarf the small additional costs associated with adding notch filters.

These alternatives are relatively simple and cost-effective means of addressing the potential for A Block second harmonic interference to commercial GPS systems when implemented prior to actual deployment and do not require substantial monetary or frictional costs.

**Incremental Capacity Provided by the A Block**

A combined D Block + Public Safety Broadband Block would yield two 10 MHz spectrum blocks. A conventional LTE deployment would use a 10 MHz block to house 9 MHz of usable carriers and 500 kHz of roll-off on either side for the uplink. For the downlink, a 10 MHz block would house 8.46 MHz of usable spectrum with 500 kHz roll off on either side (the reduced amount of spectrum for the downlink is to ensure 2 MHz of spacing between the Public Safety Narrowband downlink and commercial cellular downlink signals).

If the A Block were combined with the Public Safety Broadband Spectrum, the spectrum available for Public Safety broadband would consist of two 11 MHz LTE blocks. The downlink would be comprised of 9.36 MHz of usable carriers with 500 kHz spacing on one side and 930 kHz spacing on the other side. The uplink would be comprised of 9.9 MHz of usable carriers with 500 kHz of spacing on the lower side and 600 kHz of spacing on the upper side.[6]

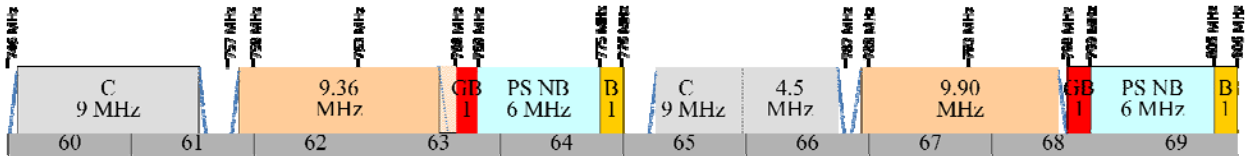


**Figure 1: Proposed 700 MHz Band Configuration**

However with advanced signaling, as is used by Verizon Wireless in the C Block, the spectrum between the new Public Safety Broadband Spectrum (A+D+PSBB) and Public Safety Narrowband spectrum can be utilized wherever Public Safety is not deployed in the lower 1 MHz of the Public Safety Narrowband block for narrowband operations, which will be entirely within Public Safety's control.[7] Therefore, utilizing advanced signaling produces 10.44 MHz of usable Public Safety broadband spectrum for both the uplink and the downlink segments.[8] Thus, assigning the 2 MHz A Block spectrum to Public Safety increases the Public Safety Broadband Spectrum by 10 percent, but results in an operable spectrum gain of 16 percent for Public Safety.[9] In short, the relative benefits

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[6] Public Safety radio vendors have indicated the need for 2 MHz spacing between PS narrowband signals and any commercial, or cellular configured, downlink system. Thus, the uplink segment contains more usable spectrum because it does not have to contend with potential interference with the downlink signals of Public Safety Narrowband operations.

[7] In the event that the lower 1 MHz of Public Safety Narrowband spectrum is used for broadband communications, the efficiencies of adding the A Block would not be diminished. Where the lower 1 MHz of Public Safety Narrowband spectrum is used for narrowband operations, the amount of usable spectrum in the downlink portion of the Public Safety Broadband Spectrum would decrease by 540 kHz. If either of the current versions of House legislation is passed, however, this reduction in usable broadband spectrum would not occur as both pieces of legislation phase-out narrowband use of the current Public Safety Narrowband spectrum.

[8] On the mobile transmit side, the bands would be shifted to allow appropriate spacing to the Band 13 transmitters and to provide almost 19 MHz of duplex spacing, which is consistent with Band 17 duplex spacing.

[9] The gain in usable spectrum would be 16 percent (from 18 MHz to 20.88 MHz). Where the lower 1 MHz of Public Safety Narrowband spectrum is used for narrowband operations, the gain in usable spectrum would be 13 percent (from 17.46 MHz to 19.8 MHz). *See supra*, n. 7. The 13 percent increase in usable capacity – which would provide approximately $1.7 billion in incremental spectrum leasing revenues over ten years -- is a worst-case scenario (*i.e.*, it

of adding the A Block would continue to be non-linear in that the percentage increase in usable spectrum would exceed the percentage increase in absolute spectrum.

**Carrier Aggregation**

The proposed plan outlined above utilizes a single 11 MHz carrier, thus obviating the need for carrier aggregation. Thus, any concerns regarding the need to wait for adoption of associated 3GPP carrier aggregation standards are rendered moot.

**Conclusion**

If the D Block is reallocated to Public Safety use, the addition of the A Block spectrum would provide Public Safety with additional spectrum capacity of 16 percent, which is worth ~$2.1 billion in incremental spectrum leasing revenues over ten years. The addition of the A Block spectrum to the Public Safety allocation would involve relatively simple implementation measures addressed herein. The minimal costs of those measures continue to be dwarfed by the quantified economic benefits derived from Public Safety's use of the A Block spectrum. Further weighed against the minimal implementation costs are the additional substantial unquantified economic benefits resulting from the combination. In order to realize these benefits, however, the A Block must be combined with the Public Safety Broadband Spectrum within a narrow period of time. Failure to do so will waste a unique opportunity and irreversibly forgo substantial benefits for Public Safety.

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assumes that the lower 1 MHz of the Public Safety Narrowband spectrum will be used for narrowband operations in 100 percent of the nation's geography). Even if legislation phasing out narrowband usage does not become law, we believe it is highly unlikely that the lower 1 MHz of Public Safety Narrowband spectrum will be used for narrowband operations on a widespread basis. As such, we believe the 16 percent figure is closer to the actual increase in usable spectrum that would be achieved by the addition of the A Block.