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PUBLIC INTEREST COMMENT

# AMERICAN SPECTRUM POLICY SHOULD ALLOW MORE COMPENSATION TO AGENCIES FOR CLEARING AND MORE GEOGRAPHIC-BASED SHARING

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Developing a Sustainable Spectrum Strategy for America's Future
Agency: National Telecommunications and Information Administration
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The Fourth Branch Program of the Mercatus Center at George Mason University is dedicated to advancing knowledge about the effects of regulation on society, commerce, and innovation. As part of its mission, the program conducts independent legal and economic analyses to assess agency rulemakings and proposals from the perspective of consumers and the public.

The notice asks,

> How could a spectrum management paradigm be structured such that it satisfies the needs of commercial interests while preserving the spectrum access necessary to satisfy the mission requirements and operations of Federal entities?

Federal agencies are market participants for many indispensable inputs—including electricity, vehicle fleets, office supplies, and labor—but not, anomalously, for spectrum. Economic distortions arise because of the lack of price signals and the inability of agencies to transfer spectrum to commercial entities for compensation. The attached *Richmond Journal of Law and Technology* article contains research about how agencies sell and lease their real property to commercial entities and proposes a similar framework for spectrum.[1] No policy mechanism performs better at expanding new services than transferring unused and underused federal spectrum to commercial operators with exclusive, flexible use licenses.[2] There is little "low-hanging fruit" today when it comes to federal spectrum transfers, and the article proposes

[1] *See* Brent Skorup, *Sweeten the Deal: Transfer of Federal Spectrum Through Overlay Licenses*, 22 RICH. J.L. & TECH. 5 (2016).
[2] *See* THOMAS W. HAZLETT, THE POLITICAL SPECTRUM: THE TUMULTUOUS LIBERATION OF WIRELESS TECHNOLOGY, FROM HERBERT HOOVER TO THE SMARTPHONE 323–26 (Yale Univ. Press 2017); see also Skorup, *supra* note 1, at 14–29.

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using a system of overlay license auctions, which enable federal agencies to be compensated for clearing spectrum.[3]

The notice also asks,

> To what extent would the introduction of automation facilitate assessments of spectrum use and expedite the coordination of shared access, especially among Federal and non-Federal spectrum stakeholders?

Spectrum use assessments should be resisted on the commercial and federal side because they are a poor proxy for the underlying value of the wireless system. Rarely used systems can have massive social value (like missile-detection systems), while constantly used systems can have little underlying value (like a video surveillance backhaul link that easily could be replaced by a fiber link).

As for spectrum sharing, the attached paper points out that geographic-based sharing works fairly well.[4] On the other hand, opportunistic or real-time spectrum sharing—which has been a priority of the National Telecommunications and Information Administration (NTIA) since at least 1991—has never been deployed on a widespread basis, and caution is required before devoting resources to opportunistic spectrum-sharing regimes.[5]

Thank you for the opportunity to comment on this important proceeding. Spectrum demands are increasing on the commercial and federal side, and it is critical that the NTIA, federal agencies, and the FCC coordinate in order to find market-based, financially prudent, and win-win spectrum transfers and sharing mechanisms.

## ATTACHMENT

Brent Skorup, *Sweeten the Deal: Transfer of Federal Spectrum Through Overlay Licenses*, 22 RICH. J.L. & TECH. 5 (2016)

[3] Skorup, *supra* note 1, at 14–16.
[4] Skorup, *supra* note 1, at 14–24.
[5] See NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION, U.S. SPECTRUM MANAGEMENT POLICY: AGENDA FOR THE FUTURE 6 (1991); *see also* Hazlett, *supra* note 2, at 290–97; see also Skorup, *supra* note 1, at 24–29.

# SWEETEN THE DEAL: TRANSFER OF FEDERAL SPECTRUM THROUGH OVERLAY LICENSES

Brent Skorup*

Cite as: Brent Skorup, *Sweeten the Deal: Transfer of Federal Spectrum Through Overlay Licenses*, 22 RICH. J.L. & TECH. 5 (2016), http://jolt.richmond.edu/v22i2/article5.pdf.

## I. INTRODUCTION

[1] The explosion in consumer demand for wireless services that began in the 1990s caught policymakers off guard. Demand for wireless services has only accelerated, as new cellular wireless technologies—such as broadband Internet via 3G and 4G LTE—permit services such as web browsing, video streaming, the Internet of Things, and gaming, necessitating a steady influx of spectrum as an input. However, the traditional Federal Communications Commission (FCC) and National Telecommunications and Information Administration (NTIA) spectrum assignment processes, to nonfederal and federal users respectively, strained to accommodate new demands and cutting-edge services. In traditional assignment, still widely used today, the rights to free use of certain frequencies are awarded by the FCC and NTIA to deserving users.[1]

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[1] *See* 47 U.S.C. § 309(a) (2012) (the FCC "shall determine, in the case of each application filed with it . . . whether the public interest, convenience, and necessity will be served by the granting of such application."); *see also* NAT'L TELECOMMS. & INFO. ADMIN., U.S. DEP'T OF COMMERCE, MANUAL OF REGULATIONS AND PROCEDURES FOR FEDERAL RADIO FREQUENCY MANAGEMENT 8.1.1 (May 2013, rev. 2014), http://www.ntia.doc.gov/page/2011/manual-regulations-and-procedures-federal-radio-

Figuring out who is deserving of frequencies in the absence of the price system, however, is a time-consuming and politicized process. Rent-seeking and economic waste at the FCC became too obvious to ignore in the 1990s, so regulators today increasingly rely on market allocation of nonfederal spectrum through spectrum auctions.[2]

[2] The new challenge is transferring spectrum from inefficient legacy operators to bandwidth-hungry entrants. Almost no "greenfield" spectrum is left—commercial and government users occupy nearly all valuable spectrum—so policymakers are scouring existing wireless systems for surplus spectrum that can be auctioned. In the past 25 years, various incumbent users, including television broadcasters,[3] public safety agencies,[4] aeronautical systems,[5] and utility companies,[6] have seen their spectrum transferred to new licensees and repurposed for consumer uses such as mobile broadband. Not only are inefficient commercial technologies locked in because of decades of top-down spectrum assignment, but also the growing consensus among experts is that spectrum assigned to federal agencies is lightly used and would be better redeployed for consumer use.[7]

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frequency-management-redbook, *archived at* https://perma.cc/LVU9-H7F9 (describing NTIA's spectrum assignment procedures).

[2] *See* Thomas W. Hazlett, *Assigning Property Rights to Radio Spectrum Users: Why Did FCC License Auctions Take 67 Years?*, 41 J.L. & ECON. 529, 532–33 (1998).

[3] *See* Robert M. Rast, *The Dawn of Digital TV*, IEEE SPECTRUM (Oct. 3, 2005, 4:18 AM), http://spectrum.ieee.org/consumer-electronics/audiovideo/the-dawn-of-digital-tv, *archived at* https://perma.cc/Y2RF-K7PY (describing the clearing of analog broadcast television systems to allow for the 700 MHz auction).

[4] *See infra* Part B(1) (describing the PCS auction).

[5] *See* Gregory L. Rosston, *Increasing the Efficiency of Spectrum Allocation*, 45 REV. INDUS. ORG. 221, 231 (2014).

[6] *See infra* Part B(1) (describing the PCS auction).

[7] President Barack Obama concurs with this assessment. In June 2010, he issued a memorandum directing the NTIA to identify federal spectrum that can be made available

[3] Slow repurposing of federal spectrum is a hidden public policy crisis with tremendous economic costs. Delayed reassignment of spectrum to efficient use is costly to society,[8] so streamlining the process of quickly transferring swaths of spectrum between users is a policy goal that would yield significant economic benefits. Economists estimate that spectrum in the hands of inefficient incumbents represents hundreds of billions of dollars of lost consumer surplus annually.[9] Delayed deployment of new

for wireless broadband by 2020. *See* Unleashing the Wireless Broadband Revolution, 3 C.F.R. 348, 348–49 (2011); *see also* Thomas M. Lenard, Lawrence J. White & James L. Riso, *Increasing Spectrum for Broadband: What Are the Options?* 23 (Tech. Pol'y Inst.. Working Paper, 2010), https://techpolicyinstitute.org/wp-content/uploads/2010/02/increasing-spectrum-for-broadb-2007661.pdf, *archived at* https://perma.cc/G8YV-NQBV ("There appears to be a widespread consensus that spectrum in government hands is likely not being used efficiently . . . ."); Jeffrey A. Eisenach, *Spectrum Reallocation and the National Broadband Plan*, 64 FED. COMM. L.J. 87, 130 (2011); Harvey J. Levin, *The Radio Spectrum Resource*, 11 J.L. & ECON. 433, 434 (1968) ("Most other users (like those in public safety and local or federal government radio) are not directly constrained in their use of spectrum by pressures in any 'markets' for their end products or services."); Kenneth R. Carter & J. Scott Marcus, *Improving the Effectiveness and Efficiency of Spectrum Use by the Public Sector: Lessons from Europe* (Sept. 27, 2009), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1488852, *archived at* https://perma.cc/54M5-DJDD ("To a significant degree, these [efficiency] improvements have not worked their way into spectrum use by public sector users, including the military, emergency services, or aeronautical or maritime transport."); James Losey & Sascha Meinrath, *Free the Radio Spectrum*, IEEE SPECTRUM (June 28, 2010, 7:59 PM), http://spectrum.ieee.org/telecom/wireless/free-the-radio-spectrum/0, *archived at* https://perma.cc/TW26-NMXW (stating that "the 270 000 [assignments] held by government agencies . . . are woefully underutilized.").

[8] *See* COLEMAN BAZELON & GIULIA MCHENRY, LOCUSTPOINT NETWORKS, STAYING ON TRACK: REALIZING THE BENEFITS FROM THE FCC'S INCENTIVE AUCTION WITHOUT DELAY ii (2015), http://apps.fcc.gov/ecfs/document/view;ECFSSESSION=Kk3QJpkhFvcQwklx1G3Rz6tF8p3LBhxBWph1ZmjDp4nkr60XTZRG!156529071!809722108?id=60001031918, *archived at* https://perma.cc/DU6R-D5Z5 (estimating that the social costs of delaying the "Incentive Auction" of TV bands two or three years could approach $200 billion).

[9] *See, e.g.*, HAROLD FURCHTGOTT-ROTH, HUDSON INST., GRANTING LICENSED SPECTRUM FLEXIBILITY: HOW TO SPUR ECONOMIC GROWTH AND INNOVATION IN AMERICA 6 (2012), http://www.hudson.org/content/researchattachments/attachment/1084/hfr--spectrumflexibility--dec12.pdf, *archived at* https://perma.cc/N4EN-VJB5; *see also*

wireless services results chiefly because few incumbents offer to relinquish their valuable spectrum. Incumbents generally have two undesirable options: either (a) relocate to another band and purchase new, more efficient equipment or (b) mothball operations completely.

[4] The spectrum shortage is not a market failure; rather, it is a regulatory failure that prevents spectrum from being quickly transferred to its highest-valued uses. First, although some commercial users pay market rates for spectrum through auctions and secondary markets, federal agencies do not pay market rates.[10] The negligible annual fee agencies pay for their frequencies means spectrum is undervalued and agencies have little incentive to economize. Second, because federal agencies cannot sell or transfer their spectrum to commercial users, the resources are locked into inefficient federal systems.[11]

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Thomas W. Hazlett & Roberto E. Muñoz, *A Welfare Analysis of Spectrum Allocation Policies*, 40 RAND J. OF ECON. 424, 425 (2009).

[10] Agencies pay only a small, annual fee for their spectrum—$122 for each frequency assignment. *See* U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-13-7, SPECTRUM MANAGEMENT: INCENTIVES, OPPORTUNITIES, AND TESTING NEEDED TO ENHANCE SPECTRUM SHARING 11 n.14 (2012), http://www.gao.gov/assets/660/650019.pdf, *archived at* https://perma.cc/3BRP-BVNT.

[11] The Miscellaneous Receipts Act requires "an official or agent of the Government receiving money for the Government from any source" to "deposit the money in the Treasury as soon as practicable without deduction for any charge or claim." 31 U.S.C. § 3302(b) (2012). Thus, under current law, any payment to agencies would have to be submitted to the Treasury rather than be retained by the agency receiving the payment for relocation purposes. Once revenue is submitted to the Treasury, it may only be disbursed pursuant to a specific congressional directive. *See* COMMERCE SPECTRUM MGMT. ADVISORY COMM., RECOMMENDATIONS FOR IMPROVING THE PROCESS FOR IDENTIFYING SPECTRUM FOR FUTURE REALLOCATION OR SHARING 25 n.55 (2008), http://www.ntia.doc.gov/files/ntia/publications/081508_csmac_wg3_report_revised_clean_final.pdf, *archived at* https://perma.cc/P872-TP5V.

[5] To paraphrase FCC Commissioner Jessica Rosenworcel, federal agencies need "carrots and sticks" for efficient use.[12] In the next five to ten years, particularly with the hardest-to-reclaim spectrum (such as that of the Department of Defense), a "carrot" may be required. One "carrot" proposal would encourage efficient trades by giving agencies greater rights to the spectrum they possess—a system of transferable spectrum licenses[13]—so that agencies can trade and sell spectrum to commercial users and retain some of the proceeds.

[6] Commissioner Rosenworcel proposed that to affect these transactions and to channel spectrum to its highest-valued uses, the FCC and NTIA could auction off "overlay" licenses to commercial users.[14] Overlay licenses here mean flexible-use licenses to use a particular band occupied by another licensee. Overlay licenses grant auction winners (1) primary rights to any unused spectrum in the band, (2) secondary rights to spectrum in the band that is being used by an incumbent, and (3) exclusive

[12] One meritorious "stick" proposal is to charge agencies approximately the opportunity cost of their spectrum, much like the United Kingdom does. Long-term spectrum fees should be budgeted for as an operating expense so that agencies can sensibly weigh the tradeoffs between acquiring spectrum and other inputs that further their agency mission. This proposal resembles a "GSA for spectrum." *See* LENARD, WHITE, & RISO, *supra* note 7, at 26; *see also* Brent Skorup, *Reclaiming Federal Spectrum: Proposals and Recommendations*, 15 COLUM. SCI. & TECH. L. REV. 90, 110–12 (2013). For a thoughtful analysis on the merits of this proposal, see generally DOROTHY ROBYN, ECON. STUDIES AT BROOKINGS, BUILDINGS AND BANDWIDTH: LESSONS FOR SPECTRUM POLICY FROM FEDERAL PROPERTY MANAGEMENT 2 (2014), http://www.brookings.edu/~/media/research/files/papers/2014/09/23_buildings_bandwidth_spectrum_property/23_buildings_bandwidth_spectrum_property, *archived at* https://perma.cc/9QFS-4VBE.

[13] My thanks are extended to an anonymous reviewer for suggesting this term.

[14] Comm'r Jessica Rosenworcel, Remarks at CTIA 2013–The Mobile Marketplace 4 (May 22, 2013), http://www.fcc.gov/document/commissioner-rosenworcels-speech-ctia-2013, *archived at* https://perma.cc/5SYN-47JG ("So I propose we auction 2155–2180 MHz along with an additional right . . . the exclusive right to negotiate with federal incumbents [in the 1755–1780 MHz band].").

rights to bargain with existing users occupying portions of the band.[15] These licenses can be accompanied by a deadline for incumbent users to move out of the band.[16] Before that deadline, overlay licensees must protect existing users in the band, but they also reap rewards (such as faster deployment of 4G LTE services) if they can convince the incumbents to move or repack to another band.

[7] Purchasing an overlay license is akin to purchasing a city block of real property that has a few tenants with unexpired leases. The existing tenants have a superior possessory right to occupy the property, but they may willingly abandon the property for a high-enough cash payment or trade. The benefit of overlay licenses is that they create residual claimants and encourage voluntary settlements between the incumbent user or users—in this case, a federal agency—and the overlay auction winner. The FCC previously executed successful overlay auctions on the nonfederal side, and Rosenworcel called such auctions an "elegant solution" for a band encumbered by federal users.[17]

[8] There are several policy alternatives for repurposing federal spectrum. A White House–commissioned study focuses on the deficiencies of these proposals, but largely avoids comparative institutional analysis.[18] For example, the study notes the overlay auction process can be "extremely slow and cumbersome."[19] The analysis cannot

[15] *See* Brent Skorup, *Getting Away From GOSPLAN*, 36 REG. 14, 18 (Winter 2013–2014), http://object.cato.org/sites/cato.org/files/serials/files/regulation/2014/1/regulation-v36n4-7.pdf, *archived at* https://perma.cc/4MAT-W7AH.

[16] *See id.* at 18.

[17] Rosenworcel, *supra* note 14, at 4.

[18] *See* KAREN D. GORDON ET AL., IDA SCI. & TECH. POLICY INST., A REVIEW OF APPROACHES TO SHARING OR RELINQUISHING AGENCY-ASSIGNED SPECTRUM 2 (2014), https://www.ida.org/upload/stpi/pdfs/p5102final.pdf, *archived at* https://perma.cc/FD24-7HBA.

[19] *Id.* at 54.

end there, however. The important questions to be answered include (1) are overlays slow and cumbersome compared to the available alternatives and (2) which process is more likely to improve social welfare?

[9] Economist Ronald Coase pointed out that a policy should (as much as possible) be compared with other real-world policy alternatives and their economic effects.[20] Here, as in many debates, all available policy choices are costly. Regulators must consider how their rules influence relocation decisions relative to other real-world alternatives. In this paper, I make the case that private ordering through overlay auctions performs admirably when compared to the regulation-intensive spectrum-sharing regime recommended in the President's Council of Advisors on Science and Technology (PCAST) report.[21] By examining how overlay auctions and sharing techniques have worked in practice, regulators have a better understanding of the costs and benefits associated with spectrum policy decisions.[22]

## II. BACKGROUND

[10] Command-and-control spectrum allocation methods prevailed at the FCC and NTIA for decades, drawing comparisons to the former Soviet

[20] *See* Ronald H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 43 (1960) ("A better approach would seem to be to start our analysis with a situation approximating that which actually exists, to examine the effects of a proposed policy change and to attempt to decide whether the new situation would be, in total, better or worse than the original one.").

[21] *See* PRESIDENT'S COUNCIL OF ADVISORS ON SCI. & TECH., EXEC. OFFICE OF THE PRESIDENT, REALIZING THE FULL POTENTIAL OF GOVERNMENT-HELD SPECTRUM TO SPUR ECONOMIC GROWTH ix (July 2012) [hereinafter PCAST], http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf, *archived at* https://perma.cc/T5J5-L6PU.

[22] *See* Thomas W. Hazlett, *Efficient Spectrum Reallocation with Hold-Ups and Without Nirvana* 31 (George Mason Univ. Law & Econ. Research Paper Series, No. 14-16), http://iep.gmu.edu/wp-content/uploads/2014/04/nirvana.pdf, *archived at* https://perma.cc/QVF3-CWB5.

Union's State Planning Committee, known as Gosplan, "which allocated scarce resources by administrative fiat among factories and other producers in the Soviet economy."[23] Economists such as Ronald Coase pointed out during this era that spectrum has many attributes of real property, and that it might be more efficiently used by private users who (1) internalize the benefits and costs of deploying the input and (2) can sell it to parties who value it more.[24] Market-based spectrum reform—if not always practiced—essentially won the day both on the commercial side and at the FCC since the early 1990s. Auctions are held for spectrum, secondary markets permit license transfers to profit-maximizing firms, and the FCC generally avoids prescribing which wireless services must be provided. Therefore, scholars are increasingly focused on injecting market reform into the reordering of federal spectrum,[25] which the NTIA assigns to agencies through command and control.

[11] The 3,200 MHz segment of spectrum spanning 300 MHz to 3,500 MHz is in high demand for both government and commercial users. This range of frequencies, or similar approximations to it, represents the so-called "beachfront spectrum" because it has optimal propagation characteristics for many popular wireless services.[26] Lower frequencies in this range permit transmissions over long distances, whereas higher frequencies transmit shorter distances, but have a higher capacity for transmitting things like web data and streaming video. National mobile

[23] *See* Skorup, *supra* note 15, at 14.

[24] *See, e.g.*, Yochai Benkler, *Some Economics of Wireless Communications*, 16 HARV. J.L. & TECH. 25, 29–30 (2002) (citing the property rights and auctions framework as "the standard economists' view"); Thomas W. Hazlett, *The Wireless Craze, the Unlimited Bandwidth Myth, the Spectrum Auction Faux Pas, and the Punchline to Ronald Coase's "Big Joke": An Essay on Airwave Allocation Policy*, 14 HARV. J.L. & TECH. 335, 532 (2001); Eli Noam, *Spectrum Auctions: Yesterday's Heresy, Today's Orthodoxy, Tomorrow's Anachronism, Taking the Next Step to Open Access Spectrum*, 41 J.L. & ECON. 765, 766 (1998).

[25] *See, e.g.*, Eisenach, *supra* note 7, at 89; LENARD, WHITE & RISO, *supra* note 7, at i.

[26] *See* PCAST, *supra* note 21, at 141–42.

broadband carriers—the primary purchasers of available spectrum—such as Sprint and AT&T Mobility take a diversified approach. They acquire both low and high bands so that they can provide both good regional coverage (via low bands) and localized high capacity (via high bands).

[12] NTIA manages federal spectrum, and it estimated in 2012 that federal operations use about 40 percent of the in-demand spectrum.[27] Of the 3,200 MHz of beachfront spectrum, NTIA is currently analyzing close to 1,000 MHz to either share with or transfer to commercial users.[28] To that end, in late 2014, the FCC auctioned off federal spectrum in the AWS-3 auction.[29] The biggest bidders included AT&T Mobility, Verizon Wireless, Dish Network, and T-Mobile.[30] The 50 MHz band of paired spectrum (25 MHz of federal spectrum was paired with another nonfederal 25 MHz block) raised over $40 billion.[31] Several empirical studies show

[27] NTIA defined "high-value spectrum" as "spanning 225 MHz to 3,700 MHz." Mark . Goldstein, Dir. Phys. Infrastructure Issues, Testimony before the H. Comm. on Energy & Commerce, Subcomm. on Commc'n & Tech., Spectrum Management: Federal Government's Use of Spectrum and Preliminary Information on Spectrum Sharing 3 (Sept. 13, 2012) (transcript on file with U.S. Gov't Accountability Office) [hereinafter Goldstein Testimony], http://www.gao.gov/assets/650/648206.pdf, *archived at* https://perma.cc/Z4EA-LRTM.

[28] *See* PENNY PRITZKER & LAWRENCE E. STRICKLING, U.S. DEP'T OF COMMERCE, FIFTH INTERIM PROGRESS REPORT ON THE TEN-YEAR PLAN AND TIMETABLE 6, table B-1 (2015), http://www.ntia.doc.gov/files/ntia/publications/ntia_5th_interim_progress_report_on_ten-year_timetable_april_2015.pdf, *archived at* https://perma.cc/Z2YN-KXPW.

[29] *See id.* at 3.

[30] *See* Phil Goldstein, *AWS-3 Auction Results: AT&T Leads with $18.2B, Verizon at $10.4B, Dish at $10B and T-Mobile at $1.8B*, FIERCEWIRELESS (Jan. 30, 2015), http://www.fiercewireless.com/story/aws-3-auction-results-att-leads-182b-verizon-104b-dish-10b-and-t-mobile-18b/2015-01-30, *archived at* https://perma.cc/2Z73-C7FG.

[31] The paired spectrum grossed $42.5 billion, and the unpaired 15 MHz of federal spectrum grossed $2.43 billion. *See* George S. Ford & Lawrence J. Spiwak, *Auction 97 and the Value of Spectrum,* PHOENIX CENTER 1, 2 (Feb. 4, 2015), http://www.phoenix-center.org/perspectives/Perspective15-02Final.pdf, *archived at* https://perma.cc/2SUV-CYX4.

that the *annual* consumer surplus derived from wireless broadband approximates the auction value of the underlying spectrum.[32] Therefore, the $40 billion paired block of AWS-3 spectrum (when deployed) will provide about $40 billion worth of consumer surplus annually.

[13] Federal agencies are market participants for many indispensable inputs but not, anomalously, for spectrum. Agencies compete with private firms for supply of most inputs, such as labor, real estate, electricity, automotive fleets, and office supplies. Spectrum, however, is given to federal agencies very cheaply, and underused or excess spectrum cannot be sold to commercial operators.[33] Agency spectrum is removed from market processes, and agencies have little economic incentive to use or manage spectrum efficiently.[34] With little sense of the opportunity costs of the spectrum they use, agencies are largely exempt from economic pressures to use more efficient radios, outsource wireless services to

[32] *See* BAZELON & MCHENRY, *supra* note 8, at 9.

[33] Agencies pay only a small, annual fee for their spectrum—$122 for each frequency assignment. Goldstein Testimony, *supra* note 27, at 12 & n.13.

[34] PCAST concluded that, "[f]ederal users currently have no incentives to improve the efficiency with which they use their own spectrum allocation." PCAST, *supra* note 21, at ix. Some of the inefficiency is undoubtedly to be expected. Any large organization has bureaucratic friction, and federal agencies—particularly defense agencies—are especially risk averse. A lack of transparency regarding federal uses of spectrum and the fragmented authority over federal spectrum management certainly contributed to the government failure. Transparency in spectrum use is generally unrewarded and is therefore undersupplied. *See* HAROLD FELD & GREGORY ROSE, BREAKING THE LOGJAM: SOME MODEST PROPOSALS FOR ENHANCING TRANSPARENCY, EFFICIENCY AND INNOVATION IN PUBLIC SPECTRUM MANAGEMENT 6 (2010), http://www.publicknowledge.org/pdf/pk-fed-spectrum-transparency-whitepaper.pdf, *archived at* https://perma.cc/8LNG-QB5G. The fragmentation of authority over federal spectrum may unfortunately be intractable. A 1994 effort to consolidate Department of Defense spectrum management lasted only a year because the chiefs of Army, Navy, Air Force, and intelligence organizations all wanted to retain their own spectrum management office. U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-NSIAD-97-131, DEFENSE COMMUNICATIONS: FEDERAL FREQUENCY SPECTRUM SALE COULD IMPAIR MILITARY OPERATIONS 15 (June 1997), http://www.gao.gov/archive/1997/ns97131.pdf, *archived at* https://perma.cc/86LG-F7JH.

commercial operators, or substitute wireless communications with wired communications.

[14] Market mechanisms for repurposing federal spectrum are currently unavailable, so members of Congress and the executive branch rely mostly on scrutiny from government audits and congressional hearings, which have limited effectiveness.[35] Policymakers understand the urgency, but the Obama administration's June 2013 memorandum to federal agencies, like the PCAST report that informed the memorandum, does little about the underlying problem.[36] On the issue of efficient use of federal spectrum, the memorandum merely directs agencies to determine what spectrum could potentially be made available for sharing or clearing and requests that agencies "use the minimum spectrum reasonably necessary to most effectively meet mission requirements."[37]

[15] These sorts of requests have been around for decades. The problem is not that a president has not asked for efficient use forcefully enough; rather, the problem is that federal agencies face few economic tradeoffs.[38]

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[35] The slow relocation of government systems leads to verbal haranguing of federal administrators and to visible frustration. *See* Carl Franzen, *Congress blasts military and national telecom agency for not sharing wireless spectrum faster*, VERGE (June 27, 2013), http://www.theverge.com/2013/6/27/4470738/congress-house-wireless-spectrum-hearing-june-2013, *archived at* https://perma.cc/L26N-GZ6P ("Do you [NTIA and Department of Defense administrators] sit down and talk to each other? Why wouldn't the two of you sit down and talk about it. Why am I even having to ask this question again?") (quoting Rep. Eshoo).

[36] *See* Presidential Memorandum on Expanding America's Leadership in Wireless Innovation (June 14, 2013), 78 Fed. Reg. 37,431 (June 20, 2013), http://www.whitehouse.gov/the-press-office/2013/06/14/presidential-memorandum-expanding-americas-leadership-wireless-innovatio, *archived at* https://perma.cc/AMD3-JGXZ.

[37] *Id.* at 37,433.

[38] *See Federal Management of Radio Spectrum: Hearing Before the Subcomm. on Telecomm. & Fin. of the H. Comm. on Commerce*, 104th Cong. 10 (1995) (statement of James L. Gattuso, Vice President, Citizens for a Sound Economy).

Agencies have acceded—slowly—to congressional mandates to clear spectrum for auction. However, agencies are increasingly resistant to relocating their operations.[39] For this reason, the White House is contemplating several spectrum-clearing and spectrum-sharing methods, though no alternative has emerged as the consensus.[40]

## III. RIVAL APPROACHES

[16] Repurposing federal spectrum is a pressing economic problem that has received increasing attention. Several solutions have been proposed. A 2014 study commissioned by the White House found, every federal spectrum-repurposing proposal, including overlays, faces implementation challenges.[41] Comparisons between policies are therefore necessary for informed policymaking. Below, the PCAST dynamic sharing proposal is analyzed and compared to recent overlay auctions and the clearing of federal users.

### A. PCAST's Dynamic Sharing Proposal

[17] The political difficulties in transferring a valuable resource from one group (federal agencies) to another (commercial wireless operators and consumer device makers) guided the PCAST recommendation to do away with traditional clearing and auctioning procedures such as overlays.[42] Instead, PCAST recommended simply changing the nature of the obligations of spectrum users—a do-no-harm standard—and relying on the future advancement of technologies that enable dynamic spectrum

[39] *See* PCAST, *supra* note 21, at 9 (discussing the increasing difficulties of relocating incumbent federal systems).
[40] *See* Gordon et al., *supra* note 18, at 61.

[41] *See id.* at 13 (noting the significant challenges implementing, for example, spectrum use fees).

[42] *See* PCAST, *supra* note 21, at 1 ("Clearing and reallocation of Federal spectrum for exclusive use is not a sustainable basis for spectrum policy.").

sharing.[43] With dynamic sharing, commercial devices such as smartphones, tablets, and small cells detect and avoid—possibly in real time—interference with federal systems, such as radar and video surveillance, that use the same frequencies at the same time in the same geographic area. The benefit is that dynamic sharing eliminates the need to clear resistant federal users.

[18] The PCAST recommendations are modeled on the FCC's TV white spaces proceeding.[44] That permitted unlicensed devices and cognitive radios in the unused "white spaces" that comprise about 240 MHz of the 294 MHz allocated to television broadcasters.[45] Like federal users, television broadcasters are legacy users that, generally speaking, cannot sell their spectrum to mobile carriers.[46] After a 2002 staff recommendation for this type of spectrum sharing, the FCC issued a 2008 order allocating spectrum for white space devices' use. The first device was approved in 2012.[47] White space devices must protect incumbent broadcasters but can transmit and receive signals in geographic areas and on frequencies that do not contain television broadcasters.

[43] *See id.* at 11 ("T]he key to the new architecture is to create very wide bands and implement dynamic, real-time, spectrum sharing.").

[44] *See id.* at 24 ("We envisage that access to large Federal bands authorized for shared use can be coordinated primarily by registering and communicating with a management database, similar in concept to the White Space Databases certified by the FCC to provide permission to transmit in the TV Bands.").

[45] *See* Thomas W. Hazlett & Evan T. Leo, *The Case for Liberal Spectrum Licenses: A Technical and Economic Perspective*, 26 BERKELEY TECH. L.J. 1037, 1049 n.50 (2011) (explaining the strict rules for unlicensed devices mean much of the available frequencies cannot be exploited).

[46] *See* PCAST, *supra* note 21, at 16.

[47] *See id.* at 11–13.

[19] The device specifications formulated by the FCC have strict power limits and are quite complex because of interference concerns.[48] White space-sharing techniques rely on accurate geolocation information; yet those crucial databases of registered devices contain hundreds of errors.[49] Seven years after the 2008 order, white space–sharing technology has been used only marginally. As of this writing, only about 600 devices are in use,[50] providing data services (e.g., connecting municipal water-monitoring systems) and Wi-Fi-like Internet access (at a handful of libraries and schools).[51]

### B. Auction of Overlay Licenses

[20] An alternative proposal for spectrum reform (resembling Commissioner Rosenworcel's proposal) is to auction overlay licenses which permit the commercial use of spectrum currently encumbered by federal users.[52] These licenses are called *overlays* because they

[48] *See* EVALUATION OF THE PERFORMANCE OF PROTOTYPE TV-BAND WHITE SPACE DEVICES PHASE II, OFFICE OF ENGINEERING & TECH., FCC/OET 08-TR-1005, iv (Oct. 14, 2008), http://apps.fcc.gov/ecfs/ document/view; jsessionid=7qp3P1VbdnpcVyFWySl2N52n318pmkvNznfvhcyWdnPhqGTpyhzP!1471562840!-321460796?id=6520183093, *archived at* https://perma.cc/D2MJ-4C59.

[49] *See* Robert McDowell, *The FCC Should Fight for Our Right to TV White Space*, WIRED (Apr. 17, 2015), http://www.wired.com/2015/04/fcc-white-spaces-database/, *archived at* https://perma.cc/QQ6Y-GE9U; *see also* Mike Dano, *FCC promises to clean up error-ridden TV white space databases*, FIERCEWIRELESS (Mar. 20, 2015), http://www.fiercewireless.com/tech/story/ fcc-promises-clean-error-ridden-tv-white-space-databases/2015-03-20, *archived at* https://perma.cc/2X27-C3B2.

[50] *See* McDowell, *supra* note 49.

[51] *See* Lyndsey Gilpin, *White Space broadband: 10 communities doing big projects*, TECHREPUBLIC (Mar. 19, 2014), http://www.techrepublic.com/article/white-space-broadband-10-communities-doing-big-projects/, *archived at* https://perma.cc/B8UR-LTY5.

[52] *See* RICHARD M. NUNNO, CONG. RESEARCH SERV., SPR 97-218, RADIOFREQUENCY SPECTRUM MANAGEMENT 23 (1998) (A wireless industry association opposed this

geographically surround an existing spectrum assignment. Overlays have enabled the relocation and clearing of state government systems and public safety systems from a few hundred MHz of spectrum. Overlays have not been used for federal spectrum because agencies cannot directly receive consideration from commercial users.[53]

[21] Overlay licenses grant auction winners (1) primary rights to any unused spectrum in the band, (2) secondary rights to spectrum in the band that is being used by an incumbent, and (3) exclusive rights to bargain directly with existing users occupying portions of the band. In the case of auctioning spectrum occupied by federal users, the winning overlay licensee is required to protect the incumbent federal users but can negotiate directly with them. Overlay licensees might induce incumbents to use more efficient devices (thereby freeing up spectrum for new uses), to tolerate certain amounts of interference, to move to a different band entirely, or to cease operations altogether.[54]

[22] The policy innovation lies in combining transferable federal spectrum rights with the overlay auction framework. These rights would give agencies the ability to bargain with potential suitors and to be directly compensated for vacating or otherwise reducing their use of a band. Federal agencies are not profit-maximizing firms, but they do face budget constraints, and tradeoffs are more transparent when agencies are faced with priced assets. If permitted, agencies might improve their input mix by

proposal in the AWS-3 auction, but the crux of its opposition was that the federal users were not required to relocate by a certain date).

[53] *See* COMMENTS OF 4G AMERICAS IN THE MATTER OF AMENDMENT OF THE COMMISSION'S RULES WITH REGARD TO COMMERCIAL OPERATIONS IN THE 1695-1710 MHZ, 1755-1780 MHZ, AND 2155-2180 MHZ BANDS 8, GN DOCKET. NO. 13-185 (2013), http://www.hwglaw.com/siteFiles/News/3C0FD0FD14FA23AEC2FC7013E082AEB5.pdf, *archived at* https://perma.cc/SQ5Q-X8DB.

[54] Theoretically, overlay licensees could also bargain with incumbents to share spectrum by the millisecond or by the hour, but it is unlikely, at present, that the economics of spectrum sharing permit such agreements in practice.

selling unused assets and reinvesting the revenue. For instance (as described later) several agencies have transferable real property rights. That is, they have the authority to lease and sell federal real estate and buildings to private developers and to retain some of the proceeds.[55] Transferable spectrum rights make agencies residual claimants in a similar fashion. Overlay auctions give regulators a process to induce spectrum incumbents to sell their underused assets quickly.

[23] Although the compensation should be negotiated, successful overlay auctions have featured a command-and-control element. As explained *infra*, it is likely necessary for federal incumbents to have a deadline to vacate their bands.[56]

### 1. Case Study of the PCS Auction

[24] Overlays have been used a few times to repurpose encumbered nonfederal spectrum, including the major auctions like the PCS auction and AWS-1 auction.[57] Congress first authorized the FCC to conduct spectrum auctions in 1993 to avoid wasteful command-and-control prescriptions and to permit more spectrum for the nascent cellular phone industry.[58] With that authority, the FCC used overlay auctions for the new Broadband Personal Communications Service (PCS), a type of cellular phone technology, in the mid-1990s.[59] The FCC auctioned 120 MHz of

[55] *See* U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-11-574, DEFENSE INFRASTRUCTURE: THE ENHANCED USE LEASE PROGRAM REQUIRES MANAGEMENT ATTENTION 1–2 (2011), http://www.gao.gov/assets/330/320465.pdf, *archived at* https://perma.cc/XKX6-7JFJ.

[56] *See* Peter Cramton, Evan Kwerel & John Williams, *Efficient Relocation of Spectrum Incumbents*, 41 J.L. & ECON. 647, 649 (1998) (Overlays, then, may not be appropriate for bands where shutdown deadlines are especially unpredictable or long term).

[57] *See id.* at 661.

[58] *See id.* at 660.

[59] *See* NUNNO, *supra* note 52, at 13 ("Overlay licenses were auctioned in the PCS auctions since there were already incumbent licensees . . . using that spectrum." The auctioned spectrums were 1850–1910 MHz and 1930–1990 MHz. *Id.*

encumbered beachfront spectrum, and cellular phone companies were the major bidders. Incumbent users were mostly public utilities, railroads, and local governments operating thousands of microwave communication links, but they also included state public safety operations such as firefighters, police, and other emergency responders.[60] The auction and clearing proposals faced resistance and, echoing today's objections from federal agencies, public safety incumbents warned that the FCC's auction would disrupt their communications reliability and could "have a devastating effect on . . . millions of inhabitants" relying on their services.[61] Nevertheless, the auctions for this encumbered spectrum commenced in 1995.[62] The auction winners could deploy services where there were no incumbents and had secondary rights to the spectrum where incumbents operated.

[25] To relocate those incumbents and to free up spectrum for PCS, the FCC mandated that the PCS license winners pay the incumbents' relocation costs. But the FCC also did something novel: it gave the incumbent users transferable spectrum rights. That is, the FCC permitted the incumbent users to bargain with the overlay auction winners and, in exchange for an additional payment or in-kind benefit, move before a relocation deadline.[63]

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[60] *See* Cramton et al., *supra* note 56, at 660, 668.

[61] REPLY COMMENTS OF THE LOS ANGELES COUNTY SHERIFF'S DEPT., IN THE MATTER OF REDEVELOPMENT OF SPECTRUM TO ENCOURAGE INNOVATION IN THE USE OF NEW TELECOMMUNICATIONS TECHNOLOGIES, ET DOCKET NO. 92-9 (July 6, 1994), at 2, http://apps.fcc.gov/ecfs/document/view?id=1320380001, *archived at* https://perma.cc/ZHM2-STQF.

[62] *See* Cramton et al., *supra* note 56, at 660–61 (FCC rulemaking for the auction commenced in 1993, and the PCS auctions were carried out in 1995, 1996, and 1997).

[63] *See id.* at 668–69 ("[T]here have been reports of incumbents demanding premiums of several times actual relocation costs to relocate before the involuntary relocation period.").

[26] The FCC gave non–public safety users a two-year voluntary negotiation period during which they were not required to negotiate with the PCS overlay winners.[64] This period was followed by a one-year mandatory negotiation period during which the PCS licensee and the incumbent were required to bargain in good faith.[65] After that deadline—three years from commencement—PCS licensees could force the incumbent to move, while compensating it for relocation costs. Public safety users had a three-year voluntary negotiation period followed by a two-year mandatory negotiation period.[66]

[27] This PCS auction grossed $7.7 billion in bids.[67] There are no public records of the payments made for early relocation, but good-faith negotiations were reportedly the norm.[68] By January 1998, over half of the microwave links had been moved out of the band,[69] and the spectrum was deployed for cellular service. Most incumbent microwave links were upgraded to work on new frequencies, but about 10% shifted to wired connections or ceased operation.[70] Today PCS spectrum supplies about 20% of all licensed spectrum used for mobile broadband and is a major part of each national carrier's spectrum holdings.[71] Looking back, the

[64] *See id.* at 663, 666 (noting that in 1997, this voluntary period was shortened to one year).

[65] *See id.* at 665–66.

[66] *See* Cramton et al., *supra* note 56, at 665–66 (noting these negotiation periods and conditions were occasionally fine-tuned by the FCC.).

[67] Evan R. Kwerel & Gregory L. Rosston, *An Insiders' View of FCC Spectrum Auctions*, 17 J. REG. ECON. 253, 275 (2000).

[68] *See* Cramton et al., *supra* note 56, at 668.

[69] *See id.*

[70] *See id.*

[71] *See* FEDERAL COMMC'N COMMISSION, SEVENTEENTH REPORT, IN MATTER OF ANNUAL REPORT AND ANALYSIS OF COMPETITIVE MARKET CONDITIONS WITH RESPECT TO MOBILE WIRELESS, INCLUDING COMMERCIAL MOBILE SERVICES 50, WT DOCKET NO. 13-

concerns about widespread public safety communications disruption never materialized.

### 2. Case Study of AWS-1

[28] The 2006 Advanced Wireless Services (AWS-1) auction was an auction of 90 MHz of paired (45 MHz) spectrum that contained nonfederal and federal users.[72] The nonfederal spectrum was auctioned off via overlay licenses; the federal spectrum wasn't. Post auction, 12 federal agencies in the 1.7 GHz band[73] relocated to other bands and several nonfederal users in the 2.1 GHz band relocated. The nonfederal users included various state and commercial microwave systems, as well as Broadband Radio Service systems—which provided services like two-way broadband and public safety communications.[74]

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135 (2014), https://apps.fcc.gov/edocs_public/attachmatch/DA-14-1862A1.pdf, *archived at* https://perma.cc/3YVY-3HAW (estimating there is about 580 MHz of spectrum used for mobile broadband and 120 MHz (PCS spectrum) out of 580 MHz is a little over 20%.).

[72] *See* Rosston, *supra* note 5, at 235–36 ("The Commission adopted procedures by which new AWS licensees may relocate incumbent [nonfederal] BRS and fixed microwave service operations in a manner similar to that developed for clearing the PCS band."); *see also* Hazlett & Leo, *supra* note 45, at 1072.

[73] *See* U.S. DEP'T. OF COMMERCE, NTIA, RELOCATION OF FEDERAL RADIO SYSTEMS FROM THE 1710–1755 MHZ SPECTRUM BAND, SECOND ANNUAL PROGRESS REPORT 2 (Mar. 2009), http://www.ntia.doc.gov/legacy/osmhome/reports/Final2ndAnnualRelocationReport20090416.pdf, *archived at* https://perma.cc/8CD9-UWJT (listing those agencies: Department of Agriculture, the Department of Defense, the Department of Energy, the Department of Homeland Security, the Department of Housing and Urban Development, the Department of the Interior, the Department of Justice, the Department of Transportation, the Department of the Treasury, the National Aeronautics and Space Administration, the Tennessee Valley Authority, and the United States Postal Service).

[74] *See* FCC, NINTH REPORT AND ORDER AND ORDER IN THE MATTER OF SERVICE RULES FOR ADVANCED WIRELESS SERVICES IN THE 1.7 GHZ AND 2.1 GHZ BANDS 5, WT DOCKET NO. 02-352 (Apr. 21, 2006), https://apps.fcc.gov/edocs_public/attachmatch/FCC-06-45A1.pdf, *archived at* https://perma.cc/B9VD-2SHR.

[29] The federal users had a clearing deadline with no direct compensation from winning bidders. However, federal users received some indirect compensation. AWS-1 was the first band auctioned under the 2004 Commercial Spectrum Enhancement Act, a law giving federal agencies a limited share of pooled auction proceeds—compensation for their relocation costs.[75] The 45 MHz occupied by nonfederal users, on the other hand, was assigned via an overlay license. The FCC permitted the nonfederal incumbents—much like the incumbents in the PCS bands—to enter into private cost-sharing agreements with the new AWS licensees.[76] Despite the encumbrances, the 1.7 GHz band grossed almost $7 billion.[77] Like the agreements between overlay licensees and incumbents in the PCS auction, the post-auction cost-sharing agreements relocating the nonfederal incumbents in the 2.1 GHz band are unavailable.

[30] The federal users did not have overlay licensees to bargain with and merely faced relocation deadlines. NTIA tracked the relocation costs of federal systems in the 1.7 GHz band so that agencies could be reimbursed through the relocation fund created by the Commercial Spectrum Enhancement Act.[78] The Government Accountability Office (GAO) estimated that the encumbered 1.7 GHz band grossed almost $7 billion.[79] Relocation costs of federal users totaled around $1.5 billion[80] ($1

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[75] *See* 47 U.S.C. § 928(c) (2012).

[76] *See, e.g.*, 47 C.F.R. §§ 27.1160; 27.1170 (2015).

[77] U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-13-472, SPECTRUM MANAGEMENT: FEDERAL RELOCATION COSTS AND AUCTION REVENUES 16 (2013), http://www.gao.gov/assets/660/654794.pdf, *archived at* https://perma.cc/N5N9-D692.

[78] *See id.* at 15–16.

[79] *See id.* at 16.

[80] *See* Howard Buskirk, *NTIA Says Cost of Clearing AWS Spectrum Will Be Below $1 Billion*, COMM. DAILY (Dec. 29, 2005), www.communicationsdaily.com/articleview?s=73088&id=273162, *archived at*

billion less than a Congressional Budget Office estimate but exceeding NTIA's original estimates by about 50 percent),[81] for net revenue of $5.5 billion.

[31] Once the auction was completed, even though little financial incentive was provided beyond the benefit of upgraded wireless systems, the clearing of agencies happened fairly rapidly. Presumably, overlay licensees paying agencies to relocate would be even more effective. By December 2008, two years after the auction, dozens of federal wireless systems had been moved from the 1.7 GHz band, and licensees had deployed mobile broadband in some cities.[82] Four agencies—the Department of the Treasury, the Department of Homeland Security, the US Postal Service, and the Department of Housing and Urban Development—had vacated the band completely.[83] By late 2010, four years after the completion of the auction, seven agencies representing 81% of eligible systems had been relocated.[84] By 2011, 95% of systems were

https://perma.cc/E7G9-RNRX (Estimates for relocation costs and for upgrading technologies like outdated analog surveillance systems varied widely before the auction. On the low end, NTIA projected in a report that the cost of 2,240 frequency assignments across 12 agencies would be $936 million. In 2005, the Congressional Budget Office estimated that costs could run as high as $2.5 billion. Agencies included the Department of Defense (mostly the Navy), Department of Energy, Department of Homeland Security, and Federal Aviation Administration. The Forestry Service had 579 assignments and the Department of Energy had 596.).

[81] *See* GAO, *supra* note 75, at 11–12; *see generally* U.S. DEP'T. OF COMMERCE, NTIA, RELOCATION OF FEDERAL RADIO SYSTEMS FROM THE 1710–1755 MHZ SPECTRUM BAND, SIXTH ANNUAL PROGRESS REPORT 2–3 (Mar. 2013) [hereinafter NTIA RELOCATION], http://www.ntia.doc.gov/files/ntia/publications/sixth_annual_report_1710-1755_mhz_04042013.pdf, *archived at* https://perma.cc/CEE2-V5CM (estimating relocation costs set by the NTIA and Dep't of Commerce).

[82] *See* NTIA RELOCATION, *supra* note 79, at 1.

[83] *Id.* at 2.

[84] *See* U.S. DEP'T. OF COMMERCE, NTIA, RELOCATION OF FEDERAL RADIO SYSTEMS FROM THE 1710–1755 MHZ SPECTRUM BAND, FOURTH ANNUAL PROGRESS REPORT 2 (Mar. 2011) [hereinafter NTIA RELOCATION FOURTH],

relocated,[85] and by 2012, six years after the auction, NTIA reported that all seven agencies had ceased operations in the band.[86]

[32] Representatives from the wireless industry expressed publicly that they were satisfied with the relocation process, but some systems and agencies were more difficult.[87] Representatives from MetroPCS, the fourth-biggest bidder in the auction, with licenses mostly in the West and

http://www.ntia.doc.gov/files/ntia/publications/1710-1755mhz_cseareport_03302011.pdf, *archived at* https://perma.cc/63NR-U9WS.

[85] *See* U.S. DEP'T. OF COMMERCE, NTIA, RELOCATION OF FEDERAL RADIO SYSTEMS FROM THE 1710–1755 MHZ SPECTRUM BAND, FIFTH ANNUAL PROGRESS REPORT 2 (Mar. 2012) [hereinafter NTIA RELOCATION FIFTH], http://www.ntia.doc.gov/files/ntia/publications/fifth_annual_report_1710-1755mhz_03302012.pdf, *archived at* https://perma.cc/A6MB-3R62.

[86] *See* NTIA RELOCATION FOURTH, *supra* note 82, at 2–3; *see also* NTIA RELOCATION FIFTH, *supra* note 85, at B-11 (The types of federal wireless systems varied widely in terms of services and relocation costs. The Department of Housing and Urban Development had only five systems, for instance, that transmitted video and communications. The total relocation costs were around $21,000.); *Id.* at B-14 (The Department of Justice's Bureau of Alcohol, Tobacco, Firearms and Explosives likewise had five systems (mostly for video communications), but it had many more components, and the estimated relocation outlays totaled over $48 million); *Id.* at B-16 (The Drug Enforcement Agency had a single system, identified only as "video surveillance," that was estimated to take three years and $75 million to relocate.); *Id.* at B-21 (The U.S. Postal Service also had a single video surveillance system consisting of about 500 devices that took one year and $1.8 million to relocate.).

[87] *See* DEP'T OF COMMERCE, COMMENTS OF T-MOBILE IN THE MATTER OF RELOCATION OF FEDERAL SYSTEMS IN THE 1710–1755 MHZ FREQUENCY BAND: REVIEW OF THE INITIAL IMPLEMENTATION OF THE COMMERCIAL SPECTRUM ENHANCEMENT ACT 1, 5, DOCKET. NO. 0906231085-91085-01 (Aug. 21, 2009), http://www.ntia.doc.gov/files/ntia/t-mobile_csea_noi_comments_8-21-09_0.pdf, *archived at* https://perma.cc/N5EL-2DZQ (supporting the idea that some regions were difficult to clear, T-Mobile representatives noted in 2009 to NTIA that "T-Mobile's launch of service in the AWS band was delayed by several months, if not longer, in many markets. Indeed, even today—nearly three years after Auction No. 66—there are certain parts of the country such as the southeast w[h]ere no wireless carrier has been given access to AWS frequencies. Such delays jeopardize investment, hinder broadband deployment, and harm consumers").

the Northeast, stated that the relocation process "worked relatively well."[88] Carriers' discussions with agencies about information like channel bandwidth, antenna power, and height for each system to be relocated expedited the process.[89] Steve Sharkey, T-Mobile's chief of engineering and technology policy, said that these technical discussions with federal users "resulted in T-Mobile being able to deploy services years earlier than originally anticipated."[90]

[33] Clearing federal agencies and allowing nonfederal incumbents to bargain with the overlay licensees allowed productive use of much of the encumbered AWS-1 bands within a few years. T-Mobile was the top bidder, paying over $4 billion for AWS-1 licenses covering nearly the entire United States,[91] and illustrating the efficacy of overlays and

[88] DEP'T OF COMMERCE, COMMENTS OF METROPCS, IN THE MATTER OF RELOCATION OF FEDERAL SYSTEMS OF 1710-1755 MHZ FREQUENCY BAND: REVIEW OF THE INITIAL IMPLEMENTATION OF THE COMMERCIAL SPECTRUM ENHANCEMENT ACT 2, DOCKET NO. 0906231085-91085-01 (Aug. 21, 2009), http://www.ntia.doc.gov/files/ntia/metropcs_-_comments_on_ntia_csea_notice84803305_5_0.doc, *archived at* https://perma.cc/2EBV-MEGV.

[89] *See* COMMENTS OF T-MOBILE, *supra* note 87, at 5.

[90] *Creating Opportunities Through Improved Government Spectrum Efficiency: Hearing Before the Subcomm. on Comm'n & Tech. of H. Comm. on Energy & Commerce*, 112th Cong. 6 (2012) (statement of Steve Sharkey, Director, Chief Engineering & Tech. Policy, T-Mobile USA, Inc.); Howard Buskirk, *Spectrum Shortfall Tops Concerns at CTIA, But Signs Growing Carriers Might Embrace Sharing*, COMM. DAILY (May 11, 2012) ("'I think we're at the point of let's get engineers into a room to figure out and solve the problems,' [Sharkey] said. 'Neither side has a complete understanding of the way each other's systems work and operate.' During AWS-1 clearance when industry first tried to clear spectrum on the West Coast, the immediate reaction of government users was 'no way, it's all redlined out and it'll be a long time,' [Sharkey] said. 'But we gave them more information about how our systems really operate and the power levels that they would expect—it cleared up practically a whole coast almost immediately.'").

[91] *See* Press Release, T-Mobile USA, Statement on the Conclusion of Bidding in the FCC Auction of Advanced Wireless Services (Sept. 18, 2006), https://newsroom.t-mobile.com/news/t-mobile-usa-statement-on-conclusion-of-bidding-in-the-fcc-auction-of-advanced-wireless-services.htm, *archived at* https://perma.cc/8YW6-5LDP.

clearing. A mere two years after the auction, T-Mobile—after the clearing of federal users and negotiating with nonfederal incumbents—launched 3G service in 27 markets covering over 100 million people.[92] This included the lucrative San Francisco[93] and New York City[94] markets. By 2010, it completed most of its nationwide mobile broadband network using AWS-1 spectrum. Auction winners like MetroPCS and Leap Wireless covered millions more after clearing their AWS-1 spectrum.[95] Today that 90 MHz of AWS-1 spectrum, now cleared of incumbents, supplies about 15% of licensed mobile broadband spectrum and is used by more than 200 million Americans through technologies such as 4G LTE.[96]

## IV. COMPARISON OF DYNAMIC SHARING AND OVERLAY AUCTIONS

[34] Decades of assigning spectrum to agencies for free has locked valuable frequencies into inefficient wireless uses. Choosing the superior set of policies for repurposing federal spectrum in a timely manner means capturing tens of billions of dollars annually—from consumer welfare gains, industry investment, and jobs—that would otherwise evaporate.[97] The experiences described suggest that clearing and relocating federal

[92] *See* GLOBAL VIEW PARTNERS, MOBILE BROADBAND IN THE AMERICAS: MOMENTUM BUILDING IN THE AWS BAND 14 (2009), http://www.gsma.com/latinamerica/wp-content/uploads/2012/06/momentumbuildingintheawsbandreport.pdf, *archived at* https://perma.cc/8QNQ-PH4B.

[93] *See* COMMENTS OF T-MOBILE, *supra* note 87, at 6.

[94] *See* Katherine Noyes, *T-Mobile's 3G Network Touches Down in NYC*, TECHNEWSWORLD (May 5, 2008), http://www.technewsworld.com/story/62876.html, *archived at* https://perma.cc/YH3B-YHJZ.

[95] *See* GLOBAL VIEW PARTNERS, *supra* note 92, at 14–15.

[96] *See* FCC, *supra* note 69, at 50, 62 (showing that the 90 MHz of cleared AWS-1 spectrum constitutes around 15.5% of the total amount (580.5 MHz) of spectrum).

[97] *See* BAZELON & MCHENRY, *supra* note 8, at 13 (attachment A) (discussing the economic costs of delay in the TV broadcaster incentive auction).

systems through a system of overlay auctions yield greater economic benefit than do dynamic sharing proposals like the one contemplated by PCAST.

[35] Direct comparison of unlicensed dynamic sharing with overlays is difficult because, as mentioned, dynamic sharing technologies do not have widespread deployment. This is a red flag given the substantial costs for every year that implementation is delayed. NTIA has proposed the use of dynamic sharing strategies since at least 1991.[98] But to date these technologies have permitted very little sharing between commercial and government users.[99] The PCAST authors are aware of some of these difficulties and therefore predict that its proposed overhaul of policy would take "perhaps two to three decades."[100]

[36] That prediction is a best-case scenario. It would likely take much longer to implement a widespread complex sharing regime. Even if it becomes technically feasible to share spectrum across a wide band of frequencies in real time, the regulatory process either halts or substantially delays inter-organization sharing.[101] The unlicensed sharing approach shifts the tasks of devising certifications and regulating spectrum-sharing etiquette from market actors to regulators.[102] Nearly all wireless operators, including government agencies and commercial licensees, vigorously resist sharing spectrum with other users and technologies. There have been

[98] *See* NTIA, U.S. SPECTRUM MANAGEMENT POLICY: AGENDA FOR THE FUTURE 6 (1991), http://www.ntia.doc.gov/report/1998/us-spectrum-management-policy-agenda-future#ch3, *archived at* https://perma.cc/J4T9-SEMS.

[99] *See* Gerald R. Faulhaber, *Commentary on "The Spectrum Opportunity: Sharing as the Solution to the Wireless Crunch,"* 8 INT'L J. COMM. 116, 119 (2014).

[100] PCAST, *supra* note 21, at v, ix.

[101] *See* Thomas W. Hazlett & Brent Skorup, *Tragedy of the Regulatory Commons: LightSquared and the Missing Spectrum Rights*, 13 DUKE L. & TECH. REV. 1, 21 (2014).

[102] *See* Jerry Brito, *The Spectrum Commons in Theory and Practice*, 2007 STAN. TECH. L. REV. 1, P36–37, P54 (2007).

costly episodes of agencies and licensees fiercely objecting to even minute possibilities of interference to their own wireless operations.[103]

[37] The multitude of federal systems with vastly different performance characteristics—radar, satellite communications, air-to-ground communications, video surveillance, unmanned aircraft systems, to name a few—means that the complex challenges for consumer device makers are multiplied. No amount of engineering ingenuity can tell regulators what the "correct" probability of harmful radio interference is. In sharing disputes, the incumbents invariably commission technical analyses that highlight remote, worst-case interference scenarios. The entrants respond with their own studies showing "typical" scenarios in which their systems pose little interference threat to existing users. Regulators are caught in the middle of a tug-of-war of competing technical papers and have no propensity to make a decision that optimizes wireless output between the systems. Even after a decision is made to allow shared use, a federal system technology upgrade or a change in federal supplier could simply restart the process anew (at best) or stymie necessary and life-saving agency upgrades (at worst).

[38] Incumbents present delays and resistance toward any scheme. However, overlays and clearing have an established history of delivering spectrum to private markets, where millions of subscribers can use it productively in a few years' time. It is too early to say, as the PCAST report intimates, that clearing federal users is impractical.[104] As the PCS

[103] *See, e.g.*, Hazlett & Skorup, *supra* note 99, at 3–4 (discussing the LightSquared-GPS dispute); *Examination of the Government's Spectrum Management Process: Hearing Before the Subcomm. on Telecomm. and the Internet of H. Comm. on Energy and Commerce*, 107th Cong. 42–43 (2002), http://www.gpo.gov/fdsys/pkg/CHRG-107hhrg80674/pdf/CHRG-107hhrg80674.pdf, *archived at* https://perma.cc/UUC4-K5A6 (Ultrawideband (UWB) users struggled for more than a decade to coordinate with federal users, NTIA, and the FCC to share spectrum: "It took 13 years, including three and one half years of intensive efforts, to gain regulatory approval for UWB."); Brito, *supra* note 100, at P64 (describing how satellite incumbents objected to the FCC's exclusion zone sizes when permitting unlicensed devices).

[104] PCAST Report, *supra* note 21, at 1.

and AWS-1 examples show, much of the spectrum cleared by overlay auctions and clearing deadlines is typically redeployed commercially in under five years.[105]

[39] By giving agencies greater rights to their spectrum and a mechanism—overlay auctions—that allows the agencies to transfer those rights and to retain revenues, federal spectrum could be repurposed for consumer uses. Overlay auctions have been completed before and represent an off-the-shelf technique that FCC staff members have experience implementing.[106] Overlays present great flexibility in auction design because licenses can be nationwide, regional, or can cover narrow geographic locations. Importantly, overlays rationalize band usage by creating residual claimants who internalize the gain from spectrum investments.[107] When an overlay licensee moves an agency to another band or medium, its spectrum is more valuable. It is this increase in value that gives the parties room to negotiate.

[105] The PCS auctions took place from 1995 to 1997. *See* Cramton et al., *supra* note 56, at 660–61. Sprint was the largest bidders and by the end of 1996 had already deployed PCS operations in several major markets, including Washington, D.C. and San Diego, with planned deployments in several more markets by mid-1997. Press Release, Qualcomm, Sprint PCS Launches Advanced Wireless Service in San Diego (Dec. 27, 1996), https://www.qualcomm.com/news/releases/1996/12/27/sprint-pcs-launches-advanced-wireless-service-san-diego, *archived at* https://perma.cc/3G2M-XG7Y. T-Mobile was the largest bidder in the 2006 AWS-1 auction and by the end of 2008 had deployed 3G networks that covered over 100 million Americans by using AWS-1 bands. *See* GLOBAL VIEW PARTNERS, *supra* note 92.

[106] Overlay auctions include the PCS and AWS-1 auctions described *supra*, as well as smaller auctions like the BRS auction. *See* Cramton et al., *supra* note 56, at 660–61; Rosston, *supra* note 5, at 235–36.

[107] *See* Hazlett, *supra* note 22, at 18 ("Overlay licenses empower private [decision] agents, who internalize substantial gains [from spectrum reassignment] . . .These actors not only have superior information and incentives to those of government administrators . . .but they bring a different tool kit to the task at hand. In particular, private firms can write contracts and access capital markets.").

[40] After 25 years of forecasts that dynamic sharing is right around the corner, dynamic sharing is still largely in the research and development stage.[108] Dynamic sharing depends on complex cognitive radios or central database look-up functions that may never be deployed en masse. Despite access to some 240 MHz of prime spectrum, only 600 or so unlicensed devices in the market use TV white spaces, utilizing a crude sharing technology.[109] I am not aware of any reliable estimates, but the total investment in the white space ecosystem seven years after its 2008 allocation likely totals only a few million dollars and attracts only a few thousand users.

[41] In contrast, clearing incumbents with overlays in similar swaths of spectrum leads to investment and consumer welfare gains orders of magnitude larger, sometimes within months of auction. Hazlett et al. estimated in 2004 that the repurposing of 120 MHz of spectrum for PCS induced over $45 billion of network investment in the five-year period following the auction, from 1994 to 1998.[110] The 220 MHz of spectrum freed by the combined broadband PCS and AWS-1 auctions supplies about one-third of spectrum holdings of mobile carriers,[111] an essential

[108] *See* GAO, *supra* note 77**,** at 24; Paul Barbagallo, *For TV "White Spaces," the Global Outlook is Hopeful but Cautious*, BLOOMBERG BNA (July 16, 2014), http://www.bna.com/tv-white-spaces-n17179892333/, *archived at* https://perma.cc/CXM4-VFRX (noting that "spectrum sensing, is still nascent").

[109] *See* McDowell, *supra* note 47.

[110] THOMAS W. HAZLETT ET AL., REPORT TO U.S. CHAMBER OF COMMERCE, SENDING THE RIGHT SIGNALS: PROMOTING COMPETITION THROUGH TELECOMMUNICATIONS REFORM 1, 103 (Sept. 2004), http://www.rutledgecapital.com/pdf_files/20041006_telecom_dereg_complete_study.pdf, *archived at* https://perma.cc/4M2N-FJ97.

[111] FCC, *supra* note 69, at 50 (estimating that there is about 580 MHz of spectrum used for mobile broadband).

input for an industry that in 2014 had revenues of nearly $188 billion and capital investment of $32 billion.[112]

[42] Dynamic sharing technology simply will not enable similar economic benefits in the next several years. Given the tremendous opportunity costs of inaction in the interim, waiting for dynamic technology to be widespread is a speculative and costly option relative to clearing alternatives.[113]

## V. FINAL NOTES

### A. Response to the Counter that Federal Agencies May Not Respond to Financial Incentives

[43] Some scholars argue that giving agencies self-funding ability through transferable spectrum rights would be ineffective.[114] They counter

[112] CTIA, *Annual Wireless Industry Survey*, CTIA.ORG (2015), http://www.ctia.org/your-wireless-life/how-wireless-works/annual-wireless-industry-survey, *archived at* https://perma.cc/L48C-ZL9X.

[113] Regulators in the recent past ignored the huge consumer welfare losses that delay inflicts. *See* Jerry A. Hausman, *Valuing the Effect of Regulation on New Services in Telecommunications*, 28 BROOKINGS PAPERS ON ECON. ACTIVITY: MICROECONOMICS 1, 24 (1997), http://www.brookings.edu/~/media/Projects/BPEA/1997-micro/1997_bpeamicro_hausman.PDF, *archived at* https://perma.cc/2TE2-MQUF ("It appears that delay in cellular service was the commission's way to avoid confronting a very difficult decision. Potential losses in consumer welfare did not appear to figure into the FCC's regulatory approach.").

[114] *See, e.g.*, THOMAS LENARD & LAWRENCE WHITE, DIGITAL AGE COMMUNICATIONS ACT: REPORT FROM THE NEW SPECTRUM POLICY WORKING GROUP, TECH. POL'Y INST. 1, 20 (Mar. 2006), http://www.pff.org/issues-pubs/books/060309dacaspectrum1.0.pdf, *archived at* https://perma.cc/S7H9-TYNP; DOROTHY ROBYN, MAKING WAVES: ALTERNATIVE PATHS TO FLEXIBLE USE SPECTRUM, ASPEN INST. 1, 36 (2015), http://csreports.aspeninstitute.org/documents/Spectrum_Making_Waves.pdf, *archived at* https://perma.cc/TL4Y-5WVR ("[The argument against transferable federal spectrum rights] that has gotten the most traction in the spectrum community—is that the ability to retain the proceeds will not motivate federal agencies to transfer their spectrum because

that any gain in revenue from spectrum sales would be viewed by Congress as a windfall and would be offset in subsequent rounds of appropriations, thereby diminishing the incentive of agencies to sell their spectrum.[115]

[44] The logic is sensible, but existing evidence appears to undermine that theory. Admittedly, the literature on agency self-funding is limited,[116] and literature on the incentive effects from agency self-funding through asset sales is even scarcer. Therefore, predictions about how Congress and agencies will respond to the vestment of additional spectrum rights are largely conjectural. However, existing programs indicate that agencies (1) do not generally believe they will be penalized in the appropriations process for perceived windfalls from asset sales and (2) can be incentivized to relinquish property if they can pocket some of the gains.

[45] The examples where agencies self-fund indicate that agencies favor such arrangements, provided that they have significant control over distributing the revenue.[117] For instance, GAO analysis of financial regulatory agencies that self-fund through examination fees and the like indicates that self-funded agencies generally *prefer* self-funding to funding through the appropriations process.[118]

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of the nature of the budget process . . . . In anticipation of this zero-sum dynamic, agencies would forego the opportunity to trade spectrum for money.").

[115] *See* Robyn, *supra* note 114, at 42.

[116] *See* Charles Kruly, *Self-Funding and Agency Independence*, 81 GEO. WASH. L. REV. 1733, 1737 (2013).

[117] U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-02-864, SEC OPERATIONS: IMPLICATIONS OF ALTERNATIVE FUNDING STRUCTURES 11–12 (2002), http://www.gao.gov/new.items/d02864.pdf, *archived at* https://perma.cc/7246-JD69.

[118] *See id.* at 12–13 (stating that, if self-funding agencies in fact do receive more punitive scrutiny from Congress, the drawbacks are likely diminished in the case of spectrum sales, where agencies are merely supplementing their budgets. Presumably, Congress is more likely to scrutinize totally self-funded agencies than partially self-funded agencies).

[46] More to the point, in responding to the notion that Congress will penalize agencies for monetary windfalls provided by asset sales, Dorothy Robyn—who was in an excellent position to view such dynamics while at the General Services Administration and the Department of Defense—concluded in her influential spectrum policy paper, "[t]hat has emphatically not been my experience."[119] Robyn points out that it was the agencies themselves that lobbied Congress for agency retention of revenue from land sales during a round of painful military base closures.[120] These sales can occasionally be quite large. The Navy, for instance, sold two Marine Corps bases for $850 million[121]—likely substantial enough to receive congressional notice—but there is no evidence the Navy saw decreased appropriations as a result.

[47] Further, Congress authorizes the secretaries of the military departments to lease underused real property and personal property that the department controls in exchange for cash and in-kind consideration.[122] The military has used that authority to enter into complex leases, called *enhanced use leases*, which might grant, for example, a 50-year lease of military land to a private developer.[123] A 2011 GAO report noted that there were 17 enhanced use leases in place, with in-kind consideration valued at hundreds of millions of dollars, and dozens more were either

[119] Robyn, *supra* note 12, at 14.

[120] *See id.*

[121] *See* Robyn, *supra* note 114, at 37.

[122] *See* 10 U.S.C. § 2667(a) (2012); T. Randolph Beard et al., *Market Mechanisms and the Efficient Use and Management of Scarce Spectrum Resources*, 66 FED. COMM. L.J. 263, 291 (2013) (stating that leasing spectrum has been proposed, but the government's inefficient management of spectrum leads scholars to conclude that it is preferable for agencies to sell spectrum rather than to lease it).

[123] *See* GAO, *supra* note 55, at 2, 8 (stating that these leases often include revenue sharing between the private developer and the agency).

under review or in negotiation.[124] On the basis of agency use of these programs, Robyn concluded "the ability to retain the proceeds from the disposal of property is a key motivator for federal agencies."[125]

[48] There are risks, such as improper incentives and decreased accountability to Congress and to the president, when agencies self-fund.[126] Self-funding programs should be monitored and perhaps have mandatory sunsets, but there is some real-world evidence that allowing agencies to retain some proceeds of asset sales motivates the types of behaviors intended—namely, disposition of underused public assets into private markets, where the assets can be used more productively.

### B. Need for Mandatory Clearing Deadlines for Federal Users after an Overlay Auction

[49] One lesson from the PCS overlay auction, identified by Cramton, Kwerel, and Williams, was that relocating state government systems was significantly slowed when the agencies were permitted to stay indefinitely.[127] Such delays led the scholars to conclude that, in fact, government agencies may need weaker rights to stay than do nongovernment incumbents "because they [government users] may be too likely to stay when they should terminate or relocate."[128]

[50] Absent a deadline, economically efficient improvements tend to be underproduced or substantially delayed because incumbents have an

[124] *See id.* at 2.

[125] Robyn, *supra* note 12, at 14.

[126] *See* Kruly, *supra* note 116, at 1737.

[127] *See* Cramton et al., *supra* note 56, at 664–65.

[128] *Id.* at 665.

incentive to reject the bidder's offers indefinitely.[129] Incumbents know that their consent is required and that they can extract a portion of the producer surplus in excess of their opportunity costs—the so-called holdout problem.[130] This problem is likely exacerbated when public agencies are involved. Further, for an appreciating asset like spectrum, hoarding may be a lucrative strategy.[131]

[51] The benefit of a deadline to move wireless systems is that negotiations focus on the relocation costs (with a premium paid for speedy relocation) and not on the value to the entrant of clearing the spectrum.[132] Incumbent users thus have an incentive to settle early.[133] In the broadband PCS and AWS-1 auctions involving federal and nonfederal incumbents, deadlines helped make relocations largely successful in encouraging positive-sum settlements.[134]

### C. Role of Political Entrepreneurship in Spectrum Reallocation

[52] Overlay licenses of encumbered federal spectrum would represent uncertain investments with substantial risk discounting, so economic modeling is challenging. Information about many defense and law enforcement systems is difficult to acquire and stymies bargaining between commercial bidders and agencies. Hence, knowledgeable former

[129] *See generally* Lloyd Cohen, *Holdouts and Free Riders*, 20 J. LEGAL STUD. 351 (1991), https://web2.uconn.edu/ciom/Cohen.pdf, *archived at* https://perma.cc/NX7N-NUJX.

[130] *See* Glen Whitman, *Law & Economics Lecture 2: Externalities*, CAL. ST. UNIV. NORTHRIDGE, http://www.csun.edu/~dgw61315/L&Elect2.pdf, *archived at* https://perma.cc/NPN7-WSNR (last visited Jan. 27, 2016).

[131] *See* Robyn, *supra* note 114, at 35.

[132] *See* Cramton et al., *supra* note 56, at 649–50.

[133] *See id.* at 658.

[134] *See id.* at 649.

federal officials will likely need to use their expertise to make deals possible between agencies and commercial bidders.

[53] Such political entrepreneurship has a storied history in spectrum allocation. In the 1980s and 1990s a former wireless regulator at the FCC, acquired wireless licenses held by taxi and pizza delivery dispatchers.[135] The FCC agreed to waive rules regarding the licenses, and the purchaser aggregated the new, flexible licenses that enabled cellular phone technology.[136] His actions increased the economic value of those fragmented licenses and led to the creation of Nextel, which was one of the nation's largest mobile phone companies when it was acquired by Sprint.[137]

[54] Since 2000, following the financial failures of several satellite communications operators, the FCC has waived rules requiring satellite communications in certain bands so that the same spectrum can be used instead for ground-based cellular mobile broadband. In the mid-2000s, though they were less successful at navigating the regulatory issues than was O'Brien, financier Phil Falcone and his business partners acquired spectrum licensed to satellite communications firms SkyTerra and Inmarsat. They devoted billions of dollars to developing a new wireless network.[138] The company, LightSquared, petitioned the government for waivers, and the FCC agreed to loosen its rules to permit traditional mobile phone service in that spectrum.[139] Likewise, in 2011 Dish Network

[135] *See* Thomas W. Hazlett, *Inching Toward Wireless Capitalism*, WALL STREET J. EUROPE (Jan. 12, 2004), http://mason.gmu.edu/~thazlett/opeds/Inching%20Toward%20Wireless%20Capitalism.pdf, *archived at* https://perma.cc/MZ5V-Q3TK.

[136] *See id.*

[137] *See id.*

[138] *See* Daniel Fisher, *Lightscrewed*, FORBES (Jan. 3, 2012), http://www.forbes.com/forbes/2012/0116/feature-phil-falcone-gps-senator-grassley-communication-commission.html, *archived at* https://perma.cc/8HD8-LEWD.

[139] *See id.*

acquired 40 MHz of satellite spectrum through a fire sale purchase of two bankrupt satellite communications companies.[140] The FCC again waived most of its satellite rules and permitted traditional mobile broadband services.

[55] Finally, most relevantly, in the AWS-1 auction, T-Mobile hired defense experts, including a former general and former director of the Defense Information Systems agency, to assist in negotiating with federal agency heads. [141] Successful political entrepreneurship requires institutional knowledge of federal systems and of the idiosyncratic personalities and hierarchies that may otherwise confound successful transactions.[142] Political entrepreneurship is difficult to identify and to model formally, but it will likely play an important role if agencies are vested with spectrum rights that they can transfer for payment.

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[140] *See* FCC, REPORT AND ORDER AND ORDER OF PROPOSED MODIFICATION IN THE MATTER OF SERVICE RULES FOR ADVANCED WIRELESS SERVICES IN THE 2000–2020 MHZ AND 2180–2200 MHZ BANDS, WT DOCKET. NO. 12-70, 2, 8 (Dec. 11, 2012), http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db1218/FCC-12-151A1.pdf, *archived at* https://perma.cc/4V8C-2QBR.

[141] *T-Mobile Lobbies on Wireless Airwaves* (Dec. 12, 2007), YAHOO!, http://web.archive.org/web/20071217213319/http://biz.yahoo.com/ap/071212/t_mobile_lobbying.html?.v=1, *archived at* https://perma.cc/8T9A-USHY. T-Mobile's lobbyists included those at the Cohen Group, headed by former Clinton defense secretary William Cohen. *Id.*

[142] Political entrepreneurship admittedly resembles and likely overlaps with the notorious revolving door phenomenon in politics. It is beyond the purposes of this paper to distinguish between damaging rent-seeking and socially beneficial deal-making. Suffice it to say that in some circumstances former insiders, possessing a depth of knowledge that disinterested outsiders cannot reasonably attain, can effect Pareto improvements in regulated industries. The analysis presented *supra* suggests that Pareto improvements here are fairly easy to identify—it is likely that most transfers of spectrum from agencies to the private sector result in substantial social welfare gains. *See also* BAZELON & MCHENRY, *supra* note 8, at 9 (citing economics research that suggests the consumer benefits generated by spectrum deployed for wireless broadband are 10 to 20 times the value of the spectrum to producers).

## VI. CONCLUSION

[56] Overlay auctions are one of several tools policymakers should consider for repurposing federal spectrum. There are several plans for approaching the problem of inefficient government use, but all, to various degrees, are time consuming and costly. If overlays and clearing deadlines are time consuming because relocations typically take two to six years, what does that imply for PCAST-style unlicensed dynamic sharing that take decades to fully implement? No other reform proposal has enabled widespread consumer use and economic investment as rapidly as have overlay auctions combined with clearing deadlines. Federal agencies lack some of the incentives that private firms have to use resources efficiently. Nevertheless, when spectrum users have the ability to sell their rights and overlay auctions are used, experience suggests that spectrum can be repurposed from legacy government systems to high-value commercial uses within a few years.