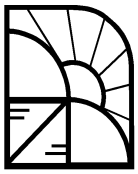

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PUBLIC SAFETY OR COMMERCIAL USE?
A COST/BENEFIT FRAMEWORK FOR THE D BLOCK

Abstract: The issue of whether the government should assign the D Block of spectrum to public safety or auction the spectrum for commercial use requires an assessment of the relative benefits and costs of these two alternatives. We propose such a framework, and preliminary analysis suggests that the 10 MHz D Block plausibly provides at least $3.4 billion more in social benefits if assigned to public safety rather than to commercial use. Much of this difference is attributable to the unique opportunity to create a contiguous 20 MHz block of spectrum, and to the fact that this opportunity exists only for the public safety community. As for the lost auction revenue, we observe that the loss of auction revenues today is more than offset by the gain of higher auction revenues and lower public safety network deployment cost in the future. Thus, an auction of the D Block adds, rather than relieves, stress to the public budget. Finally, we estimate that if policymakers choose not to give public safety the D Block and instead opt to require service obligations on other 700 MHz spectrum that would permit the encroachment of public safety users during episodes of resource scarcity, then such encumbrances could materially diminish the auction value of any newly allocated 700 MHz spectrum by as much as 86%.

I. Introduction

As part of the reallocation of the spectrum made available by the digital television ("DTV") transition, the Federal Communications Commission boldly attempted to create, and fund, a nationwide interoperable public safety network. To make a very complicated story simple, as

part of the DTV transition, Congress set aside approximately 10 MHz of the new spectrum for public safety use (commonly referred to as the "Public Safety Broadband" allocation or "PSB"). When the FCC set up its auctions for the DTV spectrum, it placed the PSB next to a contiguous 10 MHz of spectrum (the D Block) that was to be auctioned, so the theory went, to create a public/private partnership that could be used for both commercial and public safety purposes utilizing both the D Block and the PSB.[1] However, due to the public service obligations imposed on the D Block auction and the questionable logic of the scheme, the auction effort failed, an outcome of little surprise to anyone.[2] Today, three years after the failed auction, the debate about what should be done next about the D Block is fully engaged.[3]

Given the observed failure of the "public/private partnership" approach, the rapid rise in public safety capacity demands, and the unique benefits of combining the PSB and the D Block, the public safety community has requested that the Federal government forgo the auction of the D Block and directly assign it to public safety. This allocation would thus provide for a full 20 MHz of contiguous prime spectrum that could be used to construct a modern, interoperable nationwide public safety communications network.[4] The FCC to date has rejected this request, planning instead to auction the D Block on an unencumbered basis for commercial use (subject to technical capability for public safety broadband use),[5] although the agency has granted some waivers to begin operations in the PSB.[6] In the FCC's view, any shortfall in capacity on the

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1 *In the Matter of Service Rules for the 698-746, 747-762 and 777-792 MHz Bands, Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems; Section 68.4(a) of the Commission's Rules Governing Hearing Aid-Compatible Telephones Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services; Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission's Rules Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010 Declaratory Ruling on Reporting Requirement under Commission's Part 1 Anti-Collusion Rule,* FCC 07-132, SECOND REPORT AND ORDER, __ FCC Rcd ___ (rel. Aug. 10, 2007) at ¶¶ 325-36.

2 *See, e.g.,* Art Brodsky, *Public Safety Doomed "D Block" Auction To Failure*, Public Knowledge Blog (March 26, 2008) (available at: http://www.publicknowledge.org/node/1479); Mathew Lasar, *700 MHz D Block Autopsy: Public Safety Net Concept Was Doomed,* ARS TECHNICA (April 27, 2008) (available at: http://arstechnica.com/old/content/2008/04/700mhz-d-block-autopsy-public-safety-net-concept-was-doomed.ars).

3 Auction 73 was closed on March 18, 2008 (http://wireless.fcc.gov/auctions/default.htm?job=auction_factsheet&id=73).

4 *See, e.g.,* Public Safety Alliance, *"What's at Stake"*, available at: http://www.psafirst.org/what-is-at-stake.

5 CONNECTING AMERICA: THE NATIONAL BROADBAND PLAN, Federal Communications Commission (March 16, 2010) (available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296935A1.pdf) (hereinafter the *National Broadband Plan*) at 86.

6 *See In Re Service Rules for the 698-746, 747-762 and 777-792 MHz Bands,* WT Docket No. 06-150; *Implementing a Nationwide Broadband, Interoperable Public Safety Network in the 700 MHz Band,* PS Docket No. 06-229; *Amendment of*

(Footnote Continued….)

public safety network can be resolved by roaming agreements with commercial carriers.[7] And, of course, an auction brings with it the potential to enrich the Treasury with much needed revenues.[8]

Interestingly, the White House has rejected the FCC's proposal and has sided with the public safety community, explicitly calling for the reallocation of the full 20 MHz of contiguous spectrum to build a modern, interoperable nationwide public safety network.[9] Such a position is consistent with the "Public Safety Spectrum and Wireless Innovation Act" recently introduced by Commerce Committee Chairman Senator Jay Rockefeller (D-WV), which would also give public safety the entire 20 MHz of the D Block and PSB.[10] This plan has received wide bi-partisan support,[11] although the FCC was reportedly opposed to it.[12] Other policymakers from both political parties, however, have views more aligned with those of the Commission,

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Part 90 of the Commission's Rules, WP Docket No. 07-100; *Third Report and Order* and *Fourth Further Notice of Proposed Rulemaking,* FCC 11-6, ___ FCC RCD __ (rel. January 26, 2011) at ¶ 4.

[7] *A Broadband Network Cost Model: A Basis for Public Funding Essential to Bringing Nationwide Interoperable Communications to America's First Responders,* OBI TECHNICAL PAPER NO. 2 (May 2010) at 1 (available at: http://download.broadband.gov/plan/fcc-omnibus-broadband-initiative-(obi)-technical-paper-broadband-network-cost-model-basis-for-public-funding-essential-to-bringing-nationwide-interoperable-communications-to-americas-first-responders.pdf) (hereinafter "*Broadband Network Cost Model*"); *see also* Jon Peha, *The Public Safety Nationwide Interoperable Broadband Network: A New Model for Capacity, Performance and Cost,* FCC White Paper (June 2010) at 18 ("The network is based on the availability of 10 megahertz of spectrum dedicated to public safety use by Congress, which provides public safety with substantially more spectrum per user than major commercial networks, providing them with the required capacity and performance for critical communications needs. Roaming and priority access will provide additional capacity on up to 70 megahertz or more of spectrum")(available at: http://fcc.gov/pshs/docs/releases/DOC-298799A1.pdf).

[8] *See, e.g.*, Oral Testimony of Coleman Bazelon, The Brattle Group, U.S. House of Representatives, Committee on Energy and Commerce Subcommittee on Communications, Technology, and the Internet (June 17, 2010).

[9] White House Press Release, *President Obama Details Plan to Win the Future through Expanded Wireless Access* (February 10, 2011) (available at: http://www.whitehouse.gov/the-press-office/2011/02/10/president-obama-details-plan-win-future-through-expanded-wireless-access).

[10] Available at: http://commerce.senate.gov/public/?a=Files.Serve&File_id=6321ae2e-fc48-412a-8eaf-15c848bc7047. To alleviate the "spectrum crunch", Senator Rockefeller is also including the bold idea of "incentive auctions" to try to coax broadcasters to free up additional spectrum. According to a study by CEA and CTIA, such incentive auctions can be expected to generate over $30 billion in new revenue, some of which can be used to fund the new public safety network. *See, Broadcast Spectrum Incentive Auctions,* White Paper prepared by CTIA: The Wireless Association and CEA: Consumer Electronics Association (February 15, 2011).

[11] http://www.house.gov/apps/list/hearing/ny03_king/dblockreallocation.html.

[12] Sara Jerome, *Rockefeller: FCC was "Not Happy" with his Public Safety Communications Plan,* THE HILL (February 6, 2011) (available at: http://thehill.com/blogs/hillicon-valley/technology/142345-sen-rockefeller-fcc-was-not-happy-with-his-public-safety-plan).

and are calling for the prompt auction of the D Block for commercial purposes.[13] This intra-governmental quibbling proceeds unabated as the public safety community waits to build a modern communications network.

Resolution to the D Block issue is a complex problem. Here, we present an economically-valid framework—heretofore absent from the debate—within which we can evaluate the cost and benefits of the relevant alternatives. While we cannot claim to answer every question relevant to the allocation decision and some of our estimates are necessarily speculative (e.g., what is the social value of public safety?), our analysis suggests that the assignment of the D Block to public safety is advised, with a net benefit of $3.4 billion dollars even when we pointedly ignore the benefits of the additional spectrum for the provision of public safety. The cost-benefit calculus depends largely on the benefits arising from the technical and economic advantages of contiguous spectrum and the relatively small impacts of a temporary, incremental increase of 10 MHz of spectrum on market outcomes. While more research on this topic is warranted, we hope future contributions will adhere to an explicit, rational framework for analysis.

II. A Decision Framework

A sensible decision framework begins by recognizing there are costs and benefits to all actions. If alternatives are mutually exclusive, as is the assignment of a *particular* 10 MHz block of spectrum, then assignment to one party excludes assignment to any other. In other words, assignment has an opportunity cost, and the proper accounting of such costs and their offsetting benefits is critical to rational decision making. The goal of public policy is to maximize economic well-being by choosing the option with the highest net value to the people of the United States.

A review of the D Block debate suggests the following characterization. Today, there is 10 MHz of spectrum that can be allocated either for public safety or for commercial purposes.[14] This D Block is contiguous to the 10 MHz PSB block already dedicated to public safety, permitting a unique opportunity for a public safety network of 20 MHz using contiguous

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[13] *See, e.g.*, Sara Jerome, *Blackburn Supporting D Block Auction,* THE HILL (January 24, 2011); Sara Jerome, *GOP Torn Between Homeland Security, Fiscal Restraint in Public Safety Fight,* THE HILL (January 26, 2011) (available at: http://thehill.com/blogs/hillicon-valley/technology/140475-gop-torn-between-homeland-security-fiscal-restraint-in-public-safety-fight); Rep. Henry Waxman, *Emergency System Needs Upgrade,* ROLL CALL (July 8, 2010)(available at: http://www.rollcall.com/features/Technology_Telecommunications/tandt/-48166-1.html).

[14] We ignore other alternatives not part of the present debate.

spectrum.[15] In the relatively near future, according to the FCC and the Obama Administration, there will be much more spectrum available. The Federal government is in the process of adding an additional 500 MHz of spectrum for commercial use, with 300 MHz of that spectrum intended to be online by 2015.[16] The need for additional spectrum for the commercial sector has been established, and the evidence indicates that public safety's current and expected needs exceed 10 MHz.[17] Thus, we assume there will be another 10 MHz that must be allocated to whichever party does not receive the current allocation. However, this new spectrum will not be contiguous to the PSB, and the D Block will not be contiguous to this new spectrum. Additionally, this future 10 MHz block allocation is assumed to be part of a contiguous block, an option likely to become available as the government reassigns 500 MHz of spectrum to commercial uses. The issue, therefore, is about the timing of benefits and costs, with one type accruing now and the other later.

Given this specification, there are two relevant options to consider in a cost-benefit tradeoff. In the first option, the D Block spectrum, which is contiguous to the PSB 10 MHz already assigned to public safety, is allocated to the public safety community, which precludes its auction now to the commercial sector. This choice permits the benefits and costs derived from public safety's use of the spectrum to accrue now, while postponing the benefits and costs from commercial use of this additional 10 MHz of spectrum into the future. That is, allocating the

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15 *See, e.g.*, Public Safety Alliance, *House of Cards: FCC's Capacity White Paper Built on Assumptions and Conjecture* (July 2, 2010) at 3 ("Since the D-Block spectrum is adjacent to the public safety broadband allocation, it is uniquely positioned to provide the needed additional capacity throughput for a public safety agency's entire coverage area including the cell edge where throughput decreases significantly. Any alternative spectrum offered in other bands will be less efficient. Additional components would be required which would increase the cost and reduce performance of broadband devices. Non-adjacent spectrum blocks of the same size as the D Block will not provide as much throughput capacity, since greater efficiency is achieved through spectrum aggregation.").

16 *National Broadband Plan* at XII ("Make 500 megahertz of spectrum newly available for broadband within 10 years, of which 300 megahertz should be made available for mobile use within five years."); Remarks by Lawrence H. Summers, *Technical Opportunities, Job Creation and Economic Growth* (June 28, 2010) (available at: http://www.whitehouse.gov/administration/eop/nec/speeches/technological-opportunities-job-creation-economic-growth); *Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband*, Department of Commerce (October 2010)(available at: http://www.ntia.doc.gov/reports/2010/TenYearPlan_11152010.pdf).

17 Bill Schrier, Chief Technology Officer, City of Seattle, *Public Safety, Government, Wireless and Spectrum,* National League of Cities (May 27, 2010) (""[M]ost urban areas will rapidly outgrow the capacity of the 10 MHz allocated by the FCC for the public safety networks."); Andrew Seybold, *Response to Roberson and Associates, LLC White Paper entitled "Technical Analysis of the Proposed 700 MHz D-Block Auction, dated August 23, 2010, contracted for by T-Mobile USA, Inc.",* (September 10, 2010) at 5 (available at: http://andrewseybold.com/wp-content/uploads/2010/09/ResponseT-MobileWP09-10-10FNL.pdf) ("Data usage has grown on commercial networks in the order of 5000% in only the past three years. Demand will follow the same curve as the commercial broadband sector as new applications and devices become available for Public Safety…").

contiguous D Block to public safety only *postpones* the allocation of an additional 10 MHz for commercial purposes (which the "new" block comes from the 500 MHz of spectrum promised by the FCC and the Obama Administration). In the second option, the D Block is auctioned for commercial purposes now, precluding its assignment for public safety purposes. In this case, the incremental benefits and costs from commercial use accrue now, but the benefits and costs of public safety's use are postponed. Framed in this way, the relevant issue is not whether the 10 MHz is used for public safety or used for commercial use, but rather *when* and *which* 10 MHz is put to use in both, and how the size and timing of benefits compare between these two alternatives.

More formally, let B_s^t represent the incremental benefits and C_s^t the incremental cost of an additional 10 MHz of spectrum assigned to sector s at time t, where s has values P for public safety and A for commercial application, and where t is 0 for the present and 1 for the future. The incremental net value of public safety assignment of the D Block today is $V_P^0 = B_P^0 - C_P^0$ today, and $V_P^1 = B_P^1 - C_P^1$ in the future. In the same way, we have net benefit V_A^0 if the 10 MHz is auctioned for commercial purposes today, and V_A^1 given future allocation. Applying the constraint that each party receives a 10 MHz block, then the best policy decision is simply to take the highest value of the two sums $V_P^0 + V_A^1$ (i.e., public safety now, auction later) and $V_A^0 + V_P^1$ (i.e., auction now, public safety later).[18] The D Block spectrum should be given to public safety if $V_P^0 + V_A^1 > V_A^0 + V_P^1$, or equivalently, $V_P^0 - V_P^1 > V_A^0 - V_A^1$. Notably, all the costs and benefits that enter into these valuations are incremental to the status quo. That is, costs and benefits are measured only for the additional 10 MHz allocation.[19]

Armed with this simple but useful framework, we can provide some meaningful commentary on this important issue and interpret some of the available evidence in a pertinent manner. In what follows, we evaluate some of the evidence and issues using the cost-benefit framework, and we believe this exercise is highly informative.

III. Assigning the D Block to Commercial Use

The total economic benefits of commercial use include profits and consumer surplus, where these benefits are only those added by the addition of 10 MHz of spectrum. As for profits, assuming there are a few relatively homogeneous bidders, the profits from the added spectrum

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[18] We ignore the possibility of either party getting both allocations.

[19] The upper 10 MHz of the D Block is already allocated to public safety and a network will be built to use that spectrum. Those costs are not incremental to the D Block.

will be largely dissipated at auction.[20] Based on an econometric analysis of the more recent spectrum auctions in the U.S., if the FCC auctioned the D Block on a truly unencumbered basis, then we could expect the auction to generate revenues in the range $1.3 to $3.3 billion.[21] There are, however, many reasons to expect this range of potential revenues is too high, including the Commission's recent track record of trading off auction revenues for other goals.

First, as seen in the earlier attempt to auction the D Block, public service obligations levied on the commercial license holder substantially reduce the value of spectrum. Only one bid was received in that auction ($472 million) and it was well below the minimum bid established by the Commission ($1.3 billion). The public safety encumbrances, therefore, imposed costs of about $0.8 to $2.8 billion, as reflected in the low bid value.[22] Given the lack of any service rules for the re-auction of the D Block, it is unclear what public safety encumbrances will be placed on the spectrum. The *National Broadband Plan* proposes that the commercial use be "technically compatible with the public safety broadband services," so some constraints will be placed on a commercial winner.[23] If there is an auction, and in light of the current debate, then we suspect there will be significant political pressure to impose public safety obligations on the D Block.[24] Thus, the expected auction revenues should be reduced to account for some types of public service obligations. If these obligations are even half as burdensome as those in the original auction, then the reduction in auction revenue would still be a sizeable 40%.

Second, the Commission has imposed certain obligations on spectrum blocks set for auction. For example, the Commission imposed stringent open platform obligations in the C Block auction of the 700 MHz spectrum, with disastrous results. Indeed, the conditions placed on the C block reduced auction revenues by a whopping 32%, with little to no perceptible benefit.[25]

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[20] G.S. Ford, T.M. Koutsky and L.J. Spiwak, *Using Auction Results to Forecast the Impact of Wireless Carterfone Regulation on Wireless Networks*, PHOENIX CENTER POLICY BULLETIN NO. 20 (Second Edition) (May 2008) (available at: http://www.phoenix-center.org/PolicyBulletin/PCPB20Final2ndEdition.pdf).

[21] Estimated from the regression analysis and data presented in *Using Auction Results, id.* The difference between the lower and upper estimates is based on the REA and Auction 73 premium.

[22] Assuming an unencumbered auction revenue range of $1.3 to $3.3 billion.

[23] *National Broadband Plan*, *supra* n. 5, p. 76.

[24] *See, e.g., Whitepaper: Technical Analysis of the Proposed 700 MHz D-Block Action*, Prepared for T-Mobile by Roberson and Associates, Inc. (August 23, 2010) (available at: http://fjallfoss.fcc.gov/ecfs/comment/view?id=6015952735), arguing that the D Block can effectively be shared under a public safety obligation. We provide no comment on the legitimacy of the analysis, but simply note that its relevance presumes the FCC will impose a public safety obligation on the D Block and that such obligations reduce expected auction revenues.

[25] *Using Auction Results, supra* n. 20.

Although the Commission did not go as far when it promulgated its recent *Open Internet Order*, the Commission did impose some obligations on wireless network operators and, equally important, threatened to extend the full C Block conditions to other commercial licensees if circumstances warrant.[26] Accordingly, it is not unreasonable to expect that the Commission could extend obligations to the D Block, including C Block-type obligations, and, as such, we expect the auction revenues for the D Block to be lower than a naïve model would predict.

Third, given the Commission's recent *Harbinger* decision[27] and concerns expressed in its *14th CRMS Report* about industry concentration[28], it is also not unreasonable to assume that the Commission may exclude some bidders from the auction.[29] A reduction in the number of bidders, particularly if these potential bidders are large firms, is likely to reduce the expected auction revenue (ceteris paribus).[30]

Finally, the economic health of the country has deteriorated since the bidding in Auction 73. Thus, the D Block auction should not be expected to produce as much revenue as the earlier auctions. Coleman Bazelon estimates that the economic crisis will reduce the expected value of spectrum by approximately 20%.[31]

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[26] *In re Preserving the Open Internet, Broadband Industry Practices,* FCC 10-201, REPORT AND ORDER, ___ FCC Rcd ___ (rel. December 23, 2010) at ¶135 (hereinafter "*Open Internet Order*").

[27] *In the Matter of Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993 Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services,* FOURTEENTH REPORT, FCC 10-81, __ FCC Rcd __ (rel. May 20, 2010) (hereinafter "*Fourteenth CMRS Report*").

[28] *In the Matter of SkyTerra Communications, Inc. and Harbinger Capital Partners Funds, Applications for Consent to Transfer of Control,* MEMORANDUM OPINION AND ORDER AND DECLARATORY RULING, DA 10-535 (rel. March 26, 2010) (hereinafter the *Harbinger Order*). For a full discussion of *Harbinger Order*, *see* George S. Ford and Lawrence J. Spiwak, *The Broadband Credibility Gap,* PHOENIX CENTER POLICY PAPER NO. 40 (June 2010) (available at: http://www.phoenix-center.org/pcpp/PCPP40Final.pdf), *and forthcoming in* 19 COMMLAW CONSPECTUS (2011).

[29] *C.f.,* Public Knowledge, "Spectrum Reform" ("The best method for ensuring that the spectrum is not simply bought by incumbent broadband providers is by limiting their eligibility to bid — either through a flat prohibition or spectrum caps.")(available at: http://www.publicknowledge.org/issues/spectrum-reform); Gregory Rose and Mark Lloyd, *The Failure of FCC Spectrum Auctions,* Center for American Progress (May 2006).

[30] Auction theory indicates that a reduction in the number of bidders will reduce auction prices in an ascending, second-price auction. *See, e.g.,* L. Phlips, THE ECONOMICS OF IMPERFECT INFORMATION (1988), Ch. 4. Accordingly, a cynical interpretation of the debate might be that the D Block presents an opportunity for some industry participants to buy spectrum at reduced prices due to the likelihood the present Commission will exclude some bidders, and in doing so establish precedent for such exclusions in future auctions.

[31] C. Bazelon, *The Need for Additional Spectrum for Wireless Broadband: The Economic Benefits and Costs of Reallocations*, The Brattle Group (October 2009) (available at: http://www.brattle.com/_documents/uploadlibrary/upload809.pdf).

Given these four factors, we expect the auction revenue from the D Block to be considerably less than the estimated range based on prior auctions ($1.3 to 3.3 billion). An auction of the D Block, depending on the rules, could produce less than $1 billion in revenue, and we suspect this low revenue amount is plausible given the current regulatory climate. We suspect auction revenue is unlikely to exceed $2 billion in the best *plausible* scenario but, again, such predictions are necessarily speculative.

Factors Reducing Auction Value of the D Block

1. Public Safety Obligations
2. Other Obligations, such as Open Internet/Platform Obligations
3. Excluded Bidders
4. Economic Crisis

As for consumer surplus additions, this relatively small addition of spectrum to the commercial sector (currently licensed 572 MHz by the Commission's count) is unlikely to be a game changer.[32] The consumer surplus gains from commercial assignment are limited to what little competitive effects may arise from the added spectrum. To evaluate this issue, we adopt a common, widely-used model of price formation familiar from previous analyses in telecommunications. Assuming Cournot Competition in Quantities, unit elasticity of demand, and a Hirschman-Herfindahl Index ("HHI") of 2500, we estimate the addition of 10 MHz of spectrum will reduce prices by about 0.6%.[33] Given a total market size of $160 billion, consumer

[32] *OBI Technical Paper No. 6*, p. 15 ("547 MHz, in total, is currently licensed under flexible use rules, which allows for mobile broadband and voice services").

[33] Price is defined as $P = cN/(N - 1)$, where c is marginal cost and N is the number of firms, taken to be the numbers-equivalent of the HHI (=1/HHI). Based on recent estimates, we assume an HHI of 2,500 producing an N of 4. *See 14th CMRS Report*, *supra* n. 27, at 51 (2,848) and Table 41 (2,200). Assuming 547 MHz of spectrum available, the addition of 10 MHz of spectrum is treated as the equivalent of adding 0.07 firms, resulting in a price cut of 0.6%. *See, e.g.*, J. Sutton, *Sunk Costs and Market Structure* (1995), Ch. 3; J.B. Duvall and G.S. Ford, *Changing Industry Structure: The Economics of Entry and Price Competition*, PHOENIX CENTER POLICY PAPER NO. 10 (April 2001) (available at: http://www.phoenix-center.org/pcpp/PCPP10Final.pdf) *and reprinted in* 7 TELECOMMUNICATIONS & SPACE LAW JOURNAL 11 (2001).

surplus gains (net of transfers) from this price cut are then about $600 million, annually.[34] While other models of price formation would yield different results, the Cournot approach used here is familiar, plausible, and implementable using relatively little information.

Another piece of the valuation puzzle arises from the fact that the future 10 MHz of spectrum could be part of a contiguous block. Turning again to the econometric analysis of previous auctions, the auction revenue from a contiguous 10 MHz block is expected to bring a premium of $2 to $6 billion (other things constant).[35] We assume that a 10 MHz block auctioned to commercial use in the future will be contiguous and will have an auction premium of $4 billion (the mid-point of the range).

Turning to the question of value, we can use this analysis to get a rough approximation of $V_A^0 - V_A^1$. Assuming the auction revenues are $2 billion, consumer surplus gains are $0.6 billion annually, the contiguous block premium is $4 billion, and the difference between time 0 and 1 is five years, the value difference from delay of the auction of 10 MHz is about $0.6 billion (= 2B + 2.6B - 4B).[36]

IV. Assigning the D Block to Public Safety

Perhaps the most daunting, yet relevant, question regards the social benefits of "public safety." Such benefits are real but difficult to quantify and, absent immediate crisis, prone to be undervalued. If we faced another event like 9-11 or Hurricane Katrina, we believe the 20 MHz would be allocated to public safety immediately and the network fully funded in a week's time. Fortunately, we are not presently victims of such a crisis and, though the lack of crisis makes the spectrum allocation decision a more difficult one, this is a burden we welcome. For the moment, we choose to set aside the quantification of the benefits of an additional 10 MHz of spectrum for public safety, looking instead at the cost side of equation.

Spectrum is not homogeneous. Not only is the 700 MHz spectrum highly valuable because its technical properties are well-suited for mobile communications, including broadband

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[34] The change in consumer surplus under unitary elasticity is market size in terms of expenditures (about $160 billion in 2010) multiplied by the natural log of the ratio of the new price to the old price. For expenditure data, see *Wireless Industry Indices: Mid-Year 2010 Results*, CTIA (November 2010) (available at: http://files.ctia.org/pdf/CTIA_Survey_Midyear_2010_Graphics.pdf).

[35] *Using Auction Results, supra* n. 20.

[36] We assume a discount rate of 4.4%. The discount rate is the government recommended discount rate for social projects evaluated over a twenty-year window. *See* OMB Circular No. A-94, APPENDIX C (Revised December 2009) (http://www.whitehouse.gov/OMB/circulars/a094/a94_appx-c.html).

Internet services, but for the public safety community the D Block has added value because it is contiguous to the PSB, which is already allocated to the public safety community. A contiguous block of 20 MHz of spectrum is substantially more valuable than 20 MHz of non-adjacent spectrum. As noted above, a 10 MHz block of contiguous spectrum in the 700 MHz band is worth about $2 to $6 billion more than a non-contiguous block of the same size.

While this value differential is estimated based on commercial use, much of this premium is based on the lower cost of deploying network for contiguous spectrum, which would likewise apply to public safety. Evidence suggests that the cost of the public safety network using 20 MHz of spectrum is probably about $10 billion.[37] Andrew Seybold, a highly regarded wireless industry expert, suggests that expanding a 10 MHz public safety network to 20 MHz adds about 15% to 25% to network deployment costs.[38] By this standard, the incremental cost of the additional 10 MHz is about $1.5 to $2.5 billion.[39] Alternately, adding a non-contiguous block of 10 MHz of spectrum to the public safety network would cost about $5 to $7.5 billion in deployment costs.[40] Assignment of the D Block to public safety, therefore, is likely to reduce the cost of the public safety network by around $4 billion in network deployment costs alone. Operational costs are likely to be lower as well, perhaps adding billions more to the savings.

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[37] White House, *supra* n. 9 (assigning $7 billion in construction costs); *Broadband Network Cost Model*, *supra* n. 7 ($6.3 billion for a 10 MHz network).

[38] A. Seybold, *Comments on the FCC White Paper: Federal Communications Commission Omnibus Broadband Initiative A Broadband Network Cost Model: A Basis for Public Funding Essential to Bringing Nationwide Interoperable Communications to America's First Responders*, Working Paper (April 26, 2010), p. 15 (available at: http://andrewseybold.com/wp-content/uploads/2010/04/Comments-FCCWP-Final-April-27-2010.pdf). The FCC study, *Broadband Network Cost Model*, *supra* n. 7, claims an additional 10 MHz of spectrum would substantially *increase* the cost of the public safety network, but we find the extreme assumptions of that analysis to be unreasonable and in violation of economic logic. Seybold, *supra* n. 38 also rejects the agency's argument ("The Commission seems to believe that there are only two choices for building out the public safety broadband network. The first choice is its option to essentially combine it with the commercial networks except for some of the radio equipment. The second is to provide a totally separate and standalone network. The FCC does not take into account that between these two extremes is a number of options that can and should be explored.").

[39] Expanding commercial networks is also costly. There is little reason to suspect that the cost of a commercial expansion to additional 10 MHz will be much different than for the public safety community. For example, it was announced that Verizon is expected to spend $4 billion in equipment alone to deploy LTE, which is about $180 million per MHz of 700 MHz spectrum. For 10 MHz, the cost would be about $1.8 billion. *Verizon Wireless Awards Alcatel-Lucent Contract Expected to be Worth US $4 Billion for Ongoing 3G Network Expansion and LTE Build out,* Alcatel-Lucent Press Release (Nov. 4, 2010) (available at: http://www.alcatel-lucent.com/wps/portal/!ut/p/kcxml/04_Sj9SPykssy0xPLMnMz0vM0Y_QjzKLd4x3tXDUL8h2VAQAURh_Yw!!?LMSG_CABINET=Docs_and_Resource_Ctr&LMSG_CONTENT_FILE=News_Releases_2010/News_Article_002258.xml).

[40] Seybold, *supra* n. 38 at p. 15.

Moreover, the cost to deploy the 700 MHz band is much lower than other bands (some estimates are 70% lower than other bands). Thus, depending on what additional spectrum is provided to the public safety community if they do not receive the current 10 MHz block, the ultimate deployment costs could be substantially higher (though this differential may also apply to the commercial licensee). We leave a more sophisticated assessment of such costs to others, and assume here that the cost difference is $4 billion.

While we have not addressed the benefits of public safety's use of the additional 10 MHz of spectrum, which could be quite large, we can see that the contiguous spectrum premium of $4 billion is itself sufficient to offset the value of commercial assignment of an additional 10 MHz ($0.6 billion). Let Z be the marginal benefits from enhanced public safety created by the combination of the D Block for public safety use. From our cost-benefit framework, the relevant decision criterion for assignment to public safety is

$$V_P^0 - V_P^1 > V_A^0 - V_A^1, \quad (1)$$

approximated here to be

$$Z + \$4 \text{ billion} > \$0.6 \text{ billion}, \quad (2)$$

which plainly holds, even without sizing Z (where $Z > 0$ and potentially is very large). Even if the 10 MHz provided zero benefit in terms of enhanced public safety, then assignment of the D Block to public safety produces $3.4 billion in additional social value over and above the commercial value of the same block. (Of course, this is a result of the constraints we imposed on the problem, i.e., 10MHz of spectrum would be provided to public safety one way or another.) We have also ignored the value of spectrum currently used for narrowband purposes by public safety that may be repurposed for commercial use as a result of migrating existing public safety capacity demands to the D Block and PSB.[41]

Notably, much of this value spread arises from the unique opportunity to create significant value by allocating a contiguous block of spectrum to public safety, and then doing so in the future for commercial use. This value is foregone by commercial allocation of the D Block today. While some may contest our estimates, it is necessary to account for the economic value arising from contiguous spectrum.

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[41] For example, Section 205(3) of the Rockefeller Bill, *supra* n. 10, requires the Commission to conduct a report within five years of enactment that examines, among other things, to determine whether there is an "opportunity for return of any spectrum to the Commission for auction to commercial providers to provide revenue to the Treasury of the United States."

V. An Alternative: Public Safety Encumbrances on Commercial Networks

Thus far in this analysis, we have assumed that if the D Block is used for commercial services, then an additional, non-contiguous 10 MHz block will be assigned for public safety use in the future. A realistic alternative to this grant of additional spectrum for public safety is simply to impose encumbrances on other 700 MHz spectrum that permit the encroachment of public safety users during episodes of resource scarcity. Unfortunately, however, it was exactly this approach that produced such miserable results in the first D Block auction. There are many complex issues that must be resolved with any sort of sharing scheme of this type, and such resolutions can be very costly. As revealed in Auction 73, public safety encumbrances substantially reduce the value of spectrum. Auctions revenues from an unencumbered D Block would have been about $3.3 billion, whereas the only bid for the encumbered block was a paltry $472 million—a mere 14% of its revenue potential.

Consider, for the moment, that incentive auctions for broadcast spectrum, which have been proposed in the Rockefeller bill, permit the recovery and repurposing of 120 MHz of quality spectrum. One study estimates that the auction revenues from this spectrum would be $35 billion, with a net value of $33 billion after relocation of existing licensees.[42] Our earlier research suggests that these predicted auction revenues are plausible.[43] Applying public safety obligations on this spectrum, however, would materially diminish its value. From the failed D Block, we might conclude that public safety obligations would reduce the auction value of the 120 MHz of spectrum to as little as $5 billion (= 35 × 0.14), a loss in revenues of $30 billion or 86% of its potential. This calculation likely represents the upper boundary of lost auction revenues since it presumes the encumbrances apply equally to all 120 MHz. Alternately, at the other extreme, using the size of the D Block in proportion, the reduction in auction revenues would be more to the tune of $2.5 billion, which is still a sizeable amount and probably more than the sale price of the D Block in a present day auction.[44] Notably, both numbers are underestimates of the total value loss since they measure only the loss in private value from the spectrum. We have ignored in these calculations the higher cost and diminished value to the public safety community (and those they serve) due to the reduced functionality inherent to a sharing of networks purposed mainly for commercial use. The fact of the matter is that no

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[42] *See supra* n. 10.

[43] We estimate a 10 MHz block could yield $3.3 billion in auction revenue. A total of 120 MHz of spectrum, in turn, would render about $40 billion. We note there are factors that could raise or lower auction revenues in the future such as encumbrances, market conditions, the number of bidders, and so forth.

[44] A 10 MHz block is 8.3% of a 120 MHz block. Assuming $35 billion in unencumbered auction revenues, each 10 MHz would bring $2.9 billion (on average). Applying the 14% factor from Auction 73, an encumbered D Block would yield only $408 million in auction revenue, cutting auction revenues by about $2.5 billion.

government agency can guarantee public safety quality access to commercial spectrum on an as-needed basis.

In all, we believe the use of encumbrances will be more costly than the assignment of an additional 10 MHz in the future (as we have modeled the issue above). So that our estimates are conservative, we do not incorporate the costs of this alternative in our calculations. Any proposal adopting this option for supplying spectrum resources to the public safety network should provide a careful study of the loss of auction revenues and the dollar value of the reduced functionality and higher costs of such a network.

VI. Conclusion

The assignment of the D Block spectrum to public safety or commercial use requires an assessment of the relative benefits and costs of these two alternatives. We propose an economically sensible cost-benefit framework in the POLICY BULLETIN. An assessment of the Commission's record and other evidence within this framework suggests that D Block assignment to public safety has a higher value, producing no less than $3.4 billion more in social benefits than commercial use. Much of this difference is attributable to the unique opportunity to create a contiguous 20 MHz block of spectrum, and the fact that this opportunity exists only for the public safety community. We recognize that this issue is complex and our analysis is preliminary. That said, our work includes many of the "big ticket items", such as potential auction revenues. However, the calculations ignore any incremental benefits to society from the use of the additional 10 MHz block by the public safety community. As these gains are likely to be large, the economics seems to lean strongly in the direction of an assignment of the license to public safety. We suggest more research on this topic, but encourage future contributions to adhere to an explicit, rational framework for analysis.

At the forefront of the debate over the D Block is the potential for auction revenue. If the D Block is assigned to public safety, then the auction revenues from the 10 MHz block are forgone. The argument has been made that auctioning the spectrum will provide revenues to help fund the public safety network and perhaps aid in deficit reduction. We argue that this argument is invalid; we observe that the loss of auction revenues today are more than offset by the gain of higher auction revenues in the future and lower public network deployment costs . Thus, the auction adds, rather than relieves, stress to the public budget. Moreover, the Rockefeller bill, which allocates the D Block to public safety, also permits the use of incentives auctions to recover high-quality broadcast television spectrum that can then be re-purposed for mobile services. According to some, this spectrum is expected to generate just over $35 billion in auction revenues, the sum of which could be used for funding the public safety network and deficit reduction. Thus, while the D Block may offer a unique opportunity for the public safety network, it is not exceptional in its ability to generate auction revenues for the federal coffer.

The allocation of spectrum resources is an inherently complex issue. In the case of the D Block, complicating the choice is the fact that while the economic benefits of public safety are exceedingly difficult to quantify, the social goal of ensuring the safety of all Americans is nonetheless at stake. Fortunately, even if we value this security benefit at zero, our analysis shows that allocation to public safety is still preferred even on purely economic grounds. In our view, based on the analysis presented above, and absent evidence to the contrary, we believe the D Block should be combined in a contiguous 20 MHz block for use by the public safety community.

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