Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Service Rules for the 698-746, 747-762 and 777-792 MHz Bands	)	WT Docket No. 06-150
	)	
Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems	)	CC Docket No. 94-102
	)	
Section 68.4(a) of the Commission's Rules Governing Hearing Aid-Compatible Telephones	)	WT Docket No. 01-309

COMMENTS OF ACCESS SPECTRUM, LLC, COLUMBIA CAPITAL III, LLC, PEGASUS COMMUNICATIONS CORPORATION AND TELCOM VENTURES, LLC

Michael I. Gottdenker, Chairman and CEO
Andrew J. Rein, Director, Strategy & Operations
Access Spectrum, LLC
2 Bethesda Metro Center
Bethesda, MD 20814-6319

Ruth Milkman
Kenneth Boley
Gunnar Halley
Lawler, Metzger, Milkman & Keeney, LLC
2001 K Street NW, Suite 802
Washington, DC 20006
kboley@lmmk.com
Counsel to Access Spectrum, LLC

Donald Doering, Chief Finanacial Officer
Columbia Capital III, LLC
201 North Union Street, Suite 300
Alexandria VA 22314

Marshall W. Pagon, Chairman and CEO
Cheryl Crate, Vice President for Corporate Communications and Government Relations
Pegasus Communications Corp.
225 City Avenue, Suite 200
Bala Cynwyd, PA 19004

Kathleen Wallman
Wallman Consulting, LLC
9332 Ramey Lane
Great Falls, VA 22066
(202) 641-5387
wallmank@wallman.com
Adviser to Pegasus Communications Corp.

Dr. Rajendra Singh, Chairman & President
Telcom Ventures, LLC
201 N. Union Street, Suite 360
Alexandria, VA 22314

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TABLE OF CONTENTS

I. Introduction and Summary 1

II. Discussion 5

A. The Need for Change 6

B. Band Plan 11

1. Enhanced U.S. Broadband Development and Improved Opportunities to Assert Global Leadership Through Superior Technological Flexibility, and Increased Capacity and Reduced Costs 11

2. Increased Benefits to Public Safety 17

3. More Efficient Use of the Spectrum 21

4. Greater Opportunities for New Entrants 22

C. Geographic Areas 23

D. Package Bidding 25

E. Efficient Mechanisms for Addressing Interdependence with Already-Licensed Spectrum 28

F. Technical Rules, Service Rules and License Term 31

1. Technical Rules 31

2. Service Rules 34

3. License Term 35

G. Bidding Preference for Commercial Operators Providing Public Safety Benefits 35

1. The Problems: High Infrastructure Costs and Need for Access to Additional Spectrum 37

2. The Solution: Creating Correct Incentives for Commercial Operators 39

III. Conclusion 44

Attachments

A: Declaration of Dr. Gregory Rosston and Dr. Scott Wallsten

B: Declaration of Dr. Paul Kolodzy

C: Declaration of Dr. Stagg Newman

Appendix: *Legal Authority for the Issuance of Public Safety Partner Bidding Preferences*

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I. INTRODUCTION AND SUMMARY

The long awaited 700 MHz auction is the FCC's last and best opportunity for a 4G auction in the United States – but only if it adjusts the band plan and rules as we proposed herein. A 4G auction[1] would open the door to create truly ubiquitous wireless broadband services providing access to real-time mobile video as well as data and voice for both commercial and public safety uses. To this end, the FCC must adopt a band plan for the Upper 700 MHz band plan based on 5.5 MHz blocks for both commercial and public safety allocations.[2]

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1 The term "4G" has not yet been formally defined. For purposes of these comments, we use the term 4G to mean the next wave of wireless services beyond today's 3G technologies.

2 Although the *Notice* concerns both the Upper and the Lower 700 MHz bands, Access Spectrum, LLC ("Access Spectrum"), Columbia Capital III, LLC ("Columbia Capital"), Pegasus Communications Corporation ("Pegasus") and Telcom Ventures ("Telcom Ventures") have focused on the significant changes that should occur in the Upper 700 MHz band where they hold licenses or license interests. *Service Rules for the 698-746, 747-762 and 777-792 MHz Bands*, Notice of Proposed Rulemaking, Fourth Further Notice of Proposed Rulemaking, and

In addition, this auction presents a unique opportunity for the FCC to confer a benefit of more than $6 billion on the public safety community ("Public Safety") by granting a bidding preference to any firm that agrees to use the commercial licensed spectrum adjacent to public safety spectrum to provide both public safety-grade infrastructure for a nationwide, interoperable network for use by Public Safety with its own exclusive spectrum, as well as providing priority access to the commercial spectrum. The combination of the changes in the band plan, the bidding preference, and the Broadband Optimization Plan will enable Public Safety to overcome the enormous cost obstacles of implementing a wireless broadband network. Failure to adopt such a plan could leave Public Safety unable to access the widest range of technology options, take advantage of commercial opportunities of scale or fund its use of robust 4G, or even 3G, technologies.

The Upper 700 MHz band is becoming available in circumstances that will create a rare "greenfield" opportunity for 4G services and applications. 4G wireless services will be about pervasive, inexpensive access to rich media and web services, including full motion video, on a range of mobile and nomadic devices. 4G services and applications will allow public safety and commercial users to send video and user-generated content to and from mobile devices, and enable reliable service anywhere the user goes – from coast to coast, in cities, suburban and rural areas, inside or outside buildings and homes. Much has changed since the adoption of the current band plan and rules in 2000[3] and this proceeding presents a one-time opportunity to optimize the use of this uniquely valuable spectrum.

Second Further Notice of Proposed Rulemaking, 21 FCC Rcd 9345 (2006) (FCC 06-114) ("*Notice*"). As a result, while addressing the Lower 700 MHz band occasionally, these comments focus primarily on the Upper 700 MHz band.

[3] *Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules,* First Report and Order, 15 FCC Rcd 476 (2000).

In lieu of the current band plan, we propose the creation of 5.5 MHz paired blocks in the Upper 700 MHz band, spectrum that will serve as the broadband platform for 4G. The proposal we advance here assumes prior or contemporaneous adoption of the Broadband Optimization Plan ("BOP"), submitted in the *Public Safety 700 MHz Broadband* proceeding.[4] The implementation of the BOP, which includes the allocation of an additional 1.5 MHz paired to Public Safety, would result in a 5.5 MHz paired broadband block in the Public Safety allocation. At the completion of implementation of the BOP and the proposal presented, the Upper 700 MHz band would enable four 5.5 MHz paired blocks, with one 5.5 MHz pair in the public safety allocation and a total of 16.5 MHz paired in the commercial allocation (including the A Block of 1.5 MHz paired). The spectrum, thus configured, would be ideally suited for the deployment of mixed-use public safety-commercial systems offering state-of-the-art wireless services and applications and affording public safety users tremendous economic benefits.[5] We also discuss below how the FCC could provide incentives to commercial operators to build such mixed-use systems through bidding credits, conditioned upon the bidders' commitment to offer broadband network infrastructure and priority access to broadband capacity at no cost to public safety users.

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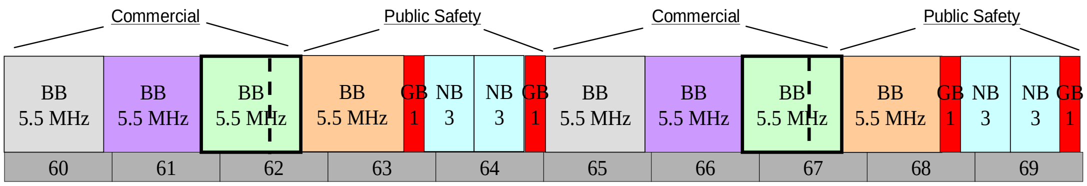
[4] Comments of Access Spectrum, L.L.C., Columbia Capital III, LLC, Intel Corporation, and Pegasus Communications Corporation, WT Docket No. 96-86, at 13-14 (June 6, 2006) ("*BOP Comments*") (filed in the *Public Safety 700 MHz Broadband* proceeding: *The Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010,* Eighth Notice of Proposed Rulemaking, 21 FCC Rcd 3668 (2006) ("*Public Safety 700 MHz Broadband NPRM*")).

[5] The FCC's pending proposals with respect to public safety broadband and the Upper 700 MHz A and B Blocks are intrinsically related to the issues in this commercial 700 MHz proceeding. All issues relating to public safety and commercial use of 700 MHz must be considered and resolved at the same time, prior to the auction of additional licenses in the 700 MHz band, in order to create the benefits described herein. The timetable for the concurrent *A&B Block* proceeding (*see infra* note 12) provides adequate time for the FCC to make the necessary changes.

Proposed Upper 700 MHz Band Plan, Assuming Adoption of BOP



BB=Broadband; NB=Narrowband; GB=Guard Band

The proposal would expand the benefits to Public Safety and improve the Upper 700 MHz commercial spectrum, measurably improving the status quo by promoting four significant public policy goals:

(1) Enhance U.S. broadband development and promote U.S. global leadership by maximizing technology options: As the last significant broadband spectrum auction on the horizon, the 700 MHz band represents the FCC's final opportunity to set the stage for U.S. global leadership in 4G. The 5.5 MHz building block approach is superior for both 3G and 4G technologies because it affords an 11 – 33 percent increase in capacity with a 10 percent increase in spectrum, leading to superior performance.

(2) Leverage commercial deployment to lower costs for Public Safety: By establishing 5.5 MHz blocks, the FCC can facilitate the opportunity for Public Safety to take advantage of economies of scale as manufacturers develop products for commercial operators in adjacent bands, which in turn increases the total market size. In addition, our proposal includes incentives for commercial operators to provide priority access to public safety agencies, as well as to share infrastructure.

(3) Use all available spectrum efficiently: Consistent with the mandate of the Communications Act,[6] our proposal structures the spectrum bands and the auction in a way that maximizes the capacity available for allocation and use, so as not to waste spectrum. Allowing use of more spectrum means that service providers will be able to construct networks at a lower dollar per MHz cost, thereby enabling greater investment, superior performance, and the delivery of a larger variety of services at lower prices to a larger number of customers.

(4) Enable new broadband entrants: The plan that we propose allows for a variety of entry strategies and, through the use of well-crafted auction rules including package bidding, will increase competition for all aspects of 4G, including access to networks, applications, and services.

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6 47 U.S.C. § 309(j)(3)(D).

As discussed in greater detail below, in order to achieve these goals, the Commission must:

- Alter the Upper 700 MHz commercial rules and band plan in light of changed circumstances, including the advent of 4G technologies and the BOP. (Section II.A)
- Divide the 33 MHz of commercial spectrum into blocks that can be used to create segments of 5.5 MHz paired (as illustrated above). (Section II.B)
- Auction the blocks by Major Economic Area (MEA). (Section II.C)
- Use package bidding in order to facilitate entry and enable the creation of larger geographic areas. (Section II.D)
- Create efficient mechanisms, including two-sided auctions, to address interdependence with already-licensed spectrum, specifically the A Blocks. (Section II.E)
- Design the service and technical rules to maximize technological flexibility and spectrum capacity, minimize infrastructure costs, and protect operations in the Upper 700 MHz public safety spectrum. (Section II.F)
- Establish an incentive (in the form of a bidding preference) for commercial operators to provide public-safety grade infrastructure and priority access for Public Safety. (Section II.G)

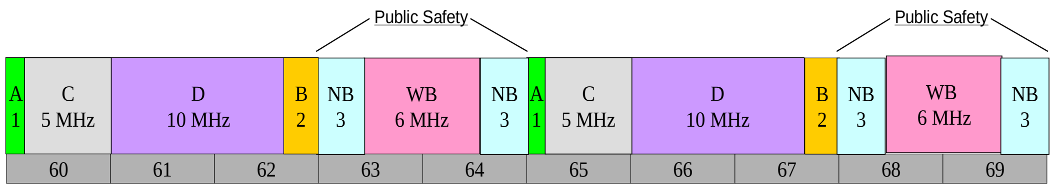
II. DISCUSSION

Material changes in the circumstances since the adoption of the current Upper 700 MHz band plan make the current plan suboptimal for achieving today’s commercial and public safety wireless broadband needs. We have devised a plan for the Upper 700 MHz band that offers measurably greater benefits for both the commercial and public safety interests in this changed environment.

A. The Need for Change

When the initial band plan for the Upper 700 MHz commercial spectrum was adopted, the Commission contemplated that 30 MHz would be available for unrestricted commercial use, as well as 6 MHz for guard bands and 24 MHz for Public Safety.[7]

Current Band Plan



WB=Wideband; NB=Narrowband; GB=Guard Band

This plan, designed almost a decade ago, came into being before the wireless broadband advances of recent years, before 4G was near commercial availability, and before the establishment of a date certain for the DTV transition. Consequently, the band plan was not set up to optimize opportunities for implementation of the public safety and commercial wireless broadband applications that are currently available and being developed.

Voice and narrowband data services will no longer be the focus of new consumer wireless usage. The demand trends in wired broadband presage what will come. In a wired broadband environment, demand is skyrocketing for video and other rich media content. Consumers are increasingly using the Internet for video applications, whether downloading or streaming television and movie programming from content producers, exchanging video files on peer-to-peer networks, or simply passing along homemade videos.

The explosive use of video offerings on iTunes using iPod devices is evidence that the demand for IP-based video extends beyond wired computers; consumers want to take their IP-

7 *See Notice* ¶¶ 5-10.

based video with them into mobile environments.[8] The ultimate goal is the downloading/streaming of video and other content rich applications directly to a mobile wireless device using spectrum such as 700 MHz. According to an Insight Research report, streaming video and music accessed through the Internet and mobile devices will generate $27 billion in revenue over the next 5 years.[9] Recent reports estimate that "[b]y the end of 2010, mobile TV broadcast subscribers worldwide will reach 102 million, a giant leap from 3.4 million in 2006."[10] Whether it is accessed via streaming or downloading, users want their video "to go."[11]

In the context of public safety, this may mean an officer on the ground downloading live video surveillance from a helicopter or emergency medical personnel transmitting not only vital signs, but also videos of a patient from the ambulance to the hospital. In the commercial context, this may mean having a video conference from a handheld device. From a service provider's perspective, this platform offers cutting edge technology that fully integrates standardized

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8 *See* Scott Ferguson, "Apple Launches New Movie Feature for iTunes," EWEEK (Sep. 12, 2006), *available at*: <http://www.eweek.com/article2/0,1759,2015207,00.asp> (Apple "claims it has sold more than 35 million videos through iTunes").

9 Nicholas Carlson, "Report: Streaming Video to Reach $27B," INTERNET NEWS (April 24, 2006), *available at*: <http://www.internetnews.com/stats/print.php/3601271>; *see also* "Video iTunes Triggered Online Video Big Bang, Says ABI Research," BUSINESS WIRE (Jan. 23, 2006), *available at*: <http://www.findarticles.com/p/articles/mi_m0EIN/is_2006_Jan_23/ai_n16019662>.

10 "Mobile TV Broadcast Subscribers to Leap to 100 Million by 2010," IN-STAT (June 21, 2006), *available at*: <http://instat.com/press.asp?ID=1694&sku=IN0603200MBS>.

11 "A Fuzzy Picture," THE ECONOMIST (Jan. 5, 2006), *available at*: <http://www.economist.com/business/displaystory.cfm?story_id=5356658&no_jw_tran=1&no_na_tran=1> ("At the moment, mobile TV is mostly streamed over 3G networks. But sending an individual data stream to each viewer is inefficient and will be unsustainable in the long run if mobile TV takes off. So, the general consensus is that 3G streaming is a prelude to the construction of dedicated mobile-TV broadcast networks, which transmit digital TV signals on entirely different frequencies to those used for voice and data. . . . [S]ome shows (such as drama) better suit the download model, while others (such as live news, sports or reality shows) are better suited to real-time transmission . . .").

computing (as currently used) with mobile telecommunications, thereby increasing the business plan options for commercial use of the band.

The spectral characteristics of 700 MHz are ideally suited to meet this demand. In fact, the spectral characteristics that made this band ideal for high bandwidth video transmissions in the form of broadcast television are precisely the same characteristics that make it ideal for broadband use in a digital environment for the next generation of wireless services.

The changed circumstances warrant a re-examination of the manner in which the commercial, public safety, and guard band spectrum are organized (which, of course, affects the manner in which the various spectrum blocks can be used). The first stage in the re-examination is occurring in the Commission's *Public Safety 700 MHz Broadband* proceeding, where Access Spectrum, Pegasus, Intel, and Columbia Capital proposed the BOP for the Upper 700 MHz band that would increase spectral efficiency, flexibility and capacity for public safety users.[12]

Under the BOP being considered in the *Public Safety 700 MHz Broadband* proceeding (see depiction below), 5.5 MHz paired would be available for public safety broadband, the A Block would become 1.5 MHz paired,[13] and technical and band manager rules that currently

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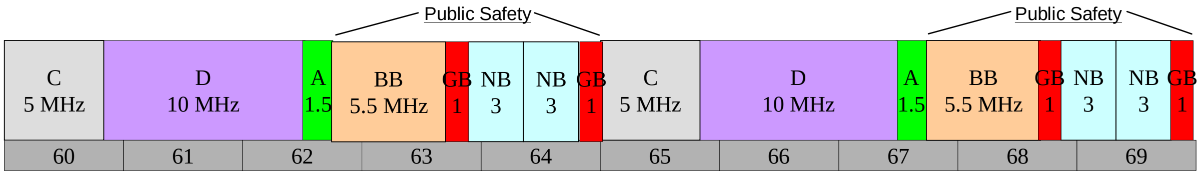
[12] *BOP Comments*. There is a growing consensus that the Broadband Optimization Plan would be a significant improvement to the plan of record. Access Spectrum and Pegasus, in conjunction with the public safety community, Motorola and M/A-Com, are making considerable progress toward resolving the technical issues associated with adoption of the plan, details of which will be filed in the proceeding addressing the Upper 700 MHz A and B Blocks: *Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission's Rules; Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010*, Notice of Proposed Rulemaking, 21 FCC Rcd 10413 (2006) (FCC 06-133) ("*A&B Block* proceeding").

[13] As a rule of thumb, next-generation technologies require at least 1.25 MHz of contiguous spectrum to provide broadband service and another few hundred kHz as a buffer for interference protection to and from adjacent channel broadband operations (unless adjacent operations use a compatible broadband technology). The 1 MHz paired A Block cannot accommodate 1.25 MHz broadband channels, and the 2 MHz paired B Block permits a single broadband channel, but in

hinder the use of the spectrum for broadband would be replaced by more standard commercial rules.

Broadband Optimization Plan



BB=Broadband; NB=Narrowband; GB=Guard Band

It would result in the availability of 33 MHz of unrestricted commercial spectrum in the Upper 700 MHz band, an increase of 3 MHz over the current configuration.[14] In addition, adoption of the BOP would remove the need for the technical restrictions, such as the prohibition on cellular architecture, which currently apply to the A and B blocks, thereby enabling those blocks to be utilized for next-generation technologies.[15] Since the C and D blocks have not yet been licensed, the FCC has the opportunity to consider the optimal band plan for the entire 33 MHz.[16]

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doing so leaves several hundred kHz paired of unused spectrum. A paired 1.5 MHz segment is sufficient spectrum to support broadband deployment. *See* "Implementing the Vision for 700 MHz: Rebanding the Upper 700 MHz A and B Blocks for Next-Generation Wireless Broadband, A White Paper Submitted by Upper 700 MHz A and B Block Licensees," submitted by Access Spectrum, L.L.C., Pegasus Guard Band, L.L.C., Columbia Capital Equity Partners III, L.P., and PTPMS II Communications, L.L.C. with support from Enterprise Wireless Alliance, attached to letter from Kenneth R. Boley to Marlene H. Dortch, WT Docket No. 05-157 (Aug. 3, 2005) ("*August 3 White Paper*"); and "Rule Changes to Implement the Proposed Rebanding of the Upper 700 MHz A and B Blocks for Next Generation Wireless Broadband," submitted by Access Spectrum, L.L.C., Pegasus Guard Band, L.L.C., Columbia Capital Equity Partners III, L.P., and PTPMS II Communications, L.L.C. with support from Enterprise Wireless Alliance, attached to letter from Kenneth R. Boley to Marlene H. Dortch, WT Docket No. 05-157 (Nov. 4, 2005) ("*Supplemental White Paper*").

14 As Access Spectrum, Columbia Capital, and Pegasus explained in their *BOP Comments*, the BOP also results in more spectrum for public safety use and much greater flexibility in the technologies that public safety could utilize in the band. *BOP Comments* at 4-6.

15 The BOP would also enable the creation of guard bands internal to public safety spectrum for the protection of public safety narrowband operations. The internal "guard bands" are designed primarily to protect public safety narrowband operations from interference from the commercial blocks; however, they are also designed to allow commercial blocks to maintain

The plan proposed here builds on the BOP to create a far superior band plan for the Upper 700 MHz band. As depicted below, the 33 MHz of commercial spectrum would be divided into blocks that can be used to create segments of 5.5 MHz paired, all auctioned by Major Economic Area ("MEA"). The auction rules would include package bidding[17] in order to facilitate new entry. These blocks would be subject to service and technical rules designed to maximize technological flexibility and spectrum capacity, minimize infrastructure costs, and protect narrowband operations in the Upper 700 MHz public safety spectrum.[18] The commercial plan would also provide for a bidding preference for the commercial licensees adjacent to Public Safety if the commercial licensee(s) agree to provide infrastructure and priority access to public safety agencies for free.

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either the current service rules or updated rules that permit full commercial wireless broadband use. The FCC should make it clear that any public safety operations deployed *within* the spectrum set aside as "guard bands" should not expect any interference protection from the adjacent commercial operations.

16 We are confident that the BOP will prove to be the best approach and will be implemented. However, even if the BOP is not adopted, the Commission should not limit its options to those consistent with 30 MHz, but rather should consider the options presented by the entire 36 MHz now allocated for commercial use in the Upper 700 MHz band. The additional 6 MHz of spectrum and the reconfiguration of the public safety allocation contemplated in the White Papers filed in 2005 by the A and B Block licensees would be much more conducive to broadband applications. *See August 3 White Paper* at 4-6 and Appendix. Moreover, new technical solutions permit the Commission to avoid having 6 MHz of valuable spectrum dedicated to "guard bands."

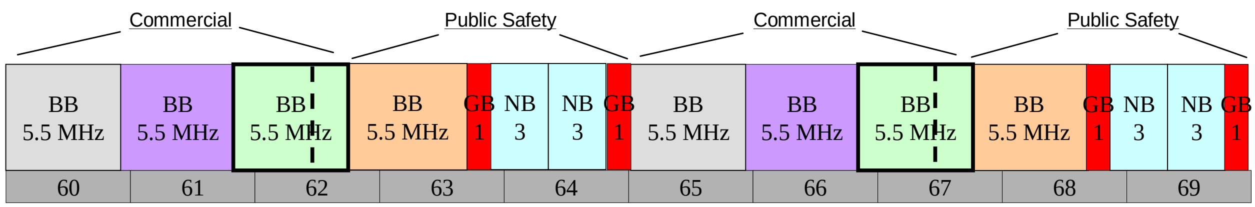
17 Package bidding allows bidders to submit all-or-nothing bids for groups of licenses as distinct from the more traditional auction method of only allowing bidders to place a separate bid for each individual license.

18 As proposed in the *Public Safety 700 MHz Broadband* proceeding, the BOP is specifically designed to protect public safety narrowband operations, including the provision of additional spectrum to public safety for use as internal guard bands. The technical rules for the commercial spectrum in the Upper 700 MHz band must continue to protect public safety narrowband operations. *See* Section II.F.1 below.

B. Band Plan

The commercial blocks would be arranged based on a plan of paired 5.5 MHz segments, as illustrated below.

Proposed Upper 700 MHz Band Plan



BB=Broadband; NB=Narrowband; GB=Guard Band

This configuration offers improved opportunities to assert global leadership through superior technological flexibility, increased capacity, and reduced operational and deployment costs. It also benefits Public Safety by dramatically reducing costs, and results in more efficient use of the spectrum and greater opportunities for new entrants.

1. Enhanced U.S. Broadband Development and Improved Opportunities to Assert Global Leadership Through Superior Technological Flexibility, Increased Capacity and Reduced Costs

Chairman Martin has indicated that broadband development is his top priority.[19] The forthcoming 700 MHz auction can further the expansion of 3G wireless broadband technologies and accelerate the introduction of 4G technologies that are necessary to the achievement of Chairman Martin's broadband development goals. Moreover, this proceeding can also create an opportunity for domestic technological development in 4G wireless broadband technology that can lead to increased exports of products incorporating American technology around the world.

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[19] Written Statement of the Honorable Kevin J. Martin, Chairman, Federal Communications Commission, Before the Committee on Commerce, Science & Transportation, United States Senate, at 2 (Sep. 12, 2006), *available at*: <http://commerce.senate.gov/public/_files/MartinStatement.pdf> ("I have made broadband deployment my highest priority at the Commission.").

The FCC's spectrum management function plays a critical role in this effort.[20] Many of the world's leading telecommunications equipment manufacturers have explained to the FCC that optimal spectrum policy can assist them in the global market for telecommunications equipment.[21] Qualcomm's success in selling CDMA technology internationally is an example of the way in which spectrum-based policies at the FCC can promote U.S. competitiveness abroad.[22]

By allocating 5.5 MHz blocks instead of 5 MHz blocks, the FCC can ensure a more efficient use of the 60 MHz of spectrum in the Upper 700 MHz band in a manner that is

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20 Two years ago, the U.S. Department of Commerce held over 20 public roundtables to discuss challenges confronted by American manufacturers. The resulting 2004 report advances policy recommendations to maximize the competitiveness of U.S. manufacturers, one of which is to reinforce efforts to promote the sale of American manufactures in global markets by, *inter alia*, promoting global use of U.S. technical standards. "Manufacturing in America: A Comprehensive Strategy to Address the Challenges to U.S. Manufacturers," U.S. Dept. of Commerce, at 79 (Jan. 2004), *available at*: <http://www.commerce.gov/opa/press/Secretary_Evans/2004_Releases/Manufacturing%20Report/DOC_MFG_Report_Complete.pdf>; *see also id.* at 69 ("[I]n many respects, international standards will define access to the global marketplace.").

21 *See Amendment of the Commission's Rules to Provide for Operation of Unlicensed NII Devices in the 5 GHz Frequency Range*, Report and Order, 12 FCC Rcd 1576, ¶ 20 (1997). There, the Commission recognized that its actions would "promote the ability of U.S. manufacturers, including small businesses, to compete globally by enabling them to develop unlicensed digital communications products for the world market." *Id.* ¶ 1.

22 *See, e.g.*, "Qualcomm Ends Year with Flourish," GLOBAL WIRELESS.COM (Nov. 8, 2002) ("Qualcomm closed its fiscal year with a flourish, as sales in Asia helped bring about a return to profitability, the company reported Thursday. . . . 'We continue to execute on our strategy for increasing global acceptance of our technology, and these efforts bore fruit with the commercial launch of the first CDMA network in China, the first two commercial deployments of our high-speed cdma2000 1xEV-DO networks in South Korea and . . . in the United States with Monet Mobile, and the successful introduction of our BREW applications development platform in South Korea, Japan and the United States,' said Dr. Irwin Jacobs, Qualcomm's chairman and chief executive officer (CEO)."). In the first quarter of 2006, 29% of global handset shipments contained CDMA technology and, in the same period, Qualcomm estimates that WCDMA handset sales by manufacturers represented approximately 30% of all manufacturer handset sales in Western Europe. *See* Qualcomm Incorporated, Form 10-Q Quarterly Report, at 21 (July 19, 2006), *available at*: <http://www.sec.gov/Archives/edgar/data/804328/000093639206000709/a22159e10vq.htm>.

technology neutral with respect to both 3G and 4G technologies. This will promote greater U.S. wireless broadband development while also increasing the likelihood that other countries adopt a 5.5 MHz profile. International adoption of the U.S. model will further enhance the benefits of scale economies not just for foreign users but also, more importantly, for U.S. consumers and service providers. This in turn will enhance the global competitiveness of U.S. manufacturers, expand their market access, and increase their exports.

As the Commission concluded in the BRS proceeding, use of 5.5 MHz blocks would substantially lower the cost of deployment.[23] Dr. Kolodzy's declaration demonstrates that 5.5 MHz blocks would increase flexibility, efficiency, and capacity, and decrease costs in the 700 MHz band as well. The more efficient use of the spectrum not only achieves statutory objectives, but also allows realization of commercial benefits. The increased capacity accomplished through efficient spectrum allocation will lower costs for service providers. Specifically, the sunk costs of network construction can be spread over a larger spectrum base resulting in greater megahertz usage per dollar spent.[24] These relatively lower costs result in a more cost-effective use of spectrum which, in turn, places service providers in the strongest position to explore different business plans, offer consumers lower prices, and increase innovation. Moreover, the more efficient service providers will be more effective competitors with a greater variety of potential technologies and applications to implement in the band.

The use of 5.5 MHz segments would maximize the range of technology options available to potential operators in the 700 MHz band, yielding greater flexibility and increased spectral

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23 *Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands*, Report and Order and Further Notice of Proposed Rulemaking, 19 FCC Rcd 14165, ¶ 41 (2004) ("*2004 MDS Report and Order*").

24 Declaration of Dr. Stagg Newman, ¶¶ 7-10, appended as Attachment C ("Newman Decl.").

efficiency and capacity. While we cannot predict the effect of 5.5 MHz paired blocks on all technologies, we discuss below the potential opportunities for the major broadband technologies,[25] including: EvDO (CDMA2000), the technology pioneered by Qualcomm and the basis of the advanced wireless networks deployed by several of the major U.S. carriers (Sprint, Verizon, Alltel); Flash-OFDM, which was used for the highly successful Washington, DC OCTO trial for broadband public safety applications;[26] WCDMA, which is likely to be the most widely deployed advanced wireless technology globally and is being deployed by Cingular, T-Mobile and others; and WiMAX, the technology just chosen by Sprint in partnership with Intel, Motorola, and Samsung for deployment of 4G services in the BRS bands,[27] and used by Clearwire and Xanadoo (Pegasus' wholly-owned subsidiary) to offer high speed wireless Internet services in competition with DSL and cable modem service.[28]

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25 As noted above, this proposal does not specify whether technologies deployed should be FDD or TDD. However, since existing public safety narrowband operations are FDD, these comments focus on FDD technologies. *See* Declaration of Dr. Paul J. Kolodzy, ¶¶ 16-17, appended as Attachment B ("Kolodzy Decl.") for a discussion of TDD technologies.

26 *See* "First-Of-A-Kind Public Safety Network Unveiled: Coalition Asks Congress to Meet 9-11 Commission Recommendations on Spectrum and Provide a National Wireless High-Speed Public Safety Network," press release issued by Office of the Chief Technology Officer, District of Columbia (Sep. 23, 2004), *available at*: <http://www.spectrumcoalition.dc.gov/img/spectrum_pressrelease.pdf>; *see also* "DC OCTO Wireless Broadband Network Wins Police Chiefs' Technology Award," press release issued by Office of the Chief Technology Officer, District of Columbia (March 10, 2006), *available at*: <http://newsroom.dc.gov/show.aspx/agency/octo/section/2/release/6342/year/2006>.

27 "Sprint Nextel Announces 4G Wireless Broadband Initiative with Intel, Motorola and Samsung," press release issued by Sprint Nextel Corp. (Aug. 8, 2006), *available at*: <http://www2.sprint.com/mr/news_dtl.do?id=12960>; "Network Leadership – Building on Strengths, Leveraging Assets, Delivering Mobility," visual aid presented by Sprint Nextel (Aug. 8, 2006), *available at*: <http://www2.sprint.com/mr/cmastaticfiles/non-landing//documents/PressKit/network-leadership_slide.pdf>.

28 "Intel, Clearwire to Accelerate Deployment of WiMAX Networks Worldwide" (Oct. 25, 2004), press release issued by Intel Corp., *available at*: <http://www.intel.com/pressroom/archive/releases/20041025net.htm>; *see also* Clearwire Corporation, Form S-1 Registration Statement at 56 (May 11, 2006), *available at*: <http://www.sec.gov/Archives/edgar/data/

EvDO (CDMA 2000). Because EvDO channels require approximately 1.25 MHz of spectrum and approximately 250 kHz of buffer between the signal band and the edge of the band, a 5.5 MHz segment can accommodate four EvDO channels, while a 5 MHz segment can accommodate only three EvDO channels.[29] Thus, a 10 percent increase in spectrum from 5 MHz to 5.5 MHz gives a 33 percent increase in capacity with a 1.25 MHz system. Further, configuring the Upper 700 MHz commercial spectrum in paired 5.5 MHz blocks would significantly reduce the costs of system deployment and operation for a EvDO operator. When operators need to add capacity to their networks, they can either reduce the coverage area of some of the cells in the network and add additional cell sites or they can increase the number of channels available to carry the traffic in each cell by using additional spectrum. Reducing the coverage area of a cell requires deployment of additional infrastructure to create new cells, requiring operators to incur costs for new RF engineering studies, tower construction or rental, backhaul, legal services (for permitting), and equipment, as well as exposing them to construction delays. These costs can be especially high in urban areas. If the spectrum is available, the option of increasing capacity by deploying an additional channel is far more attractive because the aforementioned costs can be avoided. A licensee with three EvDO channels in a 5.5 MHz segment would have the option of deploying a fourth channel to increase capacity. If the segment were only 5 MHz, that option would not exist, and the licensee would

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1285551/000095012306006136/y20080sv1.htm> ("[O]ur network is designed to operate using 5.5 MHz channels . . . ."). It is our understanding that of the five largest holders of commercial rights to BRS and EBS spectrum (Sprint Nextel, Clearwire, BellSouth, Nextwave, and Xanadoo), all but BellSouth have publicly committed to deployment of WiMAX in areas covered by their 2.5 GHz frequencies.

[29] Kolodzy Decl. ¶ 13. Each EvDO channel requires approximately 1.25 MHz for the signal band. In addition, there must be approximately 250 kHz buffer between the signal band and the edge of the band (0.250 x 2), for a total of 5.5 MHz for four EvDO channels [(1.25 x 4) + (0.250 x 2) = 5.5 MHz]. By contrast, a 5 MHz channel would only be able to accommodate three EvDO channels [(1.25 x 3) + (0.250 x 2) = 4.25 MHz].

be compelled to deploy additional infrastructure.[30] This added flexibility is particularly beneficial in the 700 MHz band, where the propagation characteristics of the spectrum enable operators to build fewer sites than would be required, for example, at 1.9 GHz where range is more limited.[31]

Flash-OFDM. Like EVDO, Flash-OFDM can operate in a signal band of as little as approximately 1.25 MHz. However, Flash-OFDM is also capable of changing its signal band to fit the available spectrum. As a result, Flash-OFDM could efficiently fill either a 5 MHz segment or a 5.5 MHz segment. Because it enables a signal bandwidth that is 500 kHz larger, the 5.5 MHz segment would provide the operator with 11 percent more capacity than would a 5.0 MHz segment.[32]

WCDMA. As explained by Dr. Kolodzy, WCDMA is defined for use in 5 MHz segments, with a signal band of 3.84 MHz. However, a 5.5 MHz segment would offer advantages over a 5 MHz segment for deploying a WCDMA channel. Specifically, the additional 500 kHz in a 5.5 MHz block would enable operators to maintain interference protection levels while reducing the cost of filtering equipment and engineering. In addition, although specifications indicate a single WCDMA channel in a segment of no less than 5 MHz, thus implying a value of 580 kHz for buffers,[33] it is feasible to employ optimized filters and reduce the size of the buffers to 330 kHz, which would enable 4 WCDMA channels within a 16.5 MHz segment.[34] As a result,

30 Newman Decl. ¶¶ 17-20.

31 Kolodzy Decl. ¶ 1 n.2.

32 *Id*. ¶ 15.

33 *Id*. ¶ 14. 5 MHz segment minus 3.84 MHz signal band leaves 1.16 MHz total for buffer, which is 580 kHz on each side of the signal band.

34 *Id*. Four channels of 3.84 each with 4 MHz center spacing equals 15.84 MHz, which leaves 660 kHz total buffer (330 kHz on each side) in a 16.5 MHz segment.

aggregating three 5.5 MHz segments to create a 16.5 MHz segment would enable an operator to deploy four WCDMA channels with optimized filtering, while three 5 MHz segments (totaling 15 MHz) would accommodate only three WCDMA channels.[35]

WiMAX. WiMAX profiles can be designed to expand to the amount of available spectrum, and since there is no profile for WiMAX yet at 700 MHz, spectrum segments of 5.5 MHz would provide superior capacity (11% more than a 5 MHz block) if operators choose to deploy WiMAX technology.[36] Further, WiMAX has been developed for use in 5.5 MHz segments in the 2.5 GHz band (Broadband Radio Services spectrum).[37] As Dr. Kolodzy notes, it would be a relatively straightforward matter to reband the 2.5 GHz WiMAX radio architecture for use in the Upper 700 MHz band, and it could be accommodated efficiently within the 5.5 MHz segments proposed in these comments.[38]

2. Increased Benefits to Public Safety

In the *Public Safety 700 MHz Broadband* proceeding, public safety entities have described their desire to be able to take advantage of broadband applications. For example, the Spectrum Coalition for Public Safety stated, "All else being equal, broadband is a superior

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35 *Id*. Three WCDMA channels center-spaced 4 MHz apart would require 11.84 MHz: 4 + 4 + (3.84 / 2) + (3.84 / 2) = 11.84. In a 15 MHz spectrum, this would leave 3.16 MHz total for buffer, or 1.58 MHz buffer on each side. As noted by Dr. Kolodzy, the specifications imply a buffer of 580 kHz on each side.

36 *Id*. ¶ 16.

37 The Commission has concluded that 5.5 MHz block sizes are appropriate in other bands, and for similar reasons. For example, in the 2.5 GHz band, where the Commission sought to promote wireless broadband capabilities, it allocated spectrum in 5.5 MHz spectrum blocks, noting that it was technologically neutral and that "the assignment of 5.5 MHz-wide channels throughout the band promotes consistency between commercial wireless services and provides licensees the opportunity to take advantage of existing and future technologies thereby substantially lowering the cost of deployment." *2004 MDS Report and Order* ¶ 41.

38 Kolodzy Decl. ¶ 16.

solution for public safety data communications."[39] The State of Hawaii urged the Commission to "encourage and ease the deployment of broadband communications" for public safety entities,[40] and Region 26 (Nebraska) 700 MHz Regional Planning Committee requested that the FCC "maximize broadband access and flexibility" for Public Safety.[41] NPSTC and APCO proposed that the Commission adopt a band plan to allow broadband deployment in the Upper 700 MHz band public safety allocation for the first time.[42] The Spectrum Coalition for Public Safety concluded that:

> Broadband wireless connections to public safety personnel, wherever their work takes them, are an increasingly important tool for public safety. The need and benefit will only grow by orders of magnitude with time.[43]

Public safety agencies are requesting rules that accommodate wireless broadband because broadband would enable a range of new capabilities, such as real-time street monitoring to help pursue suspects; video pre-assessment of a crime scene, a hostage situation or disaster area to most effectively manage the crisis or speed mass evacuations; helicopter video transmission to provide valuable on-scene information from the air; and on-line medical consultations and pre-admissions assessments during ambulance trips to speed medical care and relieve pressure on

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[39] Comments of the Spectrum Coalition for Public Safety, WT Docket No. 96-86, at 2 (filed June 6, 2006).

[40] Comments of the State of Hawaii Department of Accounting and General Services, WT Docket No. 96-86, at 1 (filed June 6, 2006).

[41] Comments of the Region 26 (Nebraska) 700 MHz Regional Planning Committee, WT Docket No. 96-86, at 1 (filed June 6, 2006).

[42] Comments of the National Public Safety Telecommunications Council, WT Docket No. 96-86, at 10-12 (filed June 5, 2006) and Comments of APCO, WT Docket No. 96-86, at 2 (filed June 6, 2006).

[43] "Public Safety Spectrum: How Much Do We Need for Data?" at 2, attached to letter from Bill Butler, Spectrum Coalition for Public Safety, to Marlene Dortch, FCC, WT Docket No. 05-157 (filed Oct. 27, 2005).

hospitals and clinics in the event of mass casualties.[44] Broadband would enable real-time, full motion video from any location to any other location; live video from an emergency scene to a command center; downloading building diagrams and blueprints to firefighters in the field; uploading and downloading of mug shots and AMBER Alert photos for police officers in the field; mapping/location-based services; digital image transfers; large file transfers; and bio-terrorism detection and response information.[45]

Finally, wireless broadband would help address the problem of interoperability among public safety entities. As the 9/11 Commission wrote,

> The inability to communicate was a critical element at the World Trade Center, Pentagon, and Somerset County, Pennsylvania, crash sites, where multiple agencies and multiple jurisdictions responded. The occurrence of this problem at three very different sites is strong evidence that compatible and adequate communications among public safety organizations at the local, state and federal levels remain an important problem.[46]

IP-based wireless broadband networks would address this issue by providing a shared network at the logical level for use by multiple agencies operating individually or in cooperation, which would provide much more flexibility and network capacity than is possible with current-generation systems that would require sharing of physical channels. Individual users would be able to open individual private connections to the network or subscribe to multicast services, and

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[44] Statement of Robert LeGrande, Deputy Chief Technology Officer, District of Columbia Government, Before the Committee on Commerce, Science, and Transportation, United States Senate, on Spectrum for Public Safety and the 9/11 Commission Report, at 6 (Sep. 8, 2004), *available at*: <http://www.spectrumcoalition.dc.gov/img/senate_report.pdf> ("LeGrande Statement").

[45] *See, e.g.*, Joint Comments of NPSTC and APCO, WT Docket No. 05-157, at 6 (April 28, 2005).

[46] The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States, at 397 (2004), *available at*: <http://www.9-11commission.gov/report/911Report.pdf>.

specified groups of users within and across agencies would be able to collaborate while maintaining security safeguards.

In the current band plan, the block sizes do not match any of the proposed broadband public safety block sizes, including those that will result from the BOP. Consequently, it would be more difficult to adapt commercial systems designed for the C (5 MHz paired) and D (10 MHz paired) blocks to public safety use. Public Safety could be foreclosed from many of the benefits of innovation and economies of scale (including lower equipment costs) from the manufacture of networks and radios for the commercial spectrum. In addition, the separation of public safety bands from commercial operations in the current band plan decreases the possibilities of shared infrastructure between commercial and public safety users and therefore curtails a valuable opportunity for Public Safety to deploy 4G technologies at significantly lower costs.

By contrast, the configuration of the Upper 700 MHz band in blocks of 5.5 MHz paired would benefit Public Safety. Under the BOP, the public safety allocation would increase by 1.5 MHz paired, with 5.5 MHz paired of contiguous spectrum available for possible broadband use.

Commercial segments of 5.5 MHz paired would spur innovation and create economies of scale as manufacturers build networks and radios for the commercial systems. The existence of four paired and adjacent segments of 5.5 MHz (three commercial, one public safety) would allow Public Safety to benefit from those innovations and economies of scale. The equipment market would be larger, and the cost of equipment would be lower for both commercial and public safety users. In fact, although both commercial and public safety entities would benefit from the larger overall market, the cost savings likely would be significantly greater for Public Safety because the Public Safety portion of the market is by far the smaller. In addition, the adjacency of the similarly-sized blocks creates opportunities for infrastructure sharing, as described below in Section II.G.[47]

3. More Efficient Use of Spectrum

As Access Spectrum, Columbia Capital, and Pegasus outlined in great detail in their comments describing the BOP in the *Public Safety 700 MHz Broadband* proceeding, the current band plan wastes a considerable amount of spectrum.[48] At first glance, it appears the current band plan wastes approximately 17 percent of the spectrum in the Upper 700 MHz band (10 MHz wasted / 60 MHz usable). However, upon further examination, spectral usage is even more inefficient than that. Deploying three EvDO channels in paired 5 MHz segments would result in approximately 4.25 MHz paired of productive spectrum (including three channels of 1.25 MHz paired each and two buffer spaces of 250 kHz paired each), leaving 750 kHz paired of unutilized spectrum. In the current band plan, EvDO deployed in the 10 MHz paired block would waste another 750 kHz[49] of additional spectrum, and if the FCC decided to auction three 5 MHz paired blocks, each additional 5 MHz paired block would also waste 750 kHz of paired spectrum.[50] Thus, in addition to wasting a total of 10 MHz of spectrum on "guard bands," in an EvDO

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47 Because the public safety broadband spectrum would be configured in paired segments, our plan contemplates paired spectrum for commercial allocations, as well. However, as noted in Section II.F.1 below, our proposal would permit commercial licensees to deploy either TDD or FDD systems, consistent with the rules designed to protect public safety and commercial operations from undue interference.

48 As explained in the *BOP Comments* and highlighted by the Commission in its *Public Safety 700 MHz Broadband NPRM*, configurations proposed for accommodating broadband in the public safety allocation would require 4 MHz of public safety spectrum for guard bands, thus bringing the total amount of spectrum wasted to 10 MHz. *BOP Comments* at 12.

49 Seven channels of 1.25 MHz paired, plus buffers of 250 kHz paired, equals 9.25 MHz paired, which is 750 kHz paired less than 10 MHz paired. If the Commission auctioned a 10 MHz block (paired) and a 5 MHz block (paired), the total amount of spectrum wasted would be 1.50 MHz paired: 750 kHz paired + 750 kHz paired = 1.50 MHz paired, or 3.0 MHz total.

50 If the Commission auctioned three 5 MHz paired blocks, the total amount of spectrum wasted would be 2.25 MHz paired: 3 x 750 kHz paired = 2.25 MHz paired, or 4.25 MHz total.

environment, the current band plan would waste an additional 3.00-4.50 MHz, bringing the total to 21-24 percent of the spectrum in the Upper 700 MHz band.

By contrast, if the FCC were to adopt our proposal, the amount of spectrum devoted to "guard bands" would be reduced from 10 MHz to 3 MHz, the amount of spectrum left unused in an EvDO environment drops from 3.00-4.50 MHz to virtually nothing, because EvDO fits without substantial waste in a 5.5 MHz segments.[51] In the Upper 700 MHz band, rather than wasting 21-24 percent of the available spectrum, our proposal would limit the waste in an EvDO environment to the guard bands only, a total of only 5 percent.

All of the broadband-capable commercial spectrum in the current band plan, and almost all of it in the band plan as it would appear after adoption of the BOP, is divided into blocks built on segments of 5 MHz. A more rational division of the 16.5 MHz of commercial broadband spectrum contemplated in the BOP would be three 5.5 MHz segments, so that each segment would be able not only to accommodate a fourth EvDO channel as described above, but also to provide 11 percent greater capacity if scalable technologies were deployed, such as WiMAX and Flash-OFDM.

As discussed above, the more efficient use of spectrum is not only mandated by the statute but is essential to cost-effective build-out of commercial and public safety networks.

4. Greater Opportunities for New Entrants

As explained in more detail in the following sections on geographic areas and package bidding, the current band plan and auction rules represent an inferior choice by failing to maximize entry and competition. As an initial matter, under our proposal, there would be two commercial blocks of 5.5 MHz paired and two smaller commercial blocks that could be

[51] Four 1.25 MHz channels, plus two buffers of 250 kHz each, equals 5.5 MHz.

combined to create a third pair of 5.5 MHz segments. Because there would be more segments to bid on and the 5.5 MHz pairs would be less expensive than the 10 MHz pair in the current D Block, this configuration would increase the likelihood that a new entrant would win a license. Because the segments would be 5.5 MHz paired, the new entrant would possess sufficient spectrum to offer services in competition with other market participants.

The ability to aggregate blocks of 5.5 MHz paired up to 16.5 MHz paired also supports new entry, because it provides additional flexibility to bidders. A new entrant could bid for the number of licenses it desired for its business strategy: if a company's strategy required 5.5 MHz paired in a particular geographic area, it could bid for one license; if more spectrum were needed, it could bid for two or three licenses. Similarly, companies that already possess spectrum holdings in other frequency allocations may wish to supplement those holdings with a single 5.5 MHz paired block.

C. Geographic Areas

Our plan proposes geographic service areas designed to facilitate market entry and to reduce transaction costs for new entrants and incumbents. The proposed geographic service areas would encourage new entrants to bid on individual licenses or aggregate them according to the needs of their particular business strategies.

Under the proposal, the Upper 700 MHz commercial spectrum would be licensed according to Major Economic Area ("MEA"), consistent with the licenses currently held by incumbents in the A and B Blocks.[52] There are 52 MEAs. Under the plan of record, the C and D Blocks are to be licensed by Economic Area Grouping ("EAG"), of which there are only six.

[52] As noted in Section II.D, we propose to permit constrained package bidding, using the twelve *Regional* Economic Area Groupings ("REAGs"), six of which cover the continental U.S., as an overlay to limit the number of package options. Each of the nation's REAGs is composed of one or more MEAs. 47 C.F.R. § 27.6(a)(1).

EAGs are not based on MEAs, and therefore, the Commission should revise its geographic area rules. The Commission should establish geographic areas that correspond directly with the geographic areas (MEAs) of the A and B Blocks (those already licensed in the band) in order to facilitate combinations of incumbent A Block licenses with new licenses.[53]

The Commission has requested comment on the use of "smaller, local license areas," particularly, whether as requested by rural operators, the FCC should "assign additional CMA ['Cellular Market Area']-sized licenses in the 700 MHz Band."[54] Unlike MEAs, CMA licenses do not aggregate cleanly to the REAG level and therefore create significant substitution inefficiencies in the Upper 700 MHz band, which could lead to lower total auction revenues. As the Commission notes, the Lower 700 MHz C Block, which has already been auctioned, is licensed by CMA, of which there are 734.[55] If additional CMA-sized licenses are desired, they should be located in the Lower 700 MHz band, in spectrum near or adjacent to the existing Lower 700 MHz C Block. This configuration would enable the holder of a CMA license in one block to obtain additional spectrum in the same CMA, thereby gaining the ability to offer additional services or capacity. Indeed, rural carriers have requested additional CMA-based 700 MHz licenses in the Lower 700 MHz band.[56]

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[53] Using MEAs for all Upper 700 MHz commercial spectrum licenses would allow an operator in a given MEA to aggregate licenses to increase spectrum holdings within that MEA in order to offer additional services or increase capacity.

[54] *Notice* ¶ 36.

[55] *Notice* ¶ 13 Table 3.

[56] *See Reallocation and Service Rules for the 698-746 MHz Spectrum Band (Television Channels 52-59)*, Report and Order, 17 FCC Rcd 1022, ¶ 96 (2002).

D. Package Bidding

The FCC should consider use of package bidding in order to ensure that the spectrum is put to its highest and best use and to maximize the efficiency of the auction, which would facilitate entry and maximize the amount of auction proceeds.

Package bidding would permit auction participants to submit all-or-nothing bids on specified combinations of licenses. Without package bidding, where a combination of two (or more) licenses is desirable, potential bidders may refrain from bidding or may bid lower amounts for the individual licenses than they would for the combination because of the risk of being unable to "win" both (or all) of the licenses required to make up the desired combination.[57] Experiments recently conducted for the Wireless Telecommunications Bureau found that package bidding raises allocational efficiency for spectrum with high complementarities (where combinations of licenses are worth more than the sum of the components) by helping bidders avoid the "exposure problem,"[58] which strongly counsels use of package bidding in the Upper 700 MHz band.[59]

Another benefit of package bidding is that it can be designed in such a way as to make it more difficult for auction participants to engage in strategic anti-competitive behavior. For

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57 The "exposure" risk and its dampening effect on auctions are discussed in Evan Kwerel and John Williams, "A Proposal for a Rapid Transition to Market Allocation of Spectrum," OPP Working Paper Series No. 38, at 14-15 (Nov. 2002), *available at*: <http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-228552A1.pdf> ("*OPP Working Paper Series No. 38*").

58 *See* Jacob K. Goeree, Charles A. Holt and John O. Ledyard, "An Experimental Comparison of the FCC's Combinatorial and Non-Combinatorial Simultaneous Multiple Round Auctions," prepared for the Wireless Telecommunications Bureau of the Federal Communications Commission, at 11 (July 12, 2006), *available at*: <http://wireless.fcc.gov/auctions/data/papersAndStudies/fcc_final_report_071206.pdf>.

59 *See also OPP Working Paper Series No. 38* at 14 ("Package bidding . . . can increase the efficiency of a market mechanism when some items are highly complementary but parties disagree about the best way to package the pieces. . . . In such cases, package bidding facilitates efficient aggregation of spectrum across geography and bandwidth.").

example, there may be potential new entrants who seek to enter on a nationwide basis, such as the DBS coalition that withdrew from the AWS auction, and the rules should be designed to facilitate their entry.[60] Efforts to block a new entrant with nationwide entry plans become more expensive because they would require the "purchase" of a nationwide package rather than strategically-identified single or regional licenses. Consequently, it becomes less likely that auction participants would be able to block new nationwide broadband entrants through the auction process for strategic reasons.

As explained in the Declaration of Dr. Gregory Rosston and Dr. Scott Wallsten, larger geographic block sizes tend to decrease transaction costs.[61] If the Commission were to determine that an auction that facilitates the acquisition of blocks larger than MEAs is desirable, the Commission should achieve this through constrained package bidding as described below, with MEAs grouped into packages that track the geographic boundaries of REAGs.[62]

Unconstrained package bidding involves complexities that limit the scale of an auction (or, more specifically, the number of licenses that can be auctioned simultaneously).[63] To decrease the complexity of package bidding and enhance its utility, the Commission should consider employing a package bidding mechanism with constrained packages. The Commission could limit the variables by pre-defining packages. Auction participants could bid on this finite

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[60] Declaration of Dr. Gregory L. Rosston and Dr. Scott Wallsten, ¶ 21, appended as Attachment A ("Rosston/Wallsten Decl.").

[61] Rosston/Wallsten Decl. ¶¶ 33-35.

[62] If the Commission were to decide that package bidding is insufficient, and that geographic areas larger than MEAs would be desirable, it should use REAGs. Under no circumstances should the Commission use EAGs because EAGs do not align with the geographic areas (MEAs) of incumbent licenses in the A and B Blocks. Because REAGs align with MEAs (the 12 REAGs are composed of one or more MEAs), the use of REAGs would provide larger geographic areas (decreasing transaction costs) while facilitating combinations of incumbent licenses with new licenses.

[63] *See OPP Working Paper Series No. 38* at 17.

number of pre-defined spectrum packages in addition to bidding on individual licenses. Reducing the number of package options would reduce the complexities of package bidding while capturing many of its advantages, rendering it more useful in the Upper 700 MHz band.

If it pursues a constrained package bidding approach, the Commission should include a nationwide package option for each block. It should also provide for regional packages. As explained above, each block should be licensed on an MEA basis. However, for bidding purposes, the 52 MEAs could be grouped into 12 regions, each region constituting a package.[64] In sum, for each block, we propose a nationwide package and 12 regional packages based on the twelve REAGs.[65] In addition, the FCC should establish packages for combinations of blocks, so that bidders may indicate that they place a higher value on being able to obtain 11 MHz paired, or 16.5 MHz paired, compared to 5.5 MHz paired. Establishing the constraints may not accommodate the full panoply of options traditionally associated with package bidding. However, it does obviate the need for *all* of the aggregation to take place in less efficient secondary markets and it reduces the exposure problem for those pursuing nationwide strategies. At the same time, the ability to bid on smaller individual licenses allows bidders to express those preferences and valuations during the course of the auction.

There may be other ways to implement package bidding that allows for bidders to express preferences for individual blocks and also for packages of licenses. To the extent that other methods allow this, the Commission should consider them as well.

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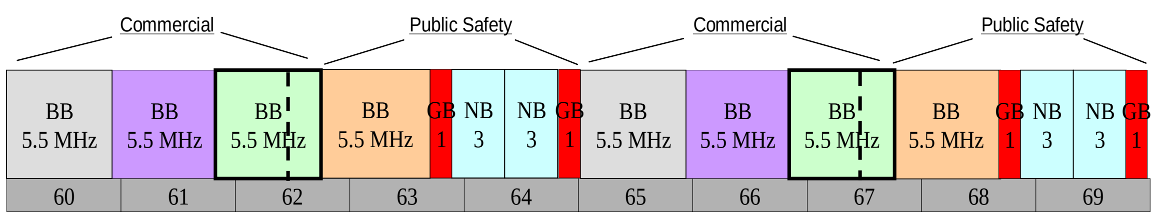
[64] Of course, to the extent that specific commercial plans call for different-sized spectrum blocks or geographic areas, licensees would be free to aggregate, disaggregate or partition as desired following the auction.

[65] This proposal does not add as many combinatorial variables as it might seem because some REAGs contain only one MEA.

E. Efficient Mechanisms for Addressing Interdependence with Already-Licensed Spectrum

As explained above, there are technological advantages that can be achieved by facilitating the use of the spectrum already licensed in the Upper 700 MHz band (the A and B Blocks) in conjunction with the spectrum in the Upper 700 MHz band that has not yet been licensed. In this regard, the spectrum that the Commission has not yet licensed is highly interdependent with the currently licensed spectrum in the band.[66]

There are a variety of ways to implement the Upper 700 MHz band plan given the existing A and B Block license assignments. The Commission may adopt a band plan including paired 4 MHz and paired 1.5 MHz blocks. Licensees for the 4 MHz block and the 1.5 MHz A Block will have strong incentives to work together because their combined spectrum can be put to more valuable uses than their individual spectrum blocks standing alone, as illustrated below:



BB=Broadband; NB=Narrowband; GB=Guard Band

For example, should the licensees both choose to adopt EvDO technology and work together to coordinate system deployment, they could accommodate four EvDO channels in a 5.5 MHz block of combined spectrum. Alternatively, they could work together to use WiMAX or WCDMA technologies since neither block alone could accommodate those technologies.

66 The *Notice* recognizes that parties may wish to combine spectrum that has been licensed with spectrum that has not yet been licensed and requests comment on means to facilitate that process. *Notice* ¶ 57. While the Commission's focus was on the lower 700 MHz band, many of the same policy considerations apply in the Upper 700 MHz band.

The *Notice* also seeks comment on ways to implement a two-sided auction.[67] The Commission states that it could facilitate the aggregation of blocks that have been licensed with blocks that have not yet been licensed by enabling a single auction for both types of licenses.[68] As the Commission notes, such a "two-sided auction" could be implemented in various ways. Under one approach, the Commission could allow existing licensees to offer their licenses in the auction, but relinquish the licenses only if the prices reached a certain level.[69] For example, a licensee with 1.5 MHz paired could deploy broadband services in that spectrum, but might be willing to move its operations to different spectrum, depending on the auction price. In this manner, the two-sided auction would be used to reveal the highest and best use for the spectrum. The two-sided auction could be combined with package bidding to allow bidders to combine encumbered and unencumbered spectrum into efficient packages.[70]

The Notice suggests that another way of implementing the two-sided auction would be to permit "incumbent licensees to return their licenses in exchange for a credit, which could be based on the prices of licenses for spectrum formerly associated with the returned licenses as determined in an auction."[71] The Commission's proposals in the *MDS* proceeding offer some

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67 *Notice* ¶ 58.

68 *Id*. With two-sided auctions, individual license holders would have the flexibility to pursue their respective business plans, which may change depending on the spectrum valuation. For example, Kwerel and Williams note that an incumbent licensee may wish to be a buyer, a seller, or both simultaneously. *OPP Working Paper Series No. 38* at 16.

69 *Notice* ¶ 58.

70 *OPP Working Paper Series No. 38* at 16.

71 *Notice* ¶ 58. On previous occasions, the Commission has proposed similar two-sided auctions using bidding offset credits for incumbent licensees and has engaged in a thorough review of its authority to do so. *See, e.g., 2004 MDS Report and Order* ¶¶ 303-304 (discussing the FCC's authority under 47 U.S.C. §§ 154(i), 303(r), and 309(j)(4)); *see also Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands*, Notice of Proposed Rule Making and Memorandum Opinion and Order,

context. The A Block (incumbent) licensees could exchange their licenses[72] for a bidding offset credit, expressed in MHzPops,[73] which could be transferred or used to offset a winning bid in a spectrum auction.[74] To minimize the transaction costs associated with the credits, the Commission could assign the bidding offset credits a face dollar value (expressed as $/MHzPop). The approach, if spectrum blocks are auctioned geographically on an MEA basis, would be to have the $/MHzPop valuation of a bidding offset credit for an incumbent license correspond to the $/MHzPop value obtained at auction for the license in that particular MEA. Another approach, particularly if package bidding results in spectrum blocks larger than MEAs, would be to have the $/MHzPop value of the bidding offset credits equal the gross value[75] of winning bids in the auction of Upper 700 MHz licenses divided by the total MHzPops auctioned.[76]

To maximize efficient spectrum allocation, the Commission could elect to make bidding offset credits divisible. Moreover, the credits could be made fully transferable before, during,

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18 FCC Rcd 6722, ¶ 242 (2003). We support the Commission's analyses and believe that the Commission possesses the authority to conduct an auction as described herein.

72 Some of the A Block licensees have a small number of spectrum use agreements and those users would need to be protected.

73 A MHzPop is the bandwidth of the license, measured in MHz, multiplied by the population within the license's geographic area.

74 *See 2004 MDS Report and Order* ¶ 305.

75 In establishing a dollar value, gross, not net, bid prices would be used. In other words, designated entity discounts and any bidding preferences such as the one described herein in Section II.G would not be applied when calculating the total value of the spectrum as bid at auction. In this way, the incumbent would not be disadvantaged by the availability of bidding credits for designated entities.

76 If the A and B Block licenses were returned to the Commission and were used to create a 5.5 MHz block, the results from the new auction could be used to calculate the value of the bidding offset credits since that is likely to reflect most accurately the current value of the spectrum. This also appears to be the approach contemplated by the Commission in this instance as well as in its discussion of other two-sided auction proposals. *See Notice* ¶ 58; *see also 2004 MDS Report and Order* ¶ 306 ("We propose that we use an average price per MHzPops, *derived from the auction for new licenses in this band,* to give the bidding offset credit a face dollar value.") (emphasis supplied).

and after the auction. The Commission could specify that the credits be usable for this and other auctions and for all services,[77] and that they apply across all bands (including the Lower 700 MHz band) and across all geographic areas.

F. Technical Rules, Service Rules and License Term

As described above, under our proposal the Upper 700 MHz commercial spectrum would be arranged based on a plan of 5.5 MHz blocks, licensed by MEA. In order to achieve the benefits of the BOP, all commercial spectrum in the Upper 700 MHz band should be subject to the same service and technical rules, and the same license terms.

1. Technical Rules

Two technical requirements that currently apply to licensees in the A and B Blocks present significant obstacles to broadband deployment. Because the A and B Blocks would no longer be adjacent to public safety narrowband operations, implementation of our proposal would permit these requirements to be replaced with the alternative technical requirements that apply to the rest of the Upper 700 MHz commercial licenses.

Operators in the Upper 700 MHz A and B Blocks currently are prohibited from "employ[ing] a cellular system architecture."[78] At the time the Commission adopted this cellular prohibition, it was expected that the A and B Blocks would be used for private wireless services,

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[77] Incumbent licensees trading in their licenses for bidding offset credits could be permitted to participate in the 700 MHz auction and could be permitted to apply their bidding offset credits to any bids they make for spectrum within the auctioned bands. Not doing so would restrict the pool of potential bidders which would result in the auction price not accurately reflecting the full demand for the spectrum.

[78] 47 C.F.R. § 27.2(b); *see also Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules*, Second Report and Order, 15 FCC Rcd 5299, ¶¶ 19-24 (2000) ("*Upper 700 MHz Second R&O*"). For a detailed description of this restriction, *see August 3 White Paper* at 26-28.

employing high-power, high-site, non-cellular system architectures.[79] The broadband operations envisioned for the 700 MHz band will almost certainly be low-power, low-site cellular systems in order to achieve the capacity, throughput, and service quality required for such broadband operations. As a result, if the prohibition on cellular architecture is retained, it would prevent the deployment of next-generation broadband operations in the rebanded A Block, including commercial networks that may be shared with Public Safety.

The current narrowband-era rules for the A and B Blocks also include extensive "adjacent channel coupled power" ("ACCP") requirements.[80] Codified in Section 27.53(d),[81] this complex framework (subsequently renamed "adjacent channel power" ("ACP")[82]) was initially designed as an alternative to the traditional use of emissions masks in order to minimize interference among public safety operations in the 764-776 MHz/794-806 MHz band.[83] Subsequently, the Commission extended these same ACP requirements to the A and B Blocks to prevent narrowband services deployed in the A and B Blocks from interfering with systems

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79 *See, e.g.*, *Upper 700 MHz Second R&O* ¶ 32 (regarding likely services in the 700 MHz Guard bands, citing example of "end users such as railroads or pipelines").

80 *Id.* ¶¶ 16-17.

81 47 C.F.R. § 27.53(d).

82 *The Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communication Requirements Through the Year 2010*, Fifth Memorandum Opinion and Order, Sixth Report and Order, and Seventh Notice of Proposed Rulemaking, 20 FCC Rcd 831, ¶ 18 (2005).

83 *See The Development of Operational, Technical and Spectrum Requirements For Meeting Federal, State and Local Public Safety Agency Communication Requirements Through the Year 2010; Establishment of Rules and Requirements For Priority Access Service*, First Report and Order and Third Notice of Proposed Rulemaking, 14 FCC Rcd 152, ¶ 138 (1998) ("*1998 Public Safety Spectrum Order*").

operating in adjacent public safety spectrum.[84] The current ACP requirements set forth emissions limitations for transmitting devices of specific operating bandwidths. Because initial development of ACP values was intended for narrowband applications, the existing ACP tables provide limits for 6.25 kHz, 12.5 kHz, 25 kHz and 150 kHz transmitters,[85] all of which are insufficient to accommodate broadband applications that require channels on the order of 1.25 MHz or greater.

Implementation of the BOP would allow the substitution of technical rules that would permit broadband while protecting public safety operations. The addition of 1.5 MHz paired to the public safety allocation enables a configuration in which narrowband operations are consolidated at the top of the public safety allocation and broadband operations are consolidated at the bottom, adjacent to the rebanded and relocated A Block. Though Public Safety would determine the amount of spectrum to use for its broadband operations, 1 MHz of public safety spectrum immediately adjacent to the rebanded A Block would be either broadband or a 1 MHz guard band.[86] Furthermore, there would be an internal public safety guard band between the public safety narrowband spectrum and the C Block. The current technical rules for the Upper 700 MHz C and D Blocks require a greater level of power attenuation inside public safety spectrum, all of which is reserved for narrowband or wideband operations. Under the BOP, broadband would also be authorized in public safety spectrum. Because broadband receivers are more resistant to interference,[87] the Commission may wish to adopt rules for commercial

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84 *See Upper 700 MHz Second R&O* ¶ 17 ("equipment operating in the Guard Bands will have to adhere to the same ACCP OOBE criteria that we adopted for 700 MHz public safety users"); *1998 Public Safety Spectrum Order* ¶¶ 137-138.

85 47 C.F.R. §§ 27.53(d)(1), 90.543(a).

86 *BOP Comments* at 15 n.22.

87 Kolodzy Decl. ¶ 22.

licensees in the Upper 700 MHz band that require a greater level of protection for public safety narrowband and wideband operations than for public safety broadband operations.

The Commission might also consider different technical rules for commercial operators that have elected the option described in Section II.G below, to provide priority access and infrastructure to public safety agencies in exchange for a bidding preference on the commercial spectrum adjacent to Public Safety. The Commission should explore whether different technical rules, for example, permitting higher towers and higher power limits for subscriber equipment, would facilitate the deployment of public safety broadband without causing undue interference to any licensees. These technical rules could be crafted to reflect more closely the technical rules applicable to public safety spectrum.

2. Service Rules

The current service rules for the Upper 700 MHz band require A and B Block licensees to operate as band managers, leasing their spectrum to third parties rather than providing services themselves. These rules, which the Commission adopted as an experiment to improve spectrum access, flexibility, and efficiency by allowing the development of a "free market" in spectrum, provide licensees the ability to lease spectrum to third parties, but they also impose significant restrictions, including a requirement that licensees lease most of their spectrum to non-affiliated entities and refrain from using the spectrum to offer services themselves.[88] As a result, the band manager rules make it extremely difficult to use the spectrum for broadband applications.[89]

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88 *Upper 700 MHz Second R&O* ¶¶ 29-31, 54 (band manager "will act only as a spectrum broker and not as a wireless service provider"), 59 ("[I]n order to ensure that we conduct a useful test of the Band Manager concept and obtain the full benefits of this new licensing approach, . . . we will require Guard Band Managers to lease the predominant amount of the spectrum to non-affiliates.").

89 *See Supplemental White Paper* at 24-25.

Three years after promulgating the band manager rules, the Commission adopted a different set of rules to enable and govern secondary market spectrum leasing.[90] Although these new secondary markets rules apply to most wireless radio services, including the Upper 700 MHz C and D Blocks, the Commission did not extend the rules to licensees in the Upper 700 MHz A and B Blocks.[91] In order to permit the A Block spectrum to be used for broadband applications and to align the rules for the A Block with the remainder of the Upper 700 MHz commercial spectrum, the Commission should replace the band manager restrictions with the secondary markets rules.

3. License Term

As with technical and service rules, the license term for A Block licenses should be harmonized with the license terms for the rest of the Upper 700 MHz band. The license term should be not fewer than 10 years from February 18, 2009, when broadcasters must vacate the spectrum.[92]

G. Bidding Preference for Commercial Operators Providing Public Safety Benefits

Should the FCC adopt our proposal as has been outlined above, the benefits to the public safety community will be enormous, approximately $6.4 billion.[93] Through the bidding preference described below, the FCC will be giving proper incentive to the adjacent commercial licensees and will have established for the first time a way for local and state public safety

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[90] *Promoting Efficient Use of Spectrum Through Elimination of Barriers to the Development of Secondary Markets*, Report and Order and Further Notice of Proposed Rulemaking, 18 FCC Rcd 20604, ¶ 2 (2003).

[91] *Id*. ¶ 85 n.189; *Promoting Efficient Use of Spectrum Through Elimination of Barriers to the Development of Secondary Markets*, Second Report and Order, Order on Reconsideration, and Second Further Notice of Proposed Rulemaking, 19 FCC Rcd 17503, ¶ 64 (2004).

[92] 47 U.S.C. § 309(j)(14)(A), as amended by the Deficit Reduction Act of 2005, Pub. L. No. 109-171, 120 Stat. 4, § 3002 (2006).

[93] *See* Newman Decl. ¶ 1 and Table 7.

agencies actually to take advantage of 21st century technology. Specifically, Public Safety will have broadband networks built out with geographic coverage greater than commercial networks and a platform for the broadband applications that they need. Without adoption of the plan proposed herein, these substantial benefits would be unattainable, in all practical respects.

The BOP and the proposals described thus far in the comments create the following benefits for or affecting the interests of Public Safety:

- Enhance the protection of and maintain the quantity of the public safety community's mission-critical narrowband operations;
- Provide additional capacity to the public safety allocation, enabling a 5.5 MHz block of spectrum which will ensure that our country's 2.5 million public safety users have the ability to access the world's most advanced broadband technologies;
- Harmonize the sizes of the public safety and commercial broadband blocks to allow the public safety community to leverage the economies of scale inherent in the commercial wireless broadband market; and
- Locate the public safety community's broadband allocation adjacent to the commercial broadband allocation to encourage public/private "mixed-use" networks with common technology.

However, two fundamental obstacles to public safety broadband networks remain: (1) the high cost of building and maintaining networks; and (2) the need for the public safety community to gain additional capacity during emergencies. In solving these issues, it is essential to maintain security and preserve each agency's local decision-making authority.

The solution is to create considerable incentive for the adjacent commercial network to partner with the public safety community to enable the development of robust, secure public safety broadband networks. This can be achieved by providing a bidding preference to the buyer of the commercial spectrum adjacent to the public safety broadband channels in return for a commitment to permit the sharing of infrastructure, provide priority access to the commercial networks to public safety agencies, and provide virtual private networking capabilities for each public safety agency at the option of the public safety agency. This solution can be implemented without delay by Commission action in the three related proceedings that are currently ongoing: the *Public Safety 700 MHz Broadband* proceeding, the *A&B Block* proceeding, and the above-docketed *Commercial 700 MHz* proceeding. The proposal enables broadband public safety networks while permitting the absolutely critical and Congressionally-mandated auction of the commercial spectrum in the 700 MHz band.

1. The Problems: High Infrastructure Costs and Need for Access to Additional Spectrum

High Cost of Infrastructure. A major obstacle to wireless broadband for Public Safety is cost, construed broadly to include not only the cost for the initial network build, but also the ongoing costs of maintenance and renewal. All wireless networks have very high front end costs, such as the costs to secure appropriate cell site locations (and permits), construct base stations, deploy radios and antennae, and build network operations centers.[94] All wireless networks also require client devices or handsets. Indeed, proprietary wireless networks require unique proprietary handsets and unique network equipment. If these items cannot be manufactured in large volume, then economies of scale cannot be obtained. The result would be a handset that costs thousands of dollars instead of one-tenth of that amount.

Need for Access to Additional Spectrum. With advanced technology promising significant improvements in spectral efficiency, allowing wireless broadband networks to transmit more data with less spectrum than current generation technologies, a 5.5 MHz channel pair will be able readily to serve a great deal of the normal day-to-day broadband needs of the 2.5 million public safety users. However, there will be instances, such as natural and man-made disasters, where having access to additional broadband capacity would be of enormous value in

94 *See, e.g.,* Newman Decl. ¶ 9 and Table 5.

helping the public safety community respond to disasters, and therefore tremendously important to all Americans.

Both these problems (high cost of infrastructure and the need for access to additional spectrum) have plagued public safety users. Public safety users need and should have their own spectrum so as to preclude interference from other devices contesting for their spectrum. However, by using their own unique spectrum, public safety users historically have built unique networks and have designed unique, non-scaled end user equipment, such as handsets. The result is extraordinarily high cost. Only the most well-funded public safety entities can maintain the continuing expenditures necessary to build proprietary broadband networks on proprietary spectrum with proprietary handsets. To compound the problem, some public safety entities are very small organizations, such as small town fire departments or police agencies, that have very limited budgets for information technology. Moreover, this dedicated capacity can often lie unused much of the time, although its value during an emergency event is beyond question.

Everyone agrees that Public Safety has a great need for the most advanced communications technologies.[95] It will be particularly critical that public safety officials, in the active course of their duties, have tools available that will help them to prevent any terrorist attacks such as mobile access to large databases containing terrorist profiles. When the FCC recently established a new Public Safety and Homeland Security Bureau,[96] Chairman Martin stated that "[d]uring times of emergency, it is critical that the needs of the public safety

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95 *See, e.g.*, LeGrande Statement at 6, *supra* note 44.

96 *Establishment of the Public Safety and Homeland Security Bureau and Other Organizational Changes*, Order, FCC 06-35 (rel. Sep. 25, 2006).

community are met."[97] Homeland Security Secretary Michael Chertoff recently stated that "[t]he fact of the matter is, our country has learned some tough but valuable lessons in the last several years. One of those lessons learned on September 11th and learned again in natural disasters, is that communications and communications interoperability is a critical element of protecting our country and responding to all kinds of disaster."[98]

2. The Solution: Creating Correct Incentives for Commercial Operators

To address Public Safety's broadband needs while overcoming the remaining obstacles discussed above, the FCC should ensure that commercial networks for 4G technologies can be used by Public Safety with its own unique spectrum in much the same way that CONELRAD used the radio network[99] or the Emergency Alert System uses the broadcast networks,[100] but with much more security and reliability. The virtual private networking capabilities of broadband IP networks allow the additional security needs to be met. The towers and antennae for any commercial network can be used for public safety networks. Handsets can easily be designed to be tuned to either commercial or public safety frequencies, or both. A Public Safety handset would be similar to the adjacent commercial spectrum's handset in that the baseband processors and communications processors could be the same. The Public Safety handset may have

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97 *Establishment of the Public Safety and Homeland Security Bureau and Other Organizational Changes*, Statement of Chairman Kevin J. Martin (Mar. 17, 2006), *available at*: <http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-06-35A2.doc>.

98 "Remarks by Homeland Security Michael Chertoff at the Tactical Interoperable Communications Conference," Washington, DC (May 8, 2006), *available at*: <http://www.dhs.gov/dhspublic/display?content=5596>.

99 *See Amendment to Part 16 of the Commission's Rules and Regulations to Effectuate the Commission's CONELRAD Plan for the Land Transportation Radio Services*, Order, 42 F.C.C. 672 (1956); *see also Review of the Emergency Alert System*, Notice of Proposed Rulemaking, 19 FCC Rcd 15775, ¶ 6 (2004).

100 *See Review of the Emergency Alert System*, First Report and Order and Further Notice of Proposed Rulemaking, 20 FCC Rcd 18625, ¶¶ 5-11 (2005).

additional frequencies in its baseband processor, different applications processors and unique physical characteristics desired by public safety agencies (*e.g.*, more durability to withstand being dropped without malfunctioning, or to resist extreme temperatures). However, the additional cost of adding these capabilities would be far less than the cost of developing totally unique and proprietary handsets for Public Safety since most of the radio components and design would be the same as mass-produced commercial technology.[101] By ensuring that a commercial wireless broadband network is adjacent to public safety spectrum and has identical block sizes, the FCC can ensure that the adjacent public safety users have the ability to obtain network assets and handsets for prices near the low costs offered commercially, but at the same time can maintain their own unique and proprietary spectrum and performance requirements. Locating a commercial broadband network adjacent to public safety spectrum will give Public Safety a way to break the cost barrier that precludes broadband from being adopted by Public Safety.

The way to ensure that the public safety community can have additional capacity is to establish a private-public partnership in which the commercial operator adjacent to public safety spectrum provides priority access to commercial spectrum when the "lights and sirens go on." This priority access is analogous to the priority given on public roads to emergency vehicles. There is precedent for public safety use of the commercial spectrum as a complement to their dedicated use on a "virtual network basis," particularly in times of an emergency. In the commercial cellular voice world, Wireless Priority Access Service for authorized government

[101] High volume technologies based on advances in silicon processing can achieve higher performance and provide greater capacity with lower power systems and at far lower costs than using high-power expensive handsets traditionally employed by public safety. In short, the processing gains in silicon replace RF gains, lowering network and handset costs.

users is being deployed today.[102] Moreover, in the logical domain of broadband networking in the 21st century, this priority access can be guaranteed (*i.e.*, the other cars are forcibly removed from the road) through quality of service (QoS) functionality commonly offered in modern core network architectures.

However, the owner of a commercial block adjacent to Public Safety may not necessarily make its base stations and handset designs available to Public Safety or voluntarily commit to priority access. To overcome such a temptation, the FCC should offer a significant bidding preference to any bidder for the adjacent commercial spectrum that commits to making the handset designs and base stations available to Public Safety at no cost and to providing for free Public Safety priority access to commercial broadband spectrum during emergencies. Operating costs, such as public safety operators in call centers, should not be privatized; Public Safety would still bear those costs.[103] However, this bidding preference, combined with the band plan designed around 5.5 MHz blocks, would address the need for additional spectrum during peak times and would reduce by approximately $6.4 billion the cost barrier of network construction and handset design and manufacture.[104]

The licensees could deploy and operate wireless network infrastructure built to defined coverage and reliability specifications. To enforce these covenants, licensees would face

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102 *See The Development of Operational, Technical and Spectrum Requirements For Meeting Federal, State and Local Public Safety Agency Communication Requirements Through the Year 2010; Establishment of Rules and Requirements For Priority Access Service*, Second Report and Order, 15 FCC Rcd 16720 (2000). The National Communications System implements the wireless Priority Access Service through the Wireless Priority Service. *See* Wireless Priority Service (WPS) Website, *available at*: <http://wps.ncs.gov>.

103 We recognize that the precise obligations of the licensees obtaining the bidding preference would need to be determined after consultation with both commercial operators and public safety agencies.

104 Newman Decl. ¶¶ 1, 21 and Table 7.

penalties for non-compliance, including repayment of the bidding preference with interest and potentially loss of the license itself. Furthermore, the bidding preferences might be scaled to promote a certain level of coverage beyond a minimum geographical footprint or might stipulate various service level commitments, including the use of backup power generation, network uptime metrics, and other important operational requirements. For example, the "base" preference might stipulate a minimum coverage of U.S. landmass and include "kicker" credits for extending farther into the remaining, very sparsely populated rural areas that commercial operators typically avoid, and/or for "beefing up" the network's capabilities to meet Public Safety requirements. While the exact specification of these covenants is probably best left to private negotiations, the incentive regime would provide the basic framework for these negotiations to occur and give both commercial and public safety entities the incentive to reach reasonable accommodation on defining Public Safety's requirements.

In effect, this bidding preference would save an estimated $6.4 billion[105] and would ensure the public safety community has priority access to the best wireless broadband networks in the world.

All told, the proposal would create the basis for new investment in a state-of-the-art public safety wireless network and the ongoing incentives to keep it state-of-the-art over time. Our proposal connects the dots of proceedings already underway in three related areas: public safety, 700 MHz auctions, and A&B Block guard bands. The public-private partnership approach uniquely combines market incentives with small modifications to existing rules to ensure that the public safety community has sufficient wireless broadband network capabilities to protect Americans well into the 21st century. The plan provides Public Safety with spectrum

105 *Id.*

sufficient to meet peak capacity needs, but not at the expense of wholesale reconfiguration of the statutory allocation of the Upper 700 MHz band to commercial as well as public safety. Rather, the plan proposes sensible and small alterations at the margins of the existing allocations and could be implemented solely using the FCC's existing authority. In short, the proposal is practical, involves minimal change, can be considered and acted upon quickly so as to achieve a timely auction, and carries a high likelihood of success in an important project vital to our country's security and welfare.

III. CONCLUSION

In conclusion, we request that the Commission adopt the Upper 700 MHz band plan and related proposals described herein.

Respectfully submitted,

\/s/ Michael J. Gottdenker
Michael I. Gottdenker, Chairman and CEO
Andrew J. Rein, Director, Strategy & Operations
Access Spectrum, LLC
2 Bethesda Metro Center
Bethesda, MD 20814-6319

Ruth Milkman
Kenneth Boley
Gunnar Halley
Lawler, Metzger, Milkman & Keeney, LLC
2001 K Street NW, Suite 802
Washington, DC 20006
kboley@lmmk.com
Counsel to Access Spectrum, LLC

/s/ Marshall W. Pagon
Marshall W. Pagon, Chairman and CEO
Cheryl Crate, Vice President for Corporate Communications and Government Relations
Pegasus Communications Corp.
225 City Avenue, Suite 200
Bala Cynwyd, PA 19004

Kathleen Wallman
Wallman Consulting, LLC
9332 Ramey Lane
Great Falls, VA 22066
(202) 641-5387
wallmank@wallman.com
Adviser to Pegasus Communications Corp.

/s/ Donald Doering
Donald Doering, Chief Finanacial Officer
Columbia Capital III, LLC
201 North Union Street, Suite 300
Alexandria VA 22314

/s/ Dr. Rajendra Singh
Dr. Rajendra Singh, Chairman & President
Telcom Ventures, LLC
201 N. Union Street, Suite 360
Alexandria, VA 22314

September 29, 2006

ATTACHMENTS

Attachment A

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Service Rules for the 698-746, 747-762 and 777-792 MHz Bands	)	WT Docket No. 06-150
	)	
Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems	)	CC Docket No. 94-102
	)	
Section 68.4(a) of the Commission's Rules Governing Hearing Aid-Compatible Telephones	)	WT Docket No. 01-309

DECLARATION OF

Dr. Gregory L. Rosston

and

Dr. Scott Wallsten

Executive Summary

1. The lack of usable spectrum in the market is holding back advances in wireless technologies and their availability to the public. The current spectrum configuration and regulations regarding the use of spectrum in the upper 700 MHz band, which prevent it from being used optimally for high-value applications such as wireless broadband, typify this problem.
2. Three relatively low-cost changes to the 700 MHz spectrum rules could create conditions more favorable to unleashing a new wave of wireless benefits, much as the original PCS auction did in 1994. First, reduce the costs of using the spectrum efficiently by grouping the spectrum into blocks large enough to better support broadband technologies and make spectrum use flexible enough to easily migrate to whatever technologies become popular in the future. Three blocks of 5.5 MHz (paired), for example, would be friendly to CDMA, WiMAX and Flash OFDM applications whereas the current blocks would not be as well-suited to these technologies. Second, use package bidding in the auction to make it less risky for firms to try to aggregate licenses into more valuable geographic groupings. Finally, eliminate the unnecessary band manager requirement and cellular prohibition that hamstring the use of the guard band spectrum and make it incompatible with the greater 700 MHz commercial spectrum.
3. These small but significant changes have the potential to usher in a new era in wireless competition, especially broadband competition, delivering new and better

services and lower prices to consumers. In addition, 5.5 MHz blocks located next to the 5.5 MHz public safety blocks make it possible for the public safety community ("Public Safety") to share infrastructure and equipment with commercial providers, potentially leading to large savings for Public Safety. Such sharing is impossible with today's incompatible public safety and commercial band plans.

4. Adding the PCS spectrum to the wireless marketplace in 1994 unleashed a wave of competition, quickly leading to dramatically improved mobile cellular services, lower prices, and large economic benefits. Similarly, releasing spectrum in the desirable 700 MHz band to the market could further improve wireless and increase competition to existing broadband services if the band plan and auction rules give licensees the incentive and ability to choose high-value technologies and to employ them to supply services that consumers demand.

5. It is rare for the Commission to have such a large block of highly-desirable spectrum to auction at one time, and even rarer to be able make a change with so many benefits and so few costs.[1] In most auctions, the Commission must take into account a range of constraints and considerations that reduce its ability to maximize consumer welfare. By contrast, the upper 700 MHz spectrum auction is a unique opportunity to maximize consumer benefits subject to very few constraints. This auction is particularly important because such a large block of highly-desirable spectrum is unlikely to become available again to the marketplace in the foreseeable future. But the spectrum will not yield its benefits automatically – it will require a deft

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[1] The 700 MHz band is highly desirable for wireless services because its propagation characteristics allow a single cell site to serve a larger area and provide better in-building coverage than can a single site in higher bands.

understanding of technology, competition, and auction design to maximize competition and consumer welfare. The Commission should seize this chance to make spectrum policy work for the American people.

I. Introduction

6. This paper explains why the 700 MHz band is important for bringing American consumers advanced wireless services at competitive prices and steps the Commission can take to help realize these benefits. In this section we present the outline of the paper and our qualifications.

7. Section II discusses how better spectrum availability leads to consumer benefits and how the prime 700 MHz spectrum can help realize these benefits. Section III discusses simple changes that could improve the usefulness and competitiveness of 700 MHz band. Section IV explains the need for keeping post-auction transaction costs low. Section V explains the benefits of the proposed changes to Public Safety. Section VI concludes.

A. Qualifications

8. Gregory L. Rosston is the Deputy Director of the Stanford Institute for Economic Policy Research at Stanford University. He is also a Lecturer in the Economics Department at Stanford University. He received his Ph.D. and M.A. in economics from Stanford University, and his A.B. with Honors in economics from the University of California, Berkeley. His specialties in economics are industrial organization and regulation with an emphasis on telecommunications. He served at the Federal Communications Commission for three and one-half years as the Deputy

Chief Economist of the Commission, as Acting Chief Economist of the Common Carrier Bureau, and as a senior economist in the Office of Plans and Policy. In these positions, he had significant involvement with the Commission's spectrum policy and auction-related issues. He has been the author or co-author of a number of articles relating to telecommunications competition policy and spectrum policy. His Ph. D. dissertation studied the effects of FCC policy on the land mobile radio industry. He has also co-edited two books on telecommunications. He has co-hosted three conferences on implementation of package bidding with Evan Kwerel of the Federal Communications Commission. A copy of his C.V. is attached as Exhibit A to this report.

9. Scott Wallsten is a resident scholar at the American Enterprise Institute and a senior fellow at the AEI-Brookings Joint Center for Regulatory Studies. He received his Ph.D. and MA in economics from Stanford University, and received his BA *magna cum laude* in Economics from Washington University in St. Louis. His research focuses on industrial organization, regulation, and public policies, with special emphasis on telecommunications. He has also been an economist at the World Bank, where he focused on telecommunications privatization and competition around the world; a visiting scholar at the Stanford Institute for Economic Policy Research; and a staff economist at the President's Council of Economic Advisers. He has authored many articles on a wide range of telecommunications policies, and is often invited to speak as an expert at telecommunications conferences around the world. A copy of his C.V. is attached as Exhibit B to this report.

II. More effective use of spectrum will benefit consumers

10. Consumers have benefited greatly from competition and innovation in communications services. By one estimate, investments in information technology and high-speed telecom infrastructure "may be responsible for nearly one full percentage point of the annual increase in U.S. productivity since 1995 [through 2004]" (Hazlett, *et al.* 2004). As the authors note, labor productivity grew at around three percent during this period, so the increase attributable to information technology and high-speed telecom infrastructure is substantial. The array of wired and wireless services is still evolving, and the future of wireless services is likely to depend on the ability of innovative firms to acquire sufficient spectrum in which to deploy their offerings.

11. One potentially promising use of spectrum is for delivering broadband services. The number of broadband subscribers in the United States had increased to about 50 million by the end of 2005 from around 13 million in 2001.[2] Yet, the United States has fewer broadband subscribers per capita than 11 other OECD countries.[3] Meanwhile, advertised available connection speeds tend to be higher in some other countries than in the United States (see, for example, Bauer, *et al.* 2003).

12. The United States can do more to encourage broadband investment. Increases in broadband penetration and speeds to date have come mainly from competition

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[2] "FY 2004 Performance Summary," FCC (2005), *available at* http://www.fcc.gov/Reports/fcc2004performance.pdf; most recent data *available at* http://www.fcc.gov/wcb/iatd/comp.html.

[3] OECD Broadband Statistics, December 2005, *available at* http://www.oecd.org/document/39/0,2340,en_2649_34225_36459431_1_1_1_1,00.html. One of us (Wallsten) has argued that international broadband rankings are not especially meaningful in and of themselves ("Perspective: What Broadband Problem?" *available at* http://news.com.com/2010-1034_3-6090408.html). In the same editorial, however, he also argued that because of broadband's economic benefits it is important to facilitate competition and noted the inefficiencies in spectrum allocation currently inhibiting competition.

between two wireline providers – cable modem providers and telephone DSL providers – leaving another potential "pipe" to homes—wireless—largely untapped.

13. Several studies suggest that universal broadband Internet access could generate large benefits. Crandall and Jackson (2001) estimated that universal broadband could yield consumer benefits of $300-$500 billion. Litan and Rivlin (2001) estimated that ubiquitous broadband access could reduce business costs by $125 - $250 billion annually. More recently, and taking into account new uses of broadband, Litan (2005) estimated that broadband technologies could yield nearly half a trillion dollars over the next 25 years just in terms of benefits to the elderly and disabled. Given these large potential benefits, it is important to ensure that regulatory and other policies do not block continued entry, innovation, and investment.

14. Wireless service could provide a competitive broadband alternative, but terrestrial and satellite offerings are not yet sufficiently robust to compete directly with wireline services. Current wireless service offerings like EvDO and HSPD are generally slower and more expensive than wireline broadband options. For example, both Sprint PCS and Verizon Wireless charge $59.95 per month for 400-700 kbps service over their EvDO networks when purchased with a voice plan and a two-year contract.[4] While the data are not perfectly comparable, according to the Pew Internet and American Life Foundation, by March 2005 the average monthly DSL bill was $38 and the average cable Internet charge was $41 (Horrigan 2006). Even the slowest ADSL connection offers download speeds of 684 kbps and, according to the FCC's latest data, 62.3 percent of all high-speed lines offered at least 2.5 Mbps in at

[4] VerizonWireless website accessed September 7, 2006. Sprint PCS website accessed September 10, 2006.

least one direction.[5] In other words, commercial wireless broadband remains typically more expensive and slower than wireline broadband.

15. Crucial reasons for the relatively high prices of wireless broadband, its relatively slow speeds, and the small number of firms providing dedicated wireless high-speed Internet connections include the sparse amount of usable spectrum in the market, its inefficient allocation, and regulation of its use (e.g., Hazlett and Munoz 2004; Kwerel and Williams 2002). While the Commission has begun to move more spectrum into the market, a great deal of valuable spectrum is lying fallow, providing no benefits to consumers because of outdated rules and poor band plan design.

16. The costs of these barriers to the economy may be extremely high. Not only are the services currently available to consumers priced higher and of lower quality than they might otherwise be due to limited bandwidth, but entry and competition are more difficult, depriving consumers of innovation and new services that would come with increased competition. In addition, artificial spectrum scarcity limits competition and thereby keeps consumer prices higher.[6] More available spectrum in appropriately-sized blocks without use restrictions would make it possible to increase capacity on wireless services and allow them to be better situated as competitive alternatives. Because of the lower cost of deployment, competition by 700 MHz licensees should drive down consumer prices for wireless services. While today's relatively slow

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[5] See FCC (2006), "High-Speed Services for Internet Access: Status as of December 31, 2005" page 3, *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-266596A1.pdf.
In the Washington, DC area in September 2006, Verizon was offering DSL with up to 786 kbps download and 128 kbps upload bandwidth for $19.95 per month with a one-year contract. (Verizon website accessed September 10, 2006.)

[6] Higher prices do not by themselves represent an economic cost; instead, they represent a surplus transfer from consumers to producers. Higher prices that cause people not to subscribe because of higher prices cause a real economic loss.

wireless broadband is an important advance, the next leap to ubiquitous broadband wireless holds significant promise to increase consumer welfare.

III. Reconfiguring the 700 MHz band plan and service rules will increase the effective spectrum available

17. To stimulate entry and competition that will benefit consumers, the FCC cannot simply auction spectrum in the 700 MHz band without regard for the spectrum's possible uses. Some might argue that, as Ronald Coase noted, secondary market trading can erase any problems that arise from an inefficient initial assignment. However, it is critical to note that the Coase Theorem states that initial allocations do not matter if and only if transaction costs are low enough. Transaction costs for spectrum do not appear to be low – the secondary market for spectrum has been "thin," meaning that few transactions take place. Thin markets usually have high transaction costs as it can be difficult for buyers to find sellers and vice-versa and because it is difficult to determine reasonable prices.

18. As a result, the initial band plan and service rules can affect the level of competition. If the Commission sets an initial band plan that is friendly to different technologies and allows providers to aggregate sufficient spectrum easily, providers are more likely to be able to provide competitive service. To do this, the Commission must decide how the spectrum might best meet today's needs and ensure that the rules are flexible enough that licensees can change use to meet evolving needs without the Commission's subsequent intervention. Achieving these goals means carefully considering initial spectrum configurations and auction rules so that they do not deter entrants and competition.

19. The current 700 MHz band plan is not configured optimally for even today's high-value services, let alone the next generation of services. The Commission should make it possible to use the entire commercial 700 MHz spectrum efficiently. In other words, allow firms to make the best use of the spectrum at the lowest cost. Three changes would help maximize expected consumer benefits from the 700 MHz spectrum.

20. First, the Commission can help ensure that the spectrum is used efficiently by creating spectrum blocks and geographic areas that allow bidders to choose technologies and business plans that will best serve consumers. A band plan with large blocks of spectrum, such as three 5.5 MHz commercial blocks, would increase the ability of new entrants to acquire useful licenses. Similarly, previous auctions have demonstrated that large geographic areas tend to be valuable, suggesting that licenses should cover relatively large areas.

21. Second, use state-of-the-art auction techniques, like package bidding, to facilitate entry. Some firms' business plans may rely crucially on their ability to offer services across geographic areas that requires them to aggregate licenses. Without some assurance that they can bid on the entire region of interest without a risk of winning only some of the licenses they require, many firms may stay out of the auction. Package bidding, by allowing firms to place a single bid on groups of licenses, helps to assure bidders whose business plans require aggregations that they can bid with minimal exposure risk.

22. Finally, eliminate the band manager requirement and cellular prohibition. These unnecessary rules hamstring the use of the guard band spectrum and make it

incompatible with the greater 700 MHz commercial spectrum. The use rules not only make it difficult for the band to easily accommodate today's promising technologies, but also will make it costly to adapt to future technologies.

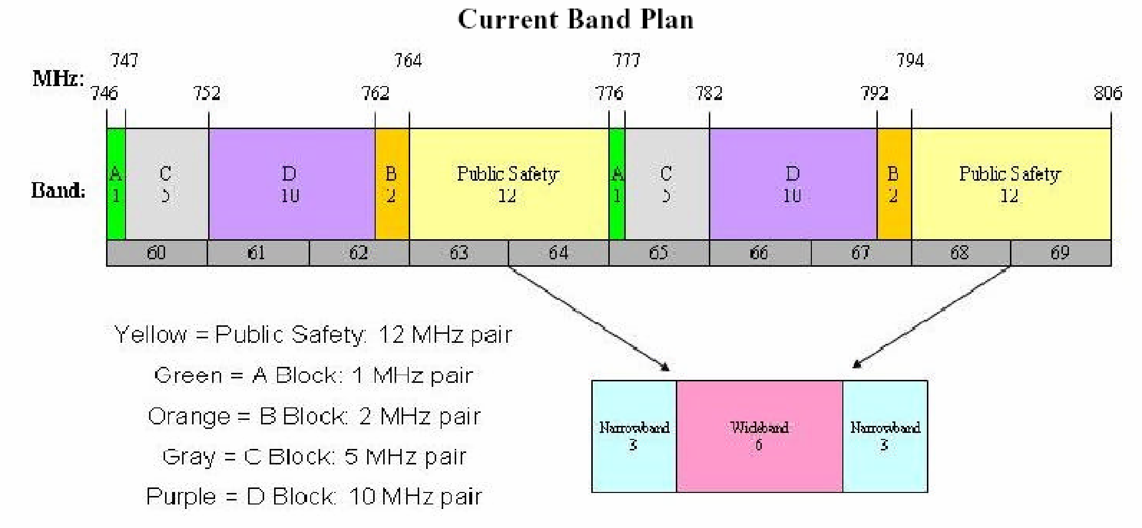
23. These changes could help catalyze entirely new types of wireless competitors and generate large benefits to society. These changes would also facilitate the creation of new, high-speed broadband providers that could compete vigorously not only with existing wireless services, but also with landline broadband offerings. In addition, these changes could yield substantial benefits to Public Safety, which could use the commercial infrastructure and equipment to benefit from the economies of scope and scale from cooperating with large commercial networks.

A. Auction efficiently-sized spectrum blocks

24. The government can help promote economically efficient spectrum use by carefully considering the size of initial bandwidth blocks. In general, these initial allocations should approximate the best estimate of the efficient use of spectrum. The amount of spectrum in each block to be licensed should take into account the characteristics of different frequencies and the different spectrum needs of various services.

25. The original upper 700 MHz band plan (Figure 1) protected yesterday's narrowband technologies, especially those used for Public Safety. It was also tied to the historical television channel assignments in an attempt to minimize transaction costs when it was thought that television broadcasters might not vacate the spectrum in a timely manner. As a result, according to the Kolodzy engineering declaration that discusses wireless technology in detail, the band is not optimally configured for supporting most of the likely broadband applications.

Figure 1



26. These past conceptions have saddled the upper 700 MHz plan with inefficiently-sized spectrum blocks.[7] Some potential providers may wish to offer services that require large bandwidths, but with the current configuration, firms would not be able to deploy the most appropriate spectrum, and ultimately not provide as vigorous competition or the same level of services to consumers at low cost. The A block is too small for the leading wireless broadband technologies. The current guard bands are likely to result in underutilized or wasted spectrum unless they can partner with or be combined with larger spectrum blocks. It is also likely that the limited amount of spectrum combined with the cellular architecture restrictions could leave the two guard band blocks unusable for broadband services for the foreseeable future.

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[7] Access Spectrum LLC and Pegasus Guard Band LLC, "Implementing the Vision for 700 MHz: Rebanding the Upper 700 MHz A and B Blocks for Next Generation Wireless Broadband" August 3, 2005, pp 4-6 discussing the difficulties using 1 MHz paired and 2 MHz paired blocks for broadband. The declaration of Dr. Paul Kolodzy discusses the advantages of 5.5 MHz blocks compared to 5 MHz blocks.

27. Reorganizing the band, contributing part of the B Block to Public Safety and putting the A block next to a larger block of spectrum with which it could partner or be combined would allow the spectrum to become part of broadband systems. The current rules and configuration make such an efficiency enhancing move impossible, effectively denying consumers the benefits of 6 MHz of spectrum that would be deployed in a sub-optimal manner. Changing the rules and band plan would reduce the transaction costs that might otherwise prevent such a move. Even liberating this relatively small amount of spectrum could increase public welfare by billions of dollars.[8]

28. Figure 2 shows the BOP band plan. While this is a vast improvement on the status quo, with the new A block next to the public safety broadband operations and a guard band inside the public safety spectrum on the upper end, there is no need, assuming that the technical rules for the A Block are harmonized with the technical rules for the rest of the commercial spectrum, to separate the A block from the rest of the commercial spectrum in the upper 700 MHz band.

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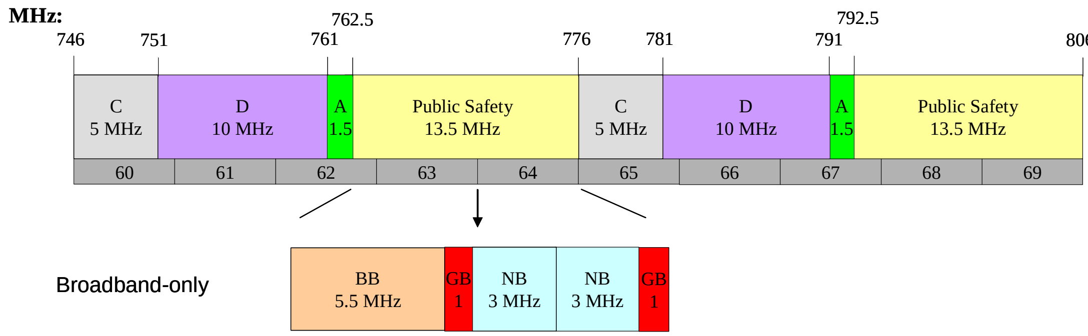
[8] *See* Hausman (1997), Rosston (1994) and Hazlett and Munoz (2004).

Figure 2
BOP



29. The 700 MHz band should be further reconfigured to increase its usefulness for today's broadband applications and to allow its use to be flexible enough to adapt to tomorrow's technologies that we cannot yet foresee. Increasing the potential usefulness of the available spectrum configuration would certainly increase consumer welfare and would likely increase auction revenues.

30. According to the Kolodzy declaration, some of the most promising wireless broadband services require at least 1.25 MHz of spectrum per channel.[9] Given the amount of commercial spectrum that can be reconfigured in the upper 700 MHz band, 5.5 MHz blocks are likely to be valuable, as a single 5.5 MHz block can accommodate four EvDO channels[10] or a robust WiMAX service.[11] A 5 MHz block can support only 3 EvDO channels, leaving nearly 1 MHz or 20% of each block unused.[12] By moving from the 5 MHz blocks to the 5.5 MHz blocks, licensees would have the option of using 4 EvDO channels and providing greater service at lower cost. According to Kolodzy, the benefits for Flash OFDM are similar.

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[9] Kolodzy Declaration, ¶ 10.
[10] Kolodzy Declaration, ¶ 13.
[11] Kolodzy Declaration, ¶ 16.
[12] Kolodzy Declaration, ¶ 13.

31. In addition, it is our understanding from the Kolodzy declaration that 5.5 MHz blocks are also compatible with WiMAX technology being developed in other bands.[13] Compatible size blocks may lead to cheaper system and end user equipment. While WCDMA-FDD is designed for a 5 MHz block, Kolodzy notes that implementing such systems in 5.5 MHz blocks may be cheaper because of lower filtering costs.[14]

32. With 5.5 MHz blocks the Commission can allow for, but not mandate, these technology choices in addition to other choices that would also be compatible with 5 MHz channels. Permitting flexible use of the spectrum would also allow licensees to further aggregate or disaggregate spectrum blocks if they so chose.

B. Facilitate efficient geographic aggregation

33. It has long been evident that commercial wireless services are provided efficiently over relatively large geographic areas. The Commission initially allocated cellular licenses over 734 relatively small areas across the country. However, these areas were too small. Service providers realized this problem in the 1980s and began to aggregate licenses to operate them at a lower cost. Later, with advances in handset technology, consumers demanded larger service territories as they began to travel with their handsets. Craig McCaw and others aggregated the small licenses, at a relatively large cost and began to provide a more national service. The PCS auctions also proved the value of large geographic coverage, with the licenses leading to new national providers and also filling in the holes of near-national providers. Consumers now benefit from more seamless coverage and substantially lower roaming rates.

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[13] Kolodzy Declaration, ¶ 16.
[14] Kolodzy Declaration, ¶ 14.

34. The results of the AWS auctions also support this observation – the REAG licenses sold for a substantial premium over the smaller geographic licenses, in part due to the risk associated with trying to aggregate the smaller blocks into efficient sized areas. Even with the smaller areas, many of the bidders tried to aggregate licenses into larger areas. The high aggregation risks may lead to inefficient license assignments that are not correctable in the secondary market. To the extent that the government can keep transaction costs low and minimize inefficient license assignment, consumers will benefit.

35. The current A block licenses are divided into 52 MEAs, making it sensible for that to be the largest number of licenses for the larger blocks of spectrum. Using smaller blocks would increase the transaction costs for providers to aggregate licenses and also would increase the transaction costs in negotiating with the guard band license holders. The Commission matched the initial band plan with the television assignments to minimize transaction costs. Now, it should consider transaction costs in the same way, but applied to the guard band licenses. If the Commission were to adopt regional geographies, it would make sense to use REAG regions for the blocks in the upper 700 MHz since these map with the existing MEA licenses. The regions in the current band plan do not map to MEAs, so this could significantly increase transaction costs.

C. Allow package bidding to encourage auction participation and entry

36. Package bidding, which allows bidders to place a single bid for a set of geographic areas and spectrum blocks, is an important tool the Commission could use in the 700 MHz auction. The Commission has studied the benefits of package bidding for many

years and put much effort and expense into designing appropriate package bidding tools and they appear to be ready and sufficiently robust to use in this auction. The 700 MHz auction has many properties that make package bidding attractive.

37. Package bidding provides the biggest gain when "exposure" risk is largest. A bidder may not bid on pieces of a package if the package is worth substantially more than the sum of the values of the individual pieces and it fears not being able to acquire sufficient pieces cost-effectively to make the package worth the price. This tends to occur when a package has a large number of pieces and when bidders have different preferences for packages.

38. Package bidding may be an especially useful tool for promoting competition. If a new entrant has an "all-or-nothing" entry strategy, requiring, say, 11 MHz paired (22 MHz) across the country, then it might not bid at all without some assurance that it could easily exit the auction if prices for some of the pieces were too high. With package bidding, the fear of acquiring an unusable "half-a-loaf" would not deter bidding because a bidder would not face the exposure risk. In addition, it would minimize the ability of other bidders to drive up the price of a nationwide aggregation artificially beyond the willingness of the entrant to pay. Without package bidding, a bidder risks paying too much if a rival bids sequentially on individual pieces of the package, driving the price for the whole above the willingness to pay, but providing no easy exit.

39. The AWS auction shows the potential benefit of package bidding. With a package for the EAs or CMAs, Echostar and DirectTV likely would have stayed in the auction longer, and possibly become new wireless broadband entrants. They only bid on the

largest regional licenses. While they could have bid on a large number of smaller licenses making up the same frequency and coverage for a small fraction of what they bid for the regional licenses, they dropped out of the auction rather than risk being caught with only a subset of nationwide coverage. In addition, the large differentials in price for licenses with similar coverage would likely have disappeared. The large regional licenses sold for a substantial premium over the EAG and CMA licenses, even though the technical characteristics do not justify such a premium. Economic theory says that similar items should sell for similar prices, but they did not in the AWS auction in part because of the auction design. The Commission has studied package bidding and developed the systems necessary to implement it. Depending on the details, package bidding can become complicated, but three 5.5 MHz blocks and twelve geographic areas should not create too many licenses for the FCC or bidders to handle.

40. Package bidding also presents potential computational and implementation issues, but these are surmountable. Paul Milgrom and Karen Wrege, for example, recently submitted comments in this proceeding and in another proceeding suggesting specific limited packages that could reduce computational complexity while also gaining much of the benefits from package bidding.[15] If necessary, the Commission could limit the number of packages, limit characteristics of packages, or even pre-define some packages. For example, if the FCC chose to stick with the 52 MEAs as the base license, the FCC could create set packages of regions (*i.e.*, twelve REAGs) and one nationwide for each block as well as regional and nationwide packages for

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[15] Comments of Paul Milgrom and Karen Wrege, AU Docket No. 06-104, and also in WT Docket 06-150.

combinations of two blocks and one for all three blocks. In addition, the Commission could let bidders choose a limited set of packages of their own. Such a plan would limit flexibility, but might be substantially better than having no package bidding at all. There may be other ways to implement package bidding in this auction that might substantially improve the outcome of the auction and subsequent provision of service to consumers.

D. Remove cellular-use restrictions and end band manager mandates

41. It is most important for economic growth that regulations do not distort or otherwise delay innovation and competition. Regulations should not, therefore, specify which technologies may or may not be used in a particular spectrum band, either now or in the future. Current rules prohibit the use of "cellular system architecture" in the upper 700 MHz A and B blocks.[16] This regulation stemmed from a desire to promote narrowband private wireless and to protect narrowband public safety services. According to a white paper by the Upper 700 MHz A and B block licensees (2005), these restrictions "would likely prevent deployment of broadband…" Rearranging the 700 MHz band in the BOP means that these restrictions are no longer necessary, if they ever were. Instead of regulating input levels and mandating (and forestalling) specific technologies in an indirect attempt to prevent interference, the Commission should address interference directly through initial Out of Band Emission ("OOBE") limits and/or Power Flux Density limits. The cellular architecture restrictions have no

[16] 47 C.F.R. § 27.2(b); *see also Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules,* Second Report and Order, 15 FCC Rcd 5299, ¶¶ 19-24 (2000) ("*Upper 700 MHz Second R&O*").

benefits, as they are unnecessary to prevent interference, especially with the revised BOP band plan, and could impose enormous economic costs if they prevent providers from offering what many believe to be today's highest-value services.

42. The Commission should make the interference rules for the new guard band similar to the rest of the commercial spectrum. This would protect public safety while also enhancing the usefulness of the guard band spectrum.

43. The current guard band rules also mandate that the licensees act as "band managers" and do not use the spectrum entirely themselves or lease to a single entity. This restriction is an inefficient, costly attempt to force spectrum licensees to subdivide even a sliver of spectrum into even more inefficient pieces. While *allowing* a licensee to act as a band manager is a good idea, mandating the subdivision renders the spectrum nearly unusable, especially since the mandate means that the spectrum cannot be combined with another block in a potentially efficient manner.

44. The Commission has adopted a framework for secondary markets for both trading of licenses and leasing of spectrum. That proceeding and the framework it set up should be applied to the 700 MHz guard band spectrum as well – there is no need to mandate the "band manager" business plan that will harm consumers.

IV. Keep post-auction transaction costs low

45. While the Commission should do its best to choose good initial license configurations, it is nearly impossible to create optimal configurations. In addition, the dynamism of the telecommunications industry makes it impossible to predict accurately what technologies will develop and be adopted in even the relatively near future. As a result, the Commission should also keep post-auction transaction costs

low to ensure that licenses can be both easily traded and easily adaptable to future technologies.

46. License holders should, for example, be allowed to aggregate blocks to suit their business plans (and, conversely, disaggregate their licensed spectrum blocks if they so choose). Switching the commercial band plan to incorporate 5.5 MHz blocks would allow licensees to pursue business plans that require 5.5 MHz, 11 MHz, or 16.5 MHz of spectrum (11, 22 or 33 MHz with the matching paired spectrum).

47. The current rebanding process presents an opportunity to reduce the chances that future regulatory intervention will be necessary by creating a configuration likely to align with today's highest uses while allowing maximum flexibility so that configurations and uses can change as demand and technology change.

V. Public Safety can benefit from economies of scale and scope

48. Under the current plan, Public Safety is slated to receive 24 MHz in the 700 MHz band. Adopting the Broadband Optimization Plan ("BOP") would increase the amount of spectrum available to Public Safety to 27 MHz. In addition to the increase in the amount of spectrum, the proposed plan makes potentially large cost savings possible for Public Safety.

49. A key concern for many public safety agencies is the cost of deploying infrastructure and end-user radios that take advantage of the prime spectrum. While the details of the cost estimates vary, they are all high, and would strain public safety budgets. One key problem with the current band plan is that public safety agencies must pay for unique designs and equipment to take advantage of their spectrum configuration.

However, if their systems could share infrastructure with commercial systems, public safety would benefit from lower initial buildout costs and less expensive handsets due to the lower costs from being part of larger volume chipsets and other equipment designed for commercial users.

50. As with most high technology equipment, the 700 MHz equipment is likely to exhibit a substantial learning curve and large economies of scale in manufacturing. Adjacent commercial and public safety 5.5 MHz blocks make it possible for Public Safety equipment to be compatible with commercial equipment. Public Safety equipment could therefore benefit from the economies of scale that come from the expected large production runs for commercial equipment. The changed band plan may make it easier for the Public Safety to save costs and therefore spend more on other ways that increase their ability to provide public safety services.

VI. Conclusions

51. The 700 MHz spectrum provides the Commission with a unique opportunity to increase broadband and wireless competition in the U.S. The benefits arising from the new wireless broadband services and lower prices can only be realized fully if the Commission adopts a band plan, auction and service rules that let the companies wanting to employ most efficient technologies and act as real competitors access the spectrum.

52. Benefits from competition can be enhanced through sound policies governing initial assignments. Such policies include determining appropriately sized spectrum blocks and geographic areas. The Commission should consider carefully the currently expected technologies and make sure that its decisions enable the best suited

technologies to thrive. But the initial spectrum configurations should be sufficiently malleable that if the Commission is wrong, or if circumstances change, that spectrum use can easily change as well.

53. The initial rules regarding block size and geography dovetail with FCC auction rules – the better designed the initial block sizes and geographic areas, the better the auction can perform, but there are also ways in which the auction may be able to be designed to allow more choice in the initial assignments. Package bidding can ameliorate problems from assigning too many blocks or geographic areas and also encourage entry and new competition.

54. The band plan change in the BOP that puts Public Safety broadband adjacent to the commercial licensees and puts internal guard bands within the Public Safety spectrum allows for additional flexibility by removing the cellular-use restriction on the current guard bands. This will make these bands substantially more useful to providers and ultimately to consumers. It also highlights the infirmities in the band manager mandates that need to be removed to ensure that the Commission can fulfill its mandate to manage spectrum in the public interest.

55. All of these changes redound to the benefit of the public by increasing the chance for efficient providers to gain access to the spectrum. They can then provide low cost and high quality services to the public. At the same time, the changes that lead to widespread deployment of commercial services lead directly to lower costs for public safety services. It is rare that the Commission has the opportunity to engage in a potentially *pareto improving* decision – one that makes everyone better off and no one worse off. The changes proposed here come close. The only parties facing

potential harm would be firms that fear additional competition, and for the public, such fear is good because it creates innovation, lowers costs, and stimulates economic growth.

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Gregory L. Rosston

Stanford Institute for Economic Policy Research
Stanford University
Stanford, CA 94305-6072
Phone (650) 566-9211
Fax (707) 922-0185
e-mail: grosston AT stanford.edu
greg AT Rosston.com

Employment

Stanford University, Stanford, CA
- Deputy Director, Stanford Institute for Economic Policy Research, 1999-
- Senior Research Fellow, Stanford Institute for Economic Policy Research, 2004-
- Research Fellow, Stanford Institute for Economic Policy Research, 1997-2004
- Lecturer in Economics and Public Policy, 1997-

Federal Communications Commission, Washington, DC
- Deputy Chief Economist, 1995-1997
- Acting Chief Economist, Common Carrier Bureau, 1996
- Senior Economist, Office of Plans and Policy, 1994-1995

Law and Economics Consulting Group, Berkeley, CA
- Senior Economist, 1990-1994

Economists Incorporated, Washington, DC
- Economist/Research Associate, 1986-1988

Education

Stanford University, M.A., Ph.D., in Economics, Specialized in the fields of Industrial Organization and Public Finance. 1986, 1994.

University of California, Berkeley, A.B. in Economics with Honors. 1984.

Papers and Publications

"An Economic Analysis of the Effects of FCC Regulation on Land Mobile Radio," unpublished Ph.D. dissertation, Stanford University. 1994.

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Other Professional Activities

Referee for *American Economic Review, Rand Journal of Economics, Industrial and Corporate Change, Journal of Industrial Economics, Telecommunication Systems, Journal of Economics and Management Science, Antitrust Law Journal.*

FCC Economist Panel Hearing on the Economics of Interconnection, May, 1996.

FCC Economist Panel Hearing on the Economics of RBOC Entry under Section 271, July, 1996.

FCC Economist Panel Hearing on Competitive Bidding for Universal Service Provision, March, 1997.

Consultant for the World Bank on Telecommunications Policy in Hungary, 1998.

FCC Academic Expert Panel on "A New FCC for the 21st Century," June 1999.

FCC Academic Expert Panel on AT&T—MediaOne Merger, February, 2000.

FCC Panel on Wireless Competition, February 2002.

FCC Workshop on Spectrum Policy, July 2002.

San Francisco Telecommunications Commission on Cable Competition, January 2003.

U.S. Senate Commerce Committee on Spectrum Policy, March 2003.

California State Senate Committee on Banking, Commerce and International Trade on the Economic Effects of Media Consolidation, March 2003.

Telecommunications Policy Research Conference, Program Committee 2002-2004

Bay Area Economic Profile Academic Review Panel, 2003-2004

National Research Council Committee on *Wireless Technology Prospects and Policy*, 2003-2004.

San Francisco City Board of Supervisors Land Use Committee on Cable Competition, July 2004.

GAO Panel on Spectrum Allocation and Assignment, August, 2005.

Awards

Chairman's Distinguished Service Award, FCC, 1997.

University of California, Brad King Award for Young Alumni Service, 1994.

National Performance Review Hammer Award for Reinventing Government, 1994.

Telecommunications Policy Research Conference Graduate Student Paper Competition, 2nd Place, 1994.

John M. Olin Foundation Fellowship, 1989-1990.

Charles Mills Gayley Fellowship, 1985.

Stanford University Fellowship, 1984-1985.

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Scott Jonathan Wallsten

AEI-Brookings Joint Center
Suite 1100
1150 17th St., NW
Washington, DC 20036

Tel: 202-862-5885
Fax: 202-862-7169
swallsten@aei.org

Education

- Stanford University, PhD, Economics, 1998.
- Stanford University, MA, Economics, 1995.
- Washington University, BA, *summa cum laude*, Economics, Mathematics (minor), 1992.

Employment

- Resident Scholar, American Enterprise Institute, 2003 – present.
- AEI-Brookings Joint Center for Regulatory Studies, Fellow 2003-2005, Senior Fellow 2005-present.
- The World Bank, Economist, 1998 – 2003.
- Stanford University, Acting Assistant Professor of Public Policy and Visiting Researcher, Stanford Institute for Economics Policy Research, 1999-2001.
- President's Council of Economic Advisers, Staff Economist, 1995-1996.

Peer-Reviewed Publications

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- "Surveying Surveys and Questioning Questions: Learning from World Bank Experience." With Lixin Colin Xu and Francesca Recanatini. March 2000.
- "Executive Compensation and Firm Performance: Big Carrot, Small Stick." SIEPR Working Paper 99-17. March 2000.

Testimony, Presentations, and Panels

- Progress and Freedom Foundation 2006 Aspen Summit, on broadband investment.
- Pew Internet and American Life Foundation, conference on broadband statistics, 2006.

- The Brookings Institution, on Telecommunications reforms in developing countries, 2006.
- AEI-Brookings Joint Center panel on network neutrality, 2006.
- McDonough School of Business, Georgetown University, on broadband policy, 2006.
- Presentation to National Defense University students on Iraq cost analysis, 2006.
- American Economic Association annual meeting, discussant and speaker in Transportation and Public Utilities Group sessions, 2006.
- AEI-Brookings Joint Center, OIRA 25th anniversary, moderator, 2005.
- NCAER-Brookings India Policy Forum, New Delhi, India, 2005.
- AEI, the economics of sports stadiums, 2005.
- AEI-Brookings Joint Center, the future of telecom deregulation, 2005.
- Stanford Institute for Economic Policy Research, telecommunications conference, co-organizer and discussant, 2005.
- CATO Institute, DC Baseball subsidies, November 2004.
- AEI-Brookings Joint Center, telecommunication and spectrum regulation, moderator, 2004.
- AEI-Brookings Joint Center, software and intellectual property rights, moderator, 2004.
- NCAER, telecommunications reform, New Delhi, India, 2004.
- AEI, globalization conference, 2004.
- Stanford University conference on Latin America, 2003.
- APEC conference on regulation, Mexico City, 2003.
- Economic History Association, St. Louis, 2002.
- FEEM Privatization Conference, Milan, 2002.
- Economic History Society, Birmingham, 2002.
- ISNIE 2002 Conference, Cambridge, 2002.
- Wharton School of Business, 2002.
- Georgetown University, 2001.
- ISNIE 2001 Conference, Berkeley, 2001.
- Ronald Coase Institute, Berkeley, 2001.
- Asia Pacific Research Center, Stanford University, Palo Alto, 2000.
- Washington University, St. Louis, 2000.
- The World Bank, 1999, 2000, 2002.
- U.S. House of Representatives, Committee on Science, Subcommittee on Technology, 1997.
- Econometrics Society Annual Meeting, Montreal, Canada 1998.
- NBER Summer Science & Tech Policy Conference, Cambridge, 1996.

Other Professional and Referee Activities

Current committees:

- Member, "Sufficient Evidence? Building Certifiably Dependable Systems," National Academies of Sciences Computer Science and Technology Board, 2003-present.

Referee for:

- American Economic Review
- Journal of Political Economy
- Journal of Industrial Economics
- RAND Journal of Economics
- Journal of Regulatory Economics
- Journal of Economic History
- Journal of Development Economics
- Journal of Comparative Economics
- Information Economics and Policy

- Telecommunications Policy
- International Journal of Industrial Organization
- Cambridge University Press
- National Science Foundation Small Business Innovation Research Program

Honors

- Alfred P. Sloan Foundation Dissertation Fellowship, 1997 – 1998.
- Phi Beta Kappa.
- Omicron Delta Epsilon, International Economics Honor Society.
- Percy Tucker Fellow, Washington University Department of Economics award for outstanding economics undergraduate.

Attachment B

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Service Rules for the 698-746, 747-762 and 777-792 MHz Bands	)	WT Docket No. 06-150
	)	
Revision of the Commission’s Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems	)	CC Docket No. 94-102
	)	
Section 68.4(a) of the Commission’s Rules Governing Hearing Aid-Compatible Telephones	)	WT Docket No. 01-309

DECLARATION OF

DR. PAUL J. KOLODZY

I, Dr. Paul J. Kolodzy, hereby declare the following:

I. Introduction

Summary

1. Because of recent changes in technology and systems development, the Commission has issued a notice of proposed rulemaking to reconsider rules for the Lower and Upper 700 MHz bands.[1] In this declaration, I provide an analysis to determine whether 5 MHz or 5.5 MHz is the superior block size for commercial spectrum in the Upper 700 MHz band to enable the greatest and most efficient use of broadband technologies in the band.[2] It also addresses the overall impact of the Broadband Optimization Plan ("BOP") proposed in the *Public Safety 700 MHz Broadband* proceeding,[3] including the impact of the BOP on the amount of spectrum available and on commercial block sizes. This analysis also addresses technical considerations to ensure protection of public safety operations.

Qualifications

2. My name is Paul Kolodzy. I have 20 years of experience in technology development for advanced communications, networking, electronic warfare, and spectrum policy. I am currently a Communications Technology Consultant in Advanced Wireless and Networking

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[1] *Service Rules for the 698-746, 747-762 and 777-792 MHz Bands,* Notice of Proposed Rulemaking, Fourth Further Notice of Proposed Rulemaking, and Second Further Notice of Proposed Rulemaking, 21 FCC Rcd 9345 (2006) (FCC 06-114) ("*Notice*").

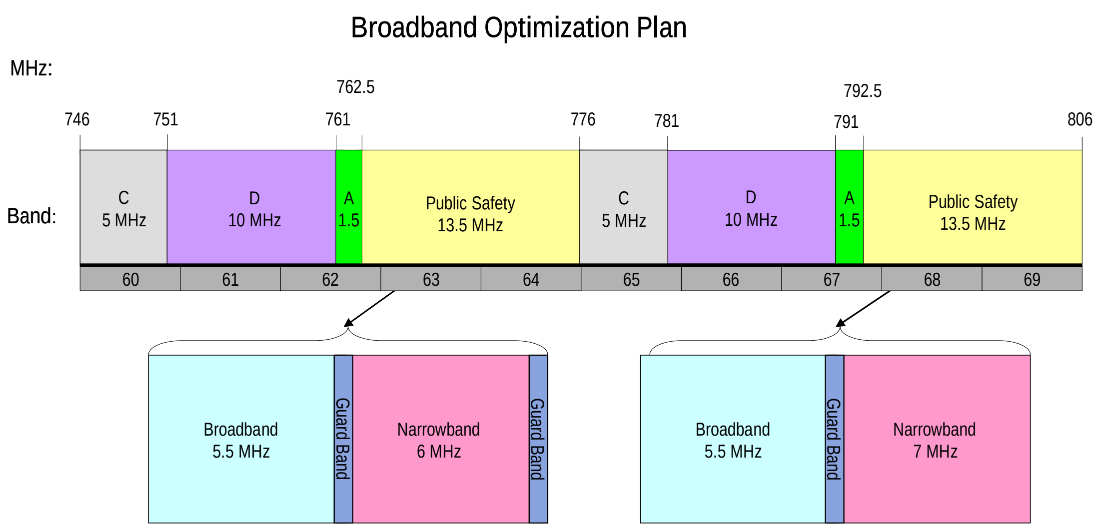
[2] The Upper 700 MHz spectrum is particularly well-suited to wireless broadband services. Its propagation characteristics are such that its signal will experience only one-seventh as much attenuation (dispersion) as the signal for a system operating at 1.9 GHz, and thus can carry greater distances. Further, the lower frequency operation will provide better transmission through walls and diffraction around buildings.

[3] Comments of Access Spectrum, L.L.C., Columbia Capital III, LLC, Intel Corporation, and Pegasus Communications Corporation, WT Docket No. 96-86 (June 6, 2006) at 13-14 ("BOP Comments") (filed in the *Public Safety 700 MHz Broadband* proceeding: *The Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010,* Eighth Notice of Proposed Rulemaking, 21 FCC Rcd 3668 (2006) (FCC 06-34)).

Technology based in the Washington, D.C. area. My career has spanned academia, commercial and government activities in all areas of advanced wireless technology. I have been: Director of the Center for Wireless Network Security ("WiNSeC") at the Stevens Institute of Technology; the Senior Spectrum Policy Advisor and Director of Spectrum Policy Task Force at the Federal Communications Commission; Program Manager at the Defense Advanced Projects Agency ("DARPA"); a manager at Sanders, a Lockheed Martin Company; and a manager at MIT Lincoln Laboratory. I hold a PhD in engineering and have made numerous presentations and publications in the areas of signal processing as well as wireless technology and policy. My CV is attached.

A. The Broadband Optimization Plan

3. As proposed in the *Public Safety 700 MHz Broadband* proceeding, the BOP would configure the Upper 700 MHz band as follows:[4]



The public safety block would increase from 12 MHz paired to 13.5 MHz paired, and the A Block would be increased to a total of 1.5 MHz paired and relocated adjacent to the lower edge

[4] BOP Comments at 13-14.

of the public safety block, where licensees would be permitted to deploy broadband operations, including cellular broadband. The C and D Blocks would remain the same size (5 and 10 MHz paired, respectively) and be relocated 1 MHz lower in the band plan, so that the C Block would be 746-751 MHz and 776-781 MHz, and the D Block would be 751-761 MHz and 781-791 MHz. The B Block would be eliminated.

4. Within the public safety block, narrowband channels (currently totaling 6 MHz paired) would be consolidated at the upper end of each segment. Thus, at 806 MHz, public safety narrowband operations would be adjacent to public safety narrowband operations in the 800 MHz band, as in the current band plan. To the extent that public safety elected to deploy broadband channels, those channels could be consolidated at the lower end of the block, and spectrum newly added to the public safety block under the BOP would be utilized at the discretion of the public safety community ("Public Safety") for internal guard bands.

5. As illustrated above, the BOP would enable 5.5 MHz paired contiguous spectrum for public safety broadband. In this scenario, at the two lower edges of the expanded public safety block, public safety broadband would be directly adjacent to commercial broadband operations in the new A Block. At 776 MHz, commercial broadband operations in the C Block would be adjacent to public safety narrowband, separated by a guard band of approximately 1 MHz of public safety spectrum. Finally, at 806 MHz, public safety narrowband operations in the Upper 700 MHz band would be directly adjacent to public safety operations in the 800 MHz band.

B. Optimization of Block Size

6. I have been asked to analyze the relative merits of different spectrum segment sizes based on two scenarios. In the first scenario, 15 MHz of spectrum is available for commercial broadband, as under current rules. Under the second scenario, 16.5 MHz of spectrum is

available for commercial broadband, as would be the case under the BOP. Under a 15 MHz scenario, the basic spectrum building block would be 5 MHz, which could be aggregated into segments of 10 or 15 MHz. Under the 16.5 MHz scenario, the basic spectrum building block would be 5.5 MHz, which could be aggregated into segments of 11 or 16.5 MHz.

1. Technologies Analyzed

7. In order to determine the segment size that would best accommodate broadband technologies, this analysis considers six advanced technologies that are available today or are expected to become available in the near term. These six technologies are:

- EvDO (Evolutionary, Data-Only), a CDMA2000 standard for advanced cellular telephony, pioneered by Qualcomm, that is the basis of the advanced networks deployed by several of the major U.S. carriers (Sprint, Verizon, Alltel);
- WCDMA/UMTS (Wideband Code Division Multiple Access/Universal Mobile Telephone System), a cellular telephony technology likely to be the most widely deployed advanced technology globally, currently being deployed by Cingular, T-Mobile and others;
- WiMax (Worldwide Interoperability for Microwave Access), a leading IP-based broadband data technology slated for deployment in the 2.5 GHz band by multiple providers including Clearwire and Sprint Nextel.
- Flash-OFDM (Flash Orthogonal Frequency Division Multiplexing), an IP-based data technology pioneered by Flarion (now Qualcomm Flarion) that succeeded in the Washington, DC OCTO (Office of Chief Technology Officer) pilot for broadband public safety applications;[5]
- FLO (Forward Link Only) a wireless broadband technology for multimedia, slated for deployment by Qualcomm in the Lower 700 MHz D Block; and
- DVB-H (Digital Video Broadcasting-Handhelds), a wireless broadband technology for bringing broadcast services to handheld receivers, standardized in Europe and currently undergoing numerous trials in Australia and Europe.

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[5] Comments of Spectrum Coalition for Public Safety, WT Docket No. 05-157 (April 28, 2005) at 2, 12.

Although there are currently no specific technologies slated for implementation in the Upper 700 MHz band, this analysis considers the primary technologies, either implemented in other bands or under development for implementation, that are likely to be deployed in large systems in the Upper 700 MHz band. The modifications that would be needed to enable any of these technologies in the Upper 700 MHz band are typical in rebanding efforts for deploying a common technology in multiple bands and should not result in any extraordinary challenges unless the final technical rules are modified.

2. Analysis

8. Larger spectrum segments contain an inherent capacity advantage over smaller spectrum segments. Thus, when a spectrum segment is increased in size, the capacity of that segment will increase in rough proportion to the segment's overall bandwidth, assuming no significant change in spectral efficiency. As a result, 5.5 MHz segments possess an inherent capacity advantage over 5.0 MHz segments. Depending on the technology deployed, however, different sizes of spectrum segments may contain additional advantages, ones that are disproportionate to their size.

9. Each technology can be deployed in spectrum segments of various widths. However, this analysis addresses the signal bandwidths that are—or are expected to be—the widths most commonly deployed. In addition, for each technology, spectrum must also be used for buffer at both the upper edge and the lower edge of the signal band. If multiple signal bands of the same technology are deployed adjacent to each other, no buffer is needed between them,[6] but there

[6] This analysis assumes deployment of broadband channels in a cooperative fashion within each segment that would mitigate near-far interference, thus allowing channels to be contiguous in the segment. If this were not the case, for example if some of the segment's spectrum were leased on the secondary market and channels were deployed without coordination to mitigate the near-far problem, buffers of approximately 250 kHz typically would be necessary between channels.

must be one buffer zone above the uppermost channel and another buffer zone below the lowermost channel. Because the amount of spectrum necessary for buffer around the signal band—or contiguous group of signal bands—depends upon the choice of filtering technology employed, this analysis generally uses 250 kHz buffers, which are commonly used for broadband deployment.[7] Thus, for example, a group of three contiguous EvDO channels of approximately 1.25 MHz each would require 4.25 MHz: 3.75 MHz for the three signal bands (1.25 x 3), plus 500 kHz for the two buffer zones (250 x 2). In some cases, where specified, different assumptions about buffer spectrum are applied based upon specific technical information detailing deployment of the technology.

10. Cutting-edge, advanced broadband technologies, including those still under development, require for their signal bands no less than approximately 1.25 MHz of spectrum. In addition, it is a common design parameter for such technologies to use a signal band of 5 MHz; with nominal filtering and 250 kHz buffers, technologies that use a 5 MHz signal band can meet current cellular out-of-band emissions restrictions (transmitter power (P) attenuated by 43 + 10 log (P) dB), in a band of 5.5 MHz of spectrum. Thus, for example, 5.5 MHz spectrum segments efficiently accommodate four channels with 1.25 MHz signal bands or a single channel with a 5 MHz signal band. Even for technologies that can be deployed in slightly smaller segments, an extra 500 kHz would enable operators to maintain interference protection levels

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As a result, uncooperative channel deployment would enable fewer channels in a given size spectrum segment.

[7] The buffer is the amount of bandwidth necessary in order to provide the proper out-of-band emissions and interference protections for given filter technology. Manufacturers have quoted common implementations for cellular operations in other bands ranging from 230 to 270 kHz. The size of the buffer is dependent upon the technical rules of the band and the filter technology that is employed in the radio design. Unless otherwise specified, this analysis uses 250 kHz which, based on the quoted values, appears reasonable.

while reducing the cost of filtering equipment and engineering.[8] In light of these considerations, I have performed an analysis of 5 MHz and 5.5 MHz segment sizes across the technologies described above.

a. Technology Types

11. *Fixed Waveform Technologies.* Wireless broadband technologies that employ fixed waveforms are designed for implementation in spectrum segments of specific sizes. Implementation of these technologies in spectrum segments different from those for which they are designed would require changes in their baseband processing and would thus be problematic for deployment platforms intended to be homogeneous worldwide. As a result, the key factor for differentiating between specific spectrum segment sizes for these technologies is the efficiency with which the technology is accommodated within the particular spectrum segment. Among fixed waveform technologies, this analysis considers three FDD technologies—EvDO, the currently deployed 1.25 MHz version of Flash-OFDM, and WCDMA/UMTS—as well as two TDD technologies—FLO and DVB-H.[9]

12. *Selectable Bandwidth Technologies.* Other wireless broadband technologies are able to scale to fit available spectrum segments, within minimum and maximum requirements. For example, the number of active subcarriers in an OFDM system may be changed so that the signal band can fit available spectrum. In the FDD category, OFDM and WiMAX share this capability, as does the TDD version of WiMAX. As a result of this scalability, the prime differentiation

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[8] A decision to use the extra 500 kHz would involve a trade-off between spectral efficiency and complexity of the RF section of the radios (*e.g.* filter roll-off and low noise amplifier performance).

[9] Another TDD technology is UMTS-TD-CDMA, which was recently selected for deployment by Public Safety in New York City. For purposes of this declaration, the analysis results for UMTS-TD-CDMA would be similar to those contained herein for WCDMA/UMTS.

between spectrum segment sizes for selectable bandwidth technologies is the amount of capacity of the deployed system.

b. Analysis by Technology

13. *EvDO*. EvDO systems have signal bands of 1.25 MHz. As a result, four EvDO channels could be deployed efficiently, without wasted spectrum, in segments of 5.5 MHz. Because two buffers of 250 kHz each would be needed, the resulting utilization percentage for four EvDO channels (a total of 5 MHz signal band) in a 5.5 MHz block would be 91 percent. A deployment of EvDO in a segment of 5 MHz would accommodate only three channels (3.75 MHz signal band), with a utilization percentage of 75 percent. Therefore, a 10 percent increase in segment bandwidth provides an increase of 33 percent in the number of channels accommodated, or a 21 percent increase in signal capacity. As a result, 5.5 MHz segments offer both greater capacity and greater spectral efficiency for EvDO than would a 5.0 MHz segment.

14. *WCDMA/UMTS.*[10] WCDMA/UMTS is defined for use in 5 MHz segments, with a signal band of 3.84 MHz. As a result, a 5 MHz segment would accommodate a single WCDMA/UMTS channel with a utilization percentage of 77 percent; a 5.5 MHz channel would also accommodate a single channel, with a utilization percentage of 70 percent. However, a 5.5 MHz segment would offer advantages for deploying a WCDMA/UMTS channel that would not be realized in a segment of only 5 MHz. As noted above, the additional 500 kHz in a 5.5 MHz block would enable operators to maintain interference protection levels while reducing the cost of filtering equipment and engineering. In addition, although specifications imply a value of 580

[10] As noted above, the analysis for WCDMA/UMTS herein includes UMTS-TD-CDMA. Although UMTS-TD-CDMA is a TDD technology, the analysis is equivalent.

kHz for filter roll-off at the band edge,[11] it is feasible to employ optimized filters to reduce band-edge roll-off and allow buffers of 330 kHz, which would enable 4 WCDMA/UMTS channels within a 16.5 MHz segment.[12] As a result, aggregating three 5.5 MHz segments to create a 16.5 MHz segment would enable an operator to deploy four WCDMA/UMTS channels with optimized filtering, for a utilization percentage of 93 percent. Three 5 MHz segments aggregated to a single 15 MHz segment would accommodate only three WCDMA/UMTS channels. Therefore, a 10 percent increase in segment bandwidth provides an increase of 33 percent in the number of WCDMA/UMTS channels accommodated, or a 21 percent increase in signal capacity.

15. *Flash-OFDM.* Like EVDO, initial Flarion deployments of Flash-OFDM have used 1.25 MHz channels. As a result, 5.5 MHz segments can efficiently accommodate four Flash-OFDM channels, while segments of 5.0 MHz can accommodate only three such channels. In addition to the 1.25 MHz channel size, however, Flash-OFDM is also capable of changing its signal band to fit the available spectrum. As a result, Flash-OFDM could efficiently fill either a 5 MHz segment or a 5.5 MHz segment with utilization rates of 90 and 91 percent, respectively. Because of the inherent capacity advantage of larger spectrum segments, the extra 500 kHz of the 5.5 MHz segment would provide the operator in that segment with 11 percent more capacity than would a 5.0 MHz segment.

16. *WiMAX (FDD or TDD).* As described above, the WiMAX signal band also can be changed to fit within available spectrum. As a result, WiMAX could efficiently fill either a 5 MHz segment or a 5.5 MHz segment with 375 kHz used for buffer on each side in typical implementation. The resulting utilization rates are thus 85 and 86 percent, respectively.

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[11] 5 MHz segment minus 3.84 MHz signal band leaves 1.16 MHz total for buffer, which is 580 kHz on each side of the signal band.

[12] Four channels of 3.84 each with 4 MHz center spacing equals 15.84 MHz, which leaves 660 kHz total buffer (330 kHz on each side) in a 16.5 MHz segment.

However, because of the inherent capacity advantage of larger spectrum segments, the extra 500 kHz of the 5.5 MHz segment would provide the operator in that segment with 11 percent more capacity than would a 5.0 MHz segment. Further, WiMAX has been defined for 5.5 MHz spectrum segments for use in the 2.5 GHz BRS/EBS bands. It should be a relatively straightforward matter to reband the 2.5 GHz WiMAX radio architecture for use in the Upper 700 MHz band.

17. *FLO and DVB-H*. Although FLO and DVB-H are different technologies, they are used for the same purpose—broadcasting—and have identical spectrum requirements. In both cases, the technologies are defined for 5, 6, 7, or 8 MHz; spectrum segments that include a fractional megahertz would leave some spectrum unused by the system's requirements. As a result, the utilization rate for FLO and DVB-H in a 5.0 MHz segment would be slightly greater than in a 5.5 MHz segment. However, as described above, the additional 500 kHz in a 5.5 MHz block would enable operators to maintain interference protection levels while reducing the cost of filtering equipment and engineering.

c. Segment Size Analysis Conclusions

18. As explained above, 5.5 MHz segments would offer greater benefits for advanced broadband technologies than would 5.0 MHz segments.[13] Those technologies with signal bands that can be adjusted to fit available spectrum benefit from the inherent advantage of larger spectrum segments: a roughly proportional increase in capacity. Those technologies with fixed

[13] In a recent, similar analysis to determine the optimal spectrum segment size in BRS/EBS spectrum, the Commission came to the same conclusion: 5.5 MHz is the optimal size spectrum segment, because a 5 MHz signal band is the most desired current size, with an additional 500 kHz for buffer. *Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands,* Report and Order and Further Notice of Proposed Rulemaking, 19 FCC Rcd 14165, ¶ 36 n.84 (2004).

waveforms are not able to adjust to meet segment sizes, but as in the case of EvDO and the 1.25 MHz version of Flash-OFDM at 5.5 MHz, and WCDMA/UMTS at 16.5 MHz, the extra spectrum can be enough to allow accommodation of an extra channel or more, resulting in a disproportionate increase in capacity.

C. Interference Protection

19. Under any plan, there are three categories of interference risk that must be addressed: (1) interference by commercial broadband to commercial broadband, (2) interference by commercial broadband to public safety narrowband, and (3) interference by commercial broadband to public safety broadband.

20. *Commercial broadband to commercial broadband.* The current rules for the Upper 700 MHz band enable broadband operations in the C and D Blocks and protect those operations from interference caused by other commercial operations. Those rules would be equally sufficient to protect commercial broadband operations if broadband systems were enabled in the A Block, as contemplated in the BOP.[14]

21. *Commercial broadband to public safety narrowband.* Under the current rules, commercial broadband is enabled in the Upper 700 MHz C and D Blocks. In the plan of record, public safety narrowband operations are separated from the C and D Blocks by the current A and B Blocks, which are used as buffers of at least 1 MHz. Thus, as reflected in the current rules, broadband systems could operate in commercial spectrum within 1 MHz of public safety narrowband operations without causing undue interference to the public safety narrowband operations. Under the BOP, commercial broadband operations would still be separated from

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[14] If the Commission were to determine that current C and D Block out-of-band emissions rules can be relaxed, the revised C and D Block rules could also be applied under the BOP to the A Block without causing undue interference to commercial operations.

public safety narrowband operations by 1 MHz of spectrum. However, unlike the current band plan, which uses commercial spectrum for that buffer, the BOP provides Public Safety additional spectrum so that the buffer may be internal to the public safety allocation and under Public Safety's control. Thus, under the BOP, public safety narrowband operations would have the same level of protection from interference caused by commercial broadband operations as under the current rules.[15]

22. *Commercial broadband to public safety broadband*. Because the Upper 700 MHz plan of record does not contemplate broadband operations in public safety spectrum, the current rules do not address interference by commercial broadband operations to public safety broadband operations. Under the BOP as illustrated above, public safety broadband operations would be adjacent to commercial broadband operations. This should not cause undue interference by the commercial system to the public safety broadband system because broadband receivers employ advanced signal processing techniques (*e.g.* processing gain) that provide greater resistance to interference created by out-of-band emissions. Therefore, out-of-band emissions into broadband channels can be greater than out-of-band emissions into narrowband channels without causing harmful interference to the broadband operations. This is borne out in the current rules for the C and D Blocks, which apply a lower level of protection for commercial broadband operations than for narrowband and wideband public safety operations. Current rules also locate commercial broadband operations on spectrum adjacent to other commercial broadband operations, not separated by a buffer. Just as adjacent commercial broadband operations would not cause harmful interference to each other under current rules, likewise a commercial broadband

[15] If the Commission were to determine that public safety narrowband operations would be sufficiently protected under relaxed C and D Block restrictions, such revised C and D Block rules could also be applied under the BOP to the A Block without causing undue interference to public safety narrowband operations.

operation would not cause harmful interference to an adjacent public safety broadband operation under similar rules.[16]

D. Conclusion

23. This declaration analyzes the six broadband technologies most likely to be deployed in Upper 700 MHz spectrum in order to determine the spectrum segment size that would best accommodate advanced broadband technologies with the greatest efficiency. The analysis indicates that 5.5 MHz is a better size for spectrum blocks in the Upper 700 MHz band than 5.0 MHz. Altering the band plan for the Upper 700 MHz band as proposed in the BOP presents an opportunity to apply the same emissions restrictions to all commercial operations in the Upper 700 MHz band while maintaining protection for public safety operations.

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[16] If the Commission determines that current rules can be relaxed with regard to interference protection for broadband operations in the C and D Blocks, the same new protections would be sufficient to protect public safety broadband operations. If, however, the Commission determines that public safety broadband operations require greater protection than commercial broadband operations, Access Spectrum and Pegasus have outlined in filings in this and other proceedings a variety of approaches available to provide such additional protection. *See Implementing the Vision for 700 MHz: Rebanding the Upper 700 MHz A and B Blocks for Next-Generation Wireless Broadband*, *ex parte* presentation by Access Spectrum, L.L.C., Pegasus Guard Band, L.L.C., Columbia Capital Equity Partners III, L.P., and PTPMS II Communications, L.L.C. with support from Enterprise Wireless Alliance, submitted via letter from Kenneth R. Boley to Marlene H. Dortch, WT Docket No. 05-157 (Aug. 3, 2005) ("White Paper"); *see also Rule Changes to Implement the Proposed Rebanding of the Upper 700 MHz A and B Blocks for Next Generation Wireless Broadband*, *ex parte* presentation by Access Spectrum, L.L.C., Pegasus Guard Band, L.L.C., Columbia Capital Equity Partners III, L.P., and PTPMS II Communications, L.L.C. with support from Enterprise Wireless Alliance, submitted via letter from Kenneth R. Boley to Marlene H. Dortch, WT Docket No. 05-157 (Nov. 4, 2005) ("Supplemental White Paper"); *see also* Comments of Pegasus Communications Corp., WT Docket 96-86 (June 6, 2006).

Declaration

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Executed on September 28, 2006

Dr. Paul J. Kolodzy

PAUL J. KOLODZY, PhD

pkolodzy@kolodzy.com

(703) 266-9489 (w)
(703) 318-9987 (m)

Wireless Consultant – Kolodzy Consulting. (2004)

Provides wireless communications consultation services to Government and commercial customers. Consultations include the areas of technology development, program management, procurement strategies, spectrum policy and acquisition, business development, and small business acquisition. Activities include start-up companies; large telecommunications service providers, equipment providers, and component developers.

Founder (2004), General Chair (2005), and Chair of Steering Committee (2004-) of IEEE Dynamic Spectrum Access Network Conference

The Dynamic Spectrum Access Network Symposium is a forum to discuss the advanced research and development of new methods to access the radio frequency spectrum for consumer, commercial, scientific, and government applications. Due to the complexities inherent in dynamic spectrum access, the research and development spans the technology, economic, policy and legal communities. DySpAN aims to provide an open forum to address the challenges and opportunities of new access techniques. 2005 conference drew 310+ participants..

Director - Wireless Network Security Center, Stevens Institute of Technology. (2002 – 2004)

Director of the Center for Wireless Network Security (WiNSeC) at Stevens Institute of Technology since November 2002. WiNSeC provides leadership in advanced technology to provide secure, interoperable wireless operations for consumer, commercial, financial, defense, and public safety applications under duress and within complex environments. He also was a member of the faculty in the schools of Engineering and Technology Management.

***Senior Spectrum Policy Advisor - Federal Communications Commission (FCC).* (2002)**

Director of Spectrum Policy Task Force charged with developing the next generation spectrum allocation and licensing processes. A contentious topic that requires a thorough understanding of the impact of advanced technology, economic and business forces, as well as the legal authority. Task Force output was a set of proposals to include changes to FCC rules and new legislative actions to significantly enhance the nation's ability to provide access to the spectrum at its highest and best use.

***Program Manager - Defense Advanced Projects Agency (DARPA)* (1999-2002)**

Program Manager of over $200M of R&D for communications programs to develop generation-after-next offensive and defensive capabilities. DARPA is world renown for the successful development of high risk, high payoff technologies

A successful program for the development, demonstration, and transition of a man-portable software definable radio prototype was accomplished. Incorporated the use of advanced materials, techniques, and leveraging, as well as coping, with advances in the commercial sector to develop the ne**X**t **G**eneration (XG) program. XG is a key enabling spectrum utilization project using dynamic frequency assignments that has profound impact to commercial and military spectrum policy

Director – Sanders, A Lockheed Martin Company (1996-1999)

Director of Signal Processing and Strategic Initiatives and reported to the VP of Advanced Technology and CTO. Sanders is a premier electronic warfare company in the United States. Responsibilities included managing the advanced technology focused on Information Warfare, Electronic Warfare, and Signal Intelligence techniques.

Group Leader/Staff Member – MIT Lincoln Laboratory (1985-1996)

I held both staff and management positions in the area of Optical Systems for Laser Radars, Signal Processing, and Target Recognition for Acoustics, RF (SAR), and Optical signatures.

1. Education

PhD, Chemical Engineering, 1986, Case Western Reserve University, Thesis: A Statistical Analysis of Laser Velocimetry

MS, Chemical Engineering, 1983, Case Western Reserve University

BS, Chemical Engineering, 1983, Purdue University

2. Awards

Office of the Secretary of Defense: Exceptional Public Service Award, March 2002

3. Presentations and Publications

Kolodzy, P. (Fette, B – editor) Chapter 2 - *Communications Policy and Spectrum Management*, in *Cognitive Radio Technology*, published by Elsevier, 2006.

Kolodzy, P. "*Interference Temperature: A Metric for Dynamic Spectrum Utilization*", International Journal of Network Management, John Wiley & Sons, 2006.

Kolodzy, P. "*Dynamic Spectrum Policies: Promises and Challenges*", CommLaw Conspectus, 2004

Kolodzy, P. "*FCC Spectrum Policy Task Force Report*", www.fcc.gov/sptf, November 2001.

Kolodzy, P. "*The Future of Mobile Wireless Communications*", Invited, Keynote Presentation to MobiCom 2003 (Mobile Computing and Communications Conference), San Diego, CA, September 2003

Kolodzy, P. "*Future Technology and Policy Challenges for Commercial Telecommunications*", Invited, World-Class Expert Panel, Nokia Innovations Group, President and President-North American Strategy Meeting, Napa Valley, CA, October 2003

Kolodzy, P. "*Spectrum Management and Policy Directions for NSF*", Invited, NSF Spectrum Working Group, Washington, DC, May 2003

Kolodzy, P. "*Spectrum Policy Challenges*", Invited, Interchange Conference between FCC and Academic Researchers, Quello Center, December 2003

Kolodzy, P. Invited and Paid, Participation in the UK Spectrum Management Advisory Group, London October 2003

Kolodzy, P. "*Technology-Policy Interplay*", Invited, IEEE Communications, in preparation.

Kolodzy, P. "*New Directions for Spectrum Management*, International Software Definable Radio Conference, London, June 2003

Kolodzy, P, "*The Promises and Challenges for Software Definable Radios*", Invited, Military Radios Symposium, Washington DC, September 2003

Kolodzy, P. *"The role of cognitive radio on novel spectrum management"*, Invited (and paid) Speaker to European Commission, DG Information Society (INFSO), October, 2003

Kolodzy, P. (Chairman) *FCC Spectrum Policy Task Force Report*, www.fcc.gov/sptf, November 2002.

Kolodzy, P. *Technology and Future Spectrum Technology*, Keynote at World Wireless Congress 2002 Conference in San Francisco.

Kolodzy, P. *Advanced Communication Technology* presented at Wireless World Research Forum, March 2002.

Kolodzy, P. *Small Unit Operations Situational Awareness System (SUO SAS)* Presented at MILCOM 2001, October, 2001, Washington, DC.

Kolodzy, P. Multiple articles published with Signal Magazine (2000-2002) on technology under my sponsorship in Transparent Antennas, Software Definable Radios, Electronic Warfare, and Opportunistic Spectrum Use.

Kolodzy, P. *Spectrum Policy: Technology Leading to New Directions,* Keynote at National Spectrum Manager Association (NSMA) 2002.

Kolodzy, P. *A DARPA Perspective on Broadband Wireless Systems* Presented at International Symposium on Advanced Radio Technologies, September, 2000, Boulder Colorado

Kolodzy, P. *Sensor/Data Fusion and Formal Methods* Presented at 1998 ANNUAL CDSP RESEARCH WORKSHOP

4. Synergistic activities

Charter Member, Higher Education Wireless Access Consortium	2003-
Chairman, Spectrum Policy Task Force	2002
Program-Committee Chair: National Symposium on Sensor and Data Fusion	1995-97

5. Collaborators and other affiliations

Appointed to the FCC Technology Advisory Committee	2003-2005
Member of IEEE	2002-
Member of AFCEA	2003-
Member, National Academy of Science Study on Advanced Spectrum Policy	2003-2005

Attachment C

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Service Rules for the 698-746, 747-762 and 777-792 MHz Bands	))	WT Docket No. 06-150
	)	
Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems	)))	CC Docket No. 94-102
	)	
Section 68.4(a) of the Commission's Rules Governing Hearing Aid-Compatible Telephones	))	WT Docket No. 01-309

DECLARATION OF

DR. STAGG NEWMAN

I, Dr. Stagg Newman, hereby declare the following:

I. SUMMARY

1. The purpose of this declaration is to quantify certain potential cost savings derived from adopting the plan proposed by Access Spectrum, Pegasus, Columbia Capital and Telcom Ventures. This plan would result in 5.5 MHz paired blocks in the Upper 700 MHz band dedicated for Public Safety and adjacent 5.5 MHz paired blocks for commercial allocations and create the opportunity and incentive for commercial operators to share infrastructure and equipment design with the public safety community ("Public Safety"). First, the declaration will demonstrate that the cost to Public Safety of an exclusive network covering 90% of the landmass of the continental United States would be $4.0 billion for a coverage only network and $8.4 billion for a network with the capacity to support the peak demand per cell site needed by Public Safety as defined by the Spectrum Coalition White Paper.[1] However, with the adoption of the Broadband Optimization Plan ("BOP") that includes infrastructure sharing with the adjacent commercial operators and priority access for Public Safety on the commercial network to handle peak demand in times of major emergencies, the additional cost to Public Safety would be only $2.0 billion (a savings of approximately $6.4 billion for Public Safety). Second, the declaration will establish that the use of 5.5 MHz blocks, rather than 5 MHz blocks, can result in as much as $2 billion in cost savings for commercial operators using typical technology that is commercially available today as they will be able to expand system capacity by adding channels rather than cell sites.

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[1] *Spectrum Needs of Emergency Response Providers*, WT Docket No. 05-157, Spectrum Coalition for Public Safety *Ex Parte* Presentation "Public Safety Spectrum: How Much Do We Need for Data?" (filed Oct. 27, 2005) ("Spectrum Coalition White Paper").

II. QUALIFICATIONS

2. At present, I provide technology, regulatory, and strategic advice and analysis to telecommunications clients around the world through my own consulting firm, Pisgah Comm Consulting. I also serve as McKinsey and Company's Representative on the Technology Advisory Council of the U.S. Federal Communications Commission. In that role I led the Broadband Working Group that assessed broadband access platforms. I also recently gave a presentation to the FCC TAC entitled "State of Technology Deployment for Fixed and Mobile Broadband Deployment – The Next Half Decade." From 2000 to 2005, I worked for McKinsey and Company as Senior Telecom Expert, lending technical expertise to several hundred client teams worldwide. I provided technical leadership for the Firm's knowledge development efforts, particularly in broadband access, high speed wireless and the intersection of technology and regulation. Prior to my work at McKinsey, I was Chief Technologist at the FCC in 1998 and 1999 where I advised the Commissioners and senior staffers on strategic technology issues. I started my telecommunications career at Bell Labs in 1976 and joined Bell Communications Research in 1984 as part of the AT&T divestiture in 1984. I served as Vice President, Network Technology and Architecture, Applied Research (1994-1997), Bell Communications Research where I managed the optical networking, wireless, and network access research programs. I received my B.S. from Davidson College and my M.S. and Ph.D. in mathematics from Cornell University. My C.V. is attached.

III. BENEFITS OF PARTNERSHIPS BETWEEN PUBLIC SAFETY AND COMMERCIAL OPERATORS

3. It is clear to me that a policy promoting network sharing between public safety agencies and their commercial 700 MHz neighbors could save Public Safety several billions of dollars in network costs. This belief stems from a quantitative analysis I undertook to estimate the build costs for a nationwide public safety wireless broadband network. I explain the assumptions and results of my analysis below.

A. Key Assumptions

4. In estimating network construction costs, I incorporated assumptions that have informed my consulting work on similar matters, adapting them wherever necessary to the peculiarities of the 700 MHz band and specific public safety requirements.

5. *Scenarios.* In order to compare a full range of deployment options for a public safety network, I considered 6 different possibilities: 3 discrete network deployment scenarios x 2 different definitions of nationwide coverage. The three deployment scenarios are summarized in the following table:

Network Scenario	Spectrum assumptions	Infrastructure assumptions
Scenario 0 (baseline)	Broadband portion of public safety allocation under proposals in Public Safety 700 MHz Broadband NPRM (<4 MHz[2]). Model assumes three 1.25 MHz carriers.	No infrastructure sharing between Public Safety and commercial neighbors.
Scenario 1 (BOP only)	Broadband portion of BOP public safety allocation (paired 5.5 MHz[3]). Model assumes four 1.25 MHz carriers.	No infrastructure sharing between Public Safety and commercial neighbors.
Scenario 2 (BOP + Adjacent block sharing)	Broadband portion of BOP public safety allocation exclusively used by Public Safety (paired 5.5 MHz), adjacent commercial blocks available to Public Safety on priority basis (additional paired 5.5 MHz) for additional capacity. Model assumes eight 1.25 MHz carriers.	Public Safety piggybacks on commercial tower infrastructure, provides capex for base stations for public safety band but uses commercial base stations for priority access in adjacent commercial block.

Table 1: Scenario Description

I considered each of these three scenarios in light of two different definitions of nationwide coverage:

"Nationwide" Definition	Coverage Description
Commercial Coverage	Coverage equivalent, in terms of landmass, population, and morphological characteristics to the actual, non-duplicative network coverage currently provided by leading nationwide commercial wireless operators and their main roaming partners within the continental United States.
90% Coverage	Commercial coverage as defined above, plus additional rural areas required to extend to cover 90% of landmass in the continental United States.

Table 2: Definitions of Nationwide Coverage

2 *The Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010*, Eighth Notice of Proposed Rulemaking, WT Docket No. 96-86, FCC 06-34 (rel. March 21, 2006). The proposals in the NPRM assume that the 6 MHz of spectrum for broadband (or wideband) is surrounded by public safety narrowband spectrum, and allow for three 1.25 MHz broadband channels, with the remainder of the broadband/wideband spectrum being used for guard bands. *See, e.g., id.*, Figure 4 (NPSTC Plan) and Figure 5 (Lucent Plan).

3 Under the BOP, the public safety spectrum is reconfigured so that 5.5 MHz is designated for broadband/wideband; and there is an additional 1 MHz of spectrum designated for use as a guard band between the broadband and narrowband spectrum.

For each scenario I analyzed: a) the cost to build a coverage-limited network, which provides a lower bound on the costs; and b) the cost to build a network with the capacity needed to meet the demand of Public Safety as specified by the Spectrum Coalition for Public Safety.[4] This latter case provides an aggressive assumption of demand and therefore provides an upper bound on capex for the near future. I assumed that the commercial network build-out in the spectrum adjacent to the public safety spectrum and available to Public Safety on a priority access basis in times of emergency would have at least enough capacity to cover the emergency demand needs of Public Safety as defined in the Spectrum Coalition report. The analysis focuses on the direct capex spend needed by public safety under each of the scenarios.

6. *Coverage Parameters.* In modeling network coverage, I incorporated assumptions about landmass and cell range under different morphological conditions. These assumptions were informed by my work with different equipment vendors and zip-code level statistics of landmass by population density for the continental United States (CONUS – excludes Alaska and Hawaii). These assumptions are summarized in Table 3:

Morphology	Definition	Cell Range	Area (% of CONUS)	Population (% of CONUS)
Urban	2,500+ pops/sq km	1.4 km	0.1%	13.4%
Suburban	500-2,500 pops/sq km	3.2 km	1.4%	33.2%
Rural	0-500 pops/sq km	12.1 km	98.5%	43.2%

Table 3: Coverage Assumptions by Morphology

I applied these morphological assumptions to zip code level data sets representing the "commercial" and "90%" coverage footprints defined in Table 2 in order to arrive at coverage cell site counts for a representative public safety build in CONUS. For the commercial footprint I modeled the non-duplicative network coverage of a leading Tier 1

[4] Spectrum Coalition White Paper.

operator along with its roaming affiliates (to account for out-of-market coverage). For the 90% scenario I assumed that all incremental coverage constitutes rural morphology, so I added rural landmass sufficient to bring the total coverage to 90% of CONUS.

7. *Capacity Parameters*. For purposes of this analysis I assumed an FDD network with paired 1.25 MHz carriers and 3-sector sites. Consistent with the Spectrum Coalition for Public Safety, I assumed an OFDM technology, for example FLASH-OFDM with 1.25 MHz channels, the technology used in the OCTO trial. I also assumed a multi-carrier n=1 reuse configuration. For the capacity per sector, I used the likely performance of these type systems based on an amalgam of industry published numbers as well as conversations with engineers of firms producing these technologies.[5] I extrapolated performance gains from adding a additional fourth carrier where appropriate from published performance specifications throughput resulting in sustained PHY[6] sector performance as summarized in Table 4:

Sector Metric	Rated Performance for 3 carriers	Implied Performance for 4 carriers
Sector Bandwidth	3.8 MHz	5.0 MHz
Forward Link Sustained	5.4 Mbps	7.1 Mbps
Reverse Link Sustained	2.2 Mbps	2.9 Mbps

Table 4: FLASH-OFDM Sector Performance

[5] For a summary of industry-published numbers, *see* "State of Technology Development for Fixed and Mobile Broadband: The Next Half Decade," by Stagg Newman, Presentation to the FCC Technological Advisory Council, p. 21 (July 20, 2006), *available at* http://www.fcc.gov/oet/tac/meetings_2006-2007.html.

[6] PHY: Physical Layer: "The OSI model defines Layer 1 as the Physical Layer and as including all electrical and mechanical aspects relating to the connection of a device to a transmission medium." Newton's Telecommunications Dictionary, 22nd Ed.

These numbers imply a downlink spectral efficiency of 1.4 bps/Hz, which is close to the 1.2 mbps assumption utilized by the Spectrum Coalition. Finally, I reduced the sector performance by 20% to account for MAC[7] overhead.

8. *User Demand.* Peak user demand assumptions are critical to understanding the potential traffic load on the network and therefore its capacity requirements. The Spectrum Coalition has produced an in-depth analysis of likely usage requirements, based in part on its involvement with the Washington, DC trial. For my analysis I used the Spectrum Coalition's estimations of peak demand by an average public safety user: 1.5 mbps in the forward link and 0.5 mbps in the reverse link (excluding header information).[8] I projected these assumptions onto a nationwide population of 2.5 million public safety users, with morphological distribution equivalent to the distribution of the overall U.S. population. Furthermore, like the Spectrum Coalition, I assumed 5% maximum concurrent usage at the busy hour. The Spectrum Coalition also indicated that demand for public safety is characterized by a "70/20" network concentration effect, whereby one can expect 70% of public safety network usage to be concentrated spatially within 20% of the network during a major crisis.[9] I incorporated this network concentration effect into the per cell site capacity requirements.[10] These busy hour usage

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[7] MAC: Medium Access Control: "The IEEE sublayer in a LAN (Local Area Network) which controls access to the shared medium by LAN-attached devices. In the context of the OSI Reference Model, the MAC layer extends above to the Data Link Layer (Layer 2) and below to the Physical Layer (Layer 1). Within the MAC sublayer are defined Data Link Layer options which specify the basis on which devices access the shared medium, and the basis on which congestion control is exercised." Newton's Telecommunications Dictionary, 22nd Ed.

[8] Spectrum Coalition White Paper, p 10.

[9] *Id.*, p. 16.

[10] 5% concurrent busy hour usage x (70% ÷ 20%) = 17.5%.

estimates determined the number of carriers per site (within usable spectrum constraints) and the increase in cell sites due to cell splitting (when spectrum is exhausted).

9. *Construction Costs.* The analysis incorporates a range of capital cost assumptions for cell site acquisition and preparation, construction of different types of towers, and radio equipment. The tower mix (rooftop, collocation, and raw land towers) varies by morphology to provide different construction cost estimates by morphology. The main costs summarized in Table 5:

Item	Capital Cost
Tower Construction *Urban:* *Suburban:* *Rural (commercial footprint):* *Rural ("90%" footprint):*	 $51,000 $61,000 $85,000 $140,000
Site Acquisition, Prep, Engineering, & Zoning	$36,000
Radios (per 10 MHz)	$30,000
Antennas, cabling, and other equipment	$11,000

Table 5: Capital Costs Assumptions

Fixed site costs are assumed to be fully duplicative between the commercial and public safety networks. Therefore, sharing of site infrastructure eliminates the construction, site acquisition, and ancillary equipment costs borne by Public Safety. Since I modeled cash capital outlays, I do not allocate any of the fixed costs associated with commercial operations to the public safety band. On the other hand, I assume that each network (public safety or commercial) bears the base station radio costs associated with its dedicated spectrum allocation. Public Safety does not pay for base station radios utilized by the commercial network to provide peak capacity during emergency, since these serve commercial purposes most of the time.

B. Results

10. The analysis ultimately arrives at a capital cost estimate for each of the scenario/coverage combinations. The results for a coverage-constrained network build, which ignores the capacity requirements implied by the Spectrum Coalition's utilization assumptions, are summarized in Table 6, below:

Scenario		**Coverage Sites**	**Public Safety Cost**
No Infrastructure Sharing (Scenarios 0 & 1)	*Commercial Coverage*	16K	$2.5B
	90% Coverage	23K	$4.0B
Infrastructure Sharing (Scenario 2)	*Commercial Coverage*	16K	$0.5B
	90% Coverage	23K	$2.0B

Table 6: Coverage Constrained Network

11. This coverage-only analysis clearly demonstrates the potential benefits of 700 MHz propagation. One could create a very robust coast-to-coast commercial footprint equivalent to a leading nationwide cellular operator and its roaming affiliates using 16,000 sites, less than an equivalent combination of 850 MHz and 1.9 GHz operators and roaming affiliates today. An additional 7,000 sites would extend coverage to 90% of continental U.S. landmass. From a cost perspective, I estimate the cost for such a network would be $2.5 - $4.0 billion, depending on the coverage target. The coverage analysis clearly shows how cost can be dramatically reduced (50-80%) through sharing of towers and other common capital equipment as provided in Scenario 2. Note that the savings are proportionately greater for the commercial coverage footprint than for the 90% footprint, because I assume that Public Safety would bear the tower and infrastructure as well as radio costs for coverage beyond a traditional commercial footprint in either instance.

12. Turning to the full analysis, which includes both coverage and capacity dimensions, we can see even more differences between the various scenarios. Table 7 summarizes the results of the analysis:

Scenario		Total Cell Sites	Public Safety Cost
Scenario 0 (baseline)	*Commercial Coverage*	47K	$7.0B
	90% Coverage	54K	$8.4B
Scenario 1 (BOP only)	*Commercial Coverage*	35K	$5.2B
	90% Coverage	42K	$6.7B
Scenario 2 (BOP + adjacent block sharing)	*Commercial Coverage*	20K	$0.6B
	90% Coverage	27K	$2.0B

Table 7: Capacity Constrained Network

As noted above, the demand estimates driving this analysis come from the Spectrum Coalition report. This analysis allows us to draw several important conclusions.

13. First, it underscores the benefits of the BOP in freeing up more usable spectrum in the current public safety allocation. Given significant busy-hour capacity requirements of Public Safety, the benefits of long radio range and correspondingly large cell sites can quickly fall prey to cell splitting. In this context, providing 33% more usable capacity with just 10% more spectrum (per the BOP) yields a noticeable difference in cost: the difference between Scenarios 0 and Scenario 1 is about 12,000 cell sites and, as mentioned above, almost $2 billion.

14. Second, as with the coverage-only analysis, the enormous economic benefits of a partnership between Public Safety and its adjacent block commercial neighbor are again apparent, this time in the dramatic site count and cost differences between Scenario 1 and Scenario 2. Because in Scenario 2 Public Safety piggybacks on the significant tower costs borne by the commercial provider (excluding the base station radio costs for the public safety allocation), the per-site capital cost to Public Safety plummets. Moreover, adding 11 MHz of usable adjacent block spectrum available on a priority basis relieves the need to split cells to provide an adequate capacity cushion to

Public Safety, resulting in approximately 35-40% reduction in cell site count (depending on definition of nationwide coverage).[11] This double effect of reduced site count and lower per-site capex causes the incremental cost of public safety networks build to drop by about *70-90 percent*, depending on the desired coverage footprint. Once more, the savings are slightly less dramatic in the higher coverage definition, because there are no benefits from tower sharing in remote areas without commercial operations.

15. Scenarios 1 and 2 will also result in very substantive annual operational cost savings for Public Safety, over and above the capex savings described above. Much of the cost of operating a network stems from site-related costs and regular site visits. The operational savings for Scenario 1 over the baseline scenario would result from the significant reduction in number of towers needed to handle the aggregate capacity. In Scenario 2, the opex savings for Public Safety would be far more dramatic as most of the operational costs related to sites and radios would be incurred in any case to support the commercial service. Therefore the incremental cost of providing the Public Safety capability would be a small part of the total operational costs. This analysis does not quantify this benefit.

16. In summary, the analysis tells me that: (1) BOP will have a significant impact on "base case" network build costs; and (2) a spectrum/infrastructure sharing plan

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[11] One might reasonably ask why I did not consider an in-between scenario whereby Public Safety would share tower infrastructure with the adjacent commercial inhabitant, but not gain priority access to the spectrum. The reason is that absent the provision of priority access to the adjacent block, the site count for Public Safety is prohibitively high—much higher than any commercial operator would support in the adjacent block. Therefore, the network design would not correspond cleanly between the two neighbors, making extensive site-sharing more difficult.

involving the adjacent commercial block can generate enormous cost savings to Public Safety.

IV. EFFICIENCIES OF 5.5 MHZ BLOCKS

17. The plan proposed by Access Spectrum, Pegasus, Columbia Capital and Telcom Ventures, by establishing 5.5 MHz channel blocks for wireless broadband in both the commercial and public safety allocations, creates significant efficiencies compared to the current arrangement. This is especially true for technologies using 1.25 MHz channels, such as EvDO (CDMA 2000) and FLASH-OFDM, where increasing the spectrum block size enables the use of an additional carrier.[12] It also applies although to a less dramatic extent, to new emerging OFDM technologies utilizing 5 MHz carriers, such as WiMAX, due to OFDM's scalability characteristics, which enable one to readily capture the increase in capacity from an increase in bandwidth. Maximizing efficiency can produce very real economic benefits by increasing the amount of usable spectrum and decreasing the need for costly cell-splitting when a network becomes capacity constrained.

18. The creation of 5.5 MHz blocks instead of 5 MHz blocks enables a 33 percent increase in effective capacity to an EvDO1.25 MHz system with a 10 percent increase in spectrum. Because EvDO and FLASH-OFDM channels require approximately 1.25 MHz of spectrum and approximately 250 kHz of buffer between the signal band and the edge of the band, a 5 MHz segment can only accommodate three EvDO channels. On the other hand, a 5.5 MHz segment can accommodate four EvDO or

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[12] The FLASH-OFDM in the market today is based on a 3 channel 1.25 MHz system in 5 MHz and will scale to 4 carriers in 5.5 MHz systems. The underlying technology is scalable. So, for example, Flarion is developing a new 5MHz system that could be scaled to 5.5 MHz.

FLASH-OFDM channels.[13] In other words, the addition of 500 kHz paired allows the use of an additional 1.25 MHz paired channel. Smaller improvements can also be found with 5 MHz OFDM systems such as WiMAX, where increasing the channel size 10% from 5.0 MHz to 5.5 MHz can yield an 11% increase in capacity.

19. An increase in usable capacity can result in significant reductions in network infrastructure cost. A cellular network may be designed to cover a maximum amount of landmass with a minimum number of cell sites by spacing cells as far apart as possible given power levels, band propagation characteristics, technologies, terrain, and other constraining factors. Each cell would have a fixed amount of data capacity to be shared by multiple users passing through its coverage area. If this capacity proves insufficient, an operator may add capacity by using additional spectrum or, if additional spectrum is not available, by splitting cells into smaller cells each covering fewer users. From an infrastructure standpoint (*i.e.,* assuming spectrum is already available or can be purchased cheaply), it is cheaper to add carriers than to split cells. The cost (both money and time) of adding a new base station radio on an existing site is much lower than the cost associated with deploying a whole new site, which requires, in addition to another base station radio, new RF engineering studies, tower construction or rental, backhaul, legal services (for zoning), etc. If spectrum is available, the option of increasing capacity by using more spectrum can save the majority of site costs, depending on the type of site.

20. The addition of an extra channel capacity can result in significant cost efficiencies to wireless operators in the 700 MHz band. The outstanding propagation characteristics of 700 MHz allow for larger cell sizes than higher frequency networks.

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[13] *See* Declaration of Dr. Paul Kolodzy at ¶¶ 13, 15.

But larger cells cover more population and therefore are likely to reach capacity limits sooner than smaller cells. Under these very likely capacity constraints, the extra channel can reduce the need for cell splitting. Given the huge cost of building a wireless network, the savings can be substantial: on the order of $2 billion for a nationwide deployment using a 1.25 MHz channel technology. These savings are due to the fact that 12,000 fewer towers are needed due to the extra channel.

V. CONCLUSIONS

21. Based on my analysis, I estimate that the cost of a public safety network covering 90% of the landmass of the continental United States and designed to handle the peak demands that Public Safety may need for major emergencies[14] could be dramatically reduced if public safety agencies could use commercial infrastructure, from $8.4 billion without infrastructure sharing to $2.0 billion with infrastructure sharing and priority access for Public Safety. Public Safety would still have dedicated spectrum and dedicated base stations for their core needs while having the right to preempt the capacity on the public network when "the lights and sirens go on." Even to build the minimal network to provide just geographic coverage as above, the additional capital cost of a public safety network covering 90% of the landmass of the continental United States would be $4.0 billion without infrastructure sharing, but only $2.0 billion with infrastructure sharing. In addition, the use of 5.5 MHz blocks rather than 5 MHz blocks can result in significant cost savings for commercial providers by enabling them to expand capacity by adding channels rather than cell sites. I estimate that these cost

[14] Spectrum Coalition White Paper.

savings could be almost $2 billion nationwide if the upper 700 MHz spectrum were reorganized into 5.5 MHz blocks.

Declaration

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Executed on September 29, 2006

Dr. Stagg Newman

Stagg Newman

41 Pisgah View Ranch Rd.
Candler, NC 28715

828-665-1531 202-250-3605
staggandcheryl@earthlink.net
stagg_newman@mckinsey.com

Executive Summary

Provides telecommunications technical and regulatory expertise to solve clients' business problems. Served as Senior Telecommunications Expert for McKinsey. Formerly senior technology manager with extensive experience in strategic planning, technology management, regulation, and new business/product development in the communications industry. Breadth of experience relevant to the convergence of voice, data, video and wireless technologies. Converted research program into >$20 M business unit with high margin that greatly exceeded P&L objectives at Bellcore. Served as Chief Technologist for the Federal Communications Commission and chief technology advisor for a Fortune 100 CEO. Ability to bridge the communications gap between technologists, regulators, and business leaders.

Professional Experience

Independent Consultant Current

Telecommunications Expert in the Confluence of Business, Technology, and Regulation

Provide telecommunications technical and regulatory expertise to solve clients' business problems; analyze the strategic interplay of technology, business and competitive forces; "network" with technical and regulatory industry leaders on behalf of clients . . Serves on the Federal Communications Commission Technology Advisory Board representing McKinsey and Company.

McKinsey and Company 2000-2005

Senior Telecommunications Expert

Provide telecommunications technical and regulatory expertise to clients and client teams throughout the world; analyze the strategic interplay of technology, business and competitive forces; "network" with technical and regulatory industry leaders on behalf of the Firm. Provide briefings for senior executives of clients around the world, particularly on the disruptive technology trends. Serves on the Federal Communications Commission Technology Advisory Board.

Federal Communications Commission 1997-2000

Chief Technologist

1998-2000

Provided strategic advice on the interplay of technology, business and competitive forces for federal communications policy. Also managed the Network Technology Division.

-developed technology input for FCC policy on broadband access, particularly *vis à vis* cable modems

-created, managed and recruited employees for Network Technology Division to provide technical input for FCC's work on unbundling, the Internet, convergence, telecom mergers, etc.
-formed first FCC Technology Advisory Council and served as Designated Federal Officer.

Director – Technology Analysis, Office of Plans and Policy. 1997-1998

Analyzed the effect of technology and convergence on FCC policy on broadband access, universal service, broadband wireless, etc.

Bell Communications Research (Bellcore) 1993-1997
$1 billion research, systems engineering, and software development organization.

Vice President, Network Architecture and Analysis, Applied Research 1994-1997
Had profit and loss responsibility for Technology Commercialization Business Unit. Directed over 100 M.S. & Ph.D. engineers responsible for research in the fundamental network technology and architectures for broadband and wireless networks for video, data communications and voice services.

-Changed "academic orientation" to commercial focus and reduced attrition by >75%.
-Converted expense program to very profitable > $20 M P&L unit, exceeding objectives by 100%
-Developed strong ties to other Strategic Business Units & Marketing.

General Manager, Broadband Network Capabilities 1993-1994
Managed 200 engineers (most with advanced degrees) and $40M budget responsible for broadband network architecture planning, requirements and technical analysis.

-Executed reorganization that provided much better customer focus.
-Provided business focus that greatly increased supplier industry revenues.
-Delivered work program with much higher quality and 8% under budget.

Pacific Telesis Group 1990-1993
Over $10B company that included Pacific Bell, and PacTel, a worldwide provider of wireless services. (This was a 32 month assignment with Pacific Telesis, one of Bellcore's owners.)

Assistant VP, Broadband Advanced Services and Products , Pacific Bell 1991-1993
Managed organization that developed new broadband products and services.

-Lead technologist on team reporting to CEO that developed corporate broadband strategy.
-Led 50% strategic downsizing and redirection of Science & Technology Division.
-Developed Advanced Broadcast Video Service and ATM Network Service.

Assistant VP - Technology, Pacific Telesis Corporate Strategy 1990-1991
Served as Chief Technologist for Chairman and senior officers.

-Developed wireless data and personal communications strategy.
-Analyzed impact of technology trends on global competitiveness.
-Analyzed cable TV threat to Telesis' businesses.

Bell Communications Research 1984-1990
Bellcore was formed from Bell Laboratories to serve the Bell Companies in the 1984 divestiture by AT&T.

Division Manager, Data Communications Technology 1988-1990
Managed new division producing RBOC data communications requirements and business strategy.

Division Manager, New Services Concepts 1986-1988
Managed division that developed new service concepts for video and high speed data communications. Also formulated the strategic direction for Bellcore's broadband work .

Division Manager, Network Service Performance 1985-1986
Managed turn around of division responsible for defining performance objectives for network services, verifying field performance, and developing state of the art test systems.

District Manager, Data Switching Requirements. 1984-1985
Formed group that produced data communications requirements and technical analysis.

Bell Laboratories 1976-1984
The research, development and systems engineering organization for A.T.&T.

Supervisor , Packet Data Communications Department 1981-1984
Supervisor, Toll Switching Systems Engineering Department 1979-1981
Member of Technical Staff , Network Management & Maintenance Department 1976-1979

Baruch College of CUNY, *Assistant Professor of Mathematics,* 1974-1975

Education

Ph.D. and M.S. in Mathematics, Cornell University 1970-1974
B. S. in Mathematics, Davidson College, 2nd in Class. 1966-1970
(Woodrow Wilson Fellow, National Science Fellow, Rhodes Scholar Finalist, Omicron Delta Kappa, Phi Beta Kappa, Captain and Most Valuable Cross Country)

Military Service

Honorable Discharge, Captain, US Army Reserve 1978
Ordnance Officer Basic Class, 1st in class out of 69 1975
Distinguished Military Graduate, Davidson College ROTC 1970

Numerous public presentations and papers (available upon request).

Legal Authority for the Issuance of Public Safety Partner Bidding Preferences

APPENDIX TO

THE COMMENTS OF ACCESS SPECTRUM, LLC, COLUMBIA CAPITAL III, LLC, PEGASUS COMMUNICATIONS CORPORATION AND TELCOM VENTURES, LLC

WT Docket No. 06-205
CC Docket No. 94-102
WT Docket No. 01-309

Filed September 29, 2006

Legal Authority for the Issuance of Public Safety Partner Bidding Preferences

Recognizing the dynamic nature of radio communications, Congress opted for an expansive grant of authority to the FCC which generally avoids micromanagement.[106] Where the Commission possesses subject matter jurisdiction (in this case, radio communication, spectrum management, and competitive bidding design), it is afforded broad discretion to promulgate rules bearing upon that realm that do not otherwise conflict with the terms of the Act.[107] Promoting public safety through the use of radio communication is one of the core purposes underlying the Communications Act[108] and one of the objectives the Commission must advance in designing spectrum auctions.[109] These directives, combined with the Commission's broad authority over auctions and spectrum management,[110] permit the issuance of public safety partner bidding preferences in the 700 MHz auction.

The statute specifically includes bidding preferences as a mechanism that the Commission may employ to further the objectives in Section 309(j)(3).[111] Although the

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106 *See National Broadcasting Co. v. United States*, 319 U.S. 190, 219 (1943) ("While Congress did not give the Commission unfettered discretion to regulate all phases of the radio industry, it did not frustrate the purposes for which the Communications Act of 1934 was brought into being by attempting an itemized catalogue of the specific manifestations of the general problems for the solution of which it was establishing a regulatory agency.").

107 *See* 47 U.S.C. §§ 154(i) and 303(r).

108 47 U.S.C. § 151.

109 *See* 47 U.S.C. §309(j)(3) (requiring the Commission to "promote the purposes specified in section 1 of this Act [47 U.S.C. § 151]" in designing competitive bidding systems).

110 *See* 47 U.S.C. §§ 309(j) and 303.

111 47 U.S.C. § 309(j)(4)(D).

statute lists small businesses, rural telephone companies, and businesses owned by members of minority groups and women as those who may be awarded bidding preferences,[112] the Commission has concluded that "[t]here is no indication in Section 309(j)(4)(D) or in its legislative history . . . that the Commission's authority to award bidding preferences is limited to such entities."[113] To the contrary, "Congress intended that Section 309(j)(4) would provide the Commission 'flexibility to utilize any combination of techniques that would serve the public interest.'"[114] Indeed, the Commission has exercised its authority to issue bidding preferences to entities other than those enumerated in the statute.[115] The public interest benefits of a public safety partner bidding preference outlined above warrant the Commission's similar use of its authority in the 700 MHz auction.[116]

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112 *Id*.

113 *Extending Wireless Telecommunications Services to Tribal Lands*, Report and Order and Further Notice of Proposed Rulemaking, 15 FCC Rcd 11794, ¶ 19 (2000).

114 *Id*. (quoting H.R. Rep. No. 111, 103rd Cong., 1st Sess. 1993, at 255).

115 *See* 47 C.F.R. § 1.2110(f)(3) (bidding credit for those deploying facilities to serve qualifying tribal lands).

116 In other contexts, the Commission has refused to issue public safety bidding preferences. *See, e.g., Amendments to Parts 1, 2, 27 and 90 of the Commission's Rules to License Services in the 216-220 MHz, 1390-1395 MHz, 1427-1429 MHz, 1429-1432 MHz, 1432-1435 MHz, 1670-1675 MHz, and 2385-2390 MHz Government Transfer Bands*, Report and Order, 17 FCC Rcd 9980 (2002). However, in those contexts, the public safety advantages to be obtained also could have been derived by assigning the spectrum in question exclusively to public safety use. By contrast, in this instance, the expense of broadband network construction and maintenance as well as the absence of scale economies for equipment would make it impossible for public safety to realize these benefits without commercial support. In sum, if the broadband capabilities and public interest benefits described above are to be realized, it necessarily must occur through a private-public mechanism such as the one proposed herein.

Certificate of Service

I, Ruth E. Holder, hereby certify that on this 29th day of September, 2006, I caused a true and correct copy of the foregoing Comments of Access Spectrum, LLC, Columbia Capital III, LLC, Pegasus Communications Corporation and Telcom Ventures, LLC, to be mailed by electronic mail to:

Best Copy and Printing, Inc. (BCPI)
Portals II, Room CY-B402
445 12th Street SW
Washington, DC 20554
fcc@bcpiweb.com

/s/ Ruth E. Holder
Ruth E. Holder