Great Expectations: Using the Language of Innovation to Command Efficiency and Shift the Burden of Spectrum Scarcity

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I. INTRODUCTION

Wireless innovation depends on avoiding near-term spectrum scarcity, but a framework for accommodating new users in fields as diverse as driverless cars and wireless microphones must somehow reconcile the interference concerns of incumbent operators with an increasingly crowded spectrum environment. Because spectrum is scarce and highly valuable, the Federal Communications Commission (FCC) must strike the right balance between incentivizing the development of new technologies and protecting the rights of existing users.[1] Fortunately, the FCC has already adopted such a framework, albeit in piecemeal fashion. Recent actions taken by the FCC to migrate old technologies into repackaged broadcast spectrum indicate a willingness to push for spectral efficiency and innovation even as the problem of harmful signal interference grows larger.[2]

The FCC's Broadcast Incentive Auction (Incentive Auction), which involves repackaging digital television channels to free up new wireless broadband spectrum, illustrates this tradeoff.[3] The FCC, acting on a congressional mandate in the Middle Class Tax Relief and Job Creation Act of 2012, has encouraged television broadcasters to relinquish spectrum they no longer need (given advances in technology and market development) in exchange for compensation.[4] Whatever spectrum the FCC reaps will be repackaged and sold to wireless broadband operators on a licensed basis.[5]

Some of the repackaged spectrum includes Television White Spaces (TVWS), vacant frequencies that originally served to prevent interference between analog television stations,[6] but now host various white space

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1. *See* Promoting Spectrum Access for Wireless Microphone Operations, *Notice of Proposed Rulemaking*, 29 FCC Rcd 12343, (2014) [hereinafter *Promoting Spectrum Access NPRM*] (statement of Chairman Wheeler) ("[W]e are exploring how best to address the needs of wireless microphone users over the long term, while encouraging development of technologies that will better facilitate sharing with other wireless uses in an increasingly crowded spectral environment.").

2. *See* Tammy Parker, *Industry Wrestles with the Growing Problem of Spectrum Pollution*, FIERCE WIRELESS (Nov. 18, 2013, 3:04 AM), http://www.fiercewireless.com/tech/story/industry-wrestles-growing-problem-spectrum-pollution/2013-11-18.

3. *See Promoting Spectrum Access NPRM*, *supra* note 1, at para. 2; *see also* Comment Sought on Competitive Bidding Procedures for Broad. Incentive Auction 1000, Including Auctions 1001 & 1002, *Public Notice*, 29 FCC Rcd 15750 (2014) (statement of Comm'r Rosenworcel) ("One novel issue strikes me as deserving special attention—what to do when new wireless licenses are impaired by interference. This is important because with these new wireless licenses the potential for co-channel interference and adjacent channel interference is real.").

4. *See* Mitchell Lazarus, *Wireless Microphone Users Face Worsening Spectrum Shortage*, COMMLAWBLOG (June 5, 2014), http://www.commlawblog.com/2014/06/articles/unlicensed-operations-and-emer/wireless-microphone-users-face-worsening-spectrum-shortage/.

5. *See id.*

6. *See id.*

devices (WSD) such as wireless microphones.[7] Because the FCC's Incentive Auction will dissolve the TVWS frequencies, WSD manufacturers are scrambling to find new spectrum for their products in an increasingly spectrum-scarce environment.[8] However, the FCC has sought to make accommodations for incumbent users of WSDs, wireless microphone operators in particular. The FCC believes that developing technology will allow these displaced users to operate in the guard bands of the repackaged television spectrum and in the duplex gap of the post-auction 600 MHz band.[9]

The FCC's proposals to accommodate the needs of unlicensed TVWS users is emblematic of a bolder willingness to rely on the agency's innovation mandate[10] to command greater efficiency and shift the burden of spectrum scarcity onto incumbent users.[11] By suggesting that both licensed and unlicensed wireless users can coexist in narrower bands of spectrum—guard bands and duplex gaps—while simultaneously requiring more stringent power requirements on the devices themselves,[12] the FCC has signaled an intention to promote innovation not only among displaced stakeholders, but also among licensees, such as TV broadcasters and wireless broadband users, who will operate adjacent to the new guard bands. Unless they can adapt, licensees and incumbent users of repackaged broadcast spectrum may be forced to operate with less protection from interference as guard bands shrink to accommodate both old and new uses.

Whereas the FCC's previous attempts to accelerate technological transitions relied to varying degrees on evidence that existing technology could mitigate interference concerns,[13] the decision to open the guard bands

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7. Sascha D. Meinrath & Michael Calabrese, *"White Space Devices" & the Myths of Harmful Interference*, 11 N.Y.U. J. LEGIS. & PUB. POL'Y 495, 497 (2008).

8. *See id.*

9. *See Promoting Spectrum Access NPRM*, *supra* note 1, at paras. 2, 52.

10. *See, e.g.*, 47 U.S.C. §§ 157(a), 303(g), 309(j)(3)(A), 316(a)(1) (2012).

11. *See* Michael O'Reilly & Jessica Rosenworcel, *Driving Wi-Fi Ahead: The Upper 5 GHz Band*, FCC BLOG (Feb. 23, 2015, 5:02 PM), http://www.fcc.gov/blog/driving-wi-fi-ahead-upper-5-ghz-band (proposing that more efficient utilization of the upper 5 GHz band should be studied to reach a compromise between preserving incumbent roadside safety systems and introducing new, unlicensed wireless systems, such as driverless car features).

12. *See Promoting Spectrum Access NPRM*, *supra* note 1, at para. 30.

13. *See* Telocator Network of Am. v. FCC, 691 F.2d 525, 539 (D.C. Cir. 1982) ("The [FCC] also relied upon its conviction that there was currently available technology capable of sustaining shared usage without an unacceptable level of interference."); *see also* Teledesic LLC v. FCC, 275 F.3d 75, 85-88 (D.C. Cir. 2001) (acknowledging that subsidized relocation of incumbent terrestrial services in the 18 GHz band did not implicate questions of technological constraints but rather the cost of adopting then existing state-of-the-art technology); Implementation of Sections 309(j) & 337 of the Comm. Act of 1934 as Amended, *Second Report and Order and Second Further Notice of Proposed Rulemaking*, 18 FCC Rcd 3034, para. 7 (2003) [hereinafter *Implementation of Sections 309(j) & 337 Second Order*] (observing that narrowband technology was available but users did not adopt it); Amendment of the Comm'n's Rules to Modify Antenna Requirements for the 10.7-11.7 GHz Band, 72 Fed. Reg. 55,673, 55,674 (Oct. 1, 2007) (to be codified at 47 C.F.R. pt. 101) [hereinafter *Amendment of Rule to Modify Antenna Requirements Final Rule*] (noting that technology *has evolved* to permit deployment of new, more efficient antenna designs).

of repackaged broadcast spectrum for unlicensed operations relies on the FCC's explicit assumption that technology will evolve to mitigate the likelihood of harmful interference.[14] The FCC's confidence in its own predictive judgment, particularly as contained in its final rule for wireless microphone operators (Final Rule), represents a novel approach to reconciling spectrum scarcity with the desire to accommodate new technologies[15]—an approach that might be summed up as "adapt or die."

This Note argues that the steps the FCC has taken to accommodate displaced TVWS users in its June 2, 2014, Incentive Auction Rule and Order (and subsequent proposed rulemakings) are representative of a policy shift that embraces the language of innovation and efficiency to justify hard choices about how to allocate the burden of spectrum scarcity.[16] This shift is strategically well-considered given the judicial deference afforded to questions of a technical nature.[17] Furthermore, this shift has the potential to become the prevailing basis for settling interference disputes in a crowded spectrum environment.

Section II of this Note begins with a description of the FCC's basis for regulating spectrum, its goal of promoting efficiency, and the approaches it has taken, particularly with respect to balancing the interference concerns of incumbents versus new entrants. Section II observes that the language of innovation and efficiency has guided the FCC's most recent proposal concerning microphone users by shifting some of the burden of technological transition onto incumbent licensees, which marks a change from the deference traditionally afforded to licensed users. Section II concludes with a discussion of the judicial deference traditionally afforded to the FCC whenever it offers predictions or judgments about the technical feasibility of spectrum-related proposals.

Section III argues that the FCC should it embrace its mandate to promote innovation and efficiency, even in the face of technological uncertainty. Section III concludes with the argument that the FCC should continue to employ the language of innovation when determining how best to manage the burden of spectrum scarcity, because underlying assumptions

14. *See* Unlicensed Use of TV Band and 600 MHz Band Spectrum, 79 Fed. Reg. 69,710, 69,719-20 (proposed Nov. 21, 2014) (to be codified at 47 C.F.R. pts. 15, 74) [hereinafter *Unlicensed Use of TV Band and 600 MHz Band Spectrum Proposed Rule*] ("Given that there is some time prior to networks being deployed, we expect manufacturers to improve filter technology and designs to ensure a minimum potential for harmful interference.").

15. Promoting Spectrum Access for Wireless Microphone Operations, 80 Fed. Reg. 71,702, 71,703 (Nov. 17, 2015) (to be codified at 47 C.F.R. pts. 2, 15, 73, 87, 90) (emphasis added) [hereinafter *Promoting Spectrum Access for Wireless Microphone Operations Final Rule*] ("The [FCC's] goal is to *enable the development* of a suite of devices that operate in different bands and can meet wireless microphone users' various needs while efficiently sharing the spectrum with other users.").

16. *See id.* at para. 60.

17. *See generally* Expanding the Econ. & Innovation Opportunities of Spectrum Through Incentive Auctions, *Report and Order*, 29 FCC Rcd 6567, para. 24 (2014).

about the future development of spectrally efficient technologies will tend to be reviewed by courts with heightened deference.

II. BACKGROUND

A. Purpose and Basis of Spectrum Regulation

The FCC's application of its statutory authority to referee interference disputes between incumbents and new entrants exposes the broader priorities underlying spectrum allocation. Foremost among these priorities is respecting the investment-backed expectations of incumbent licensees, one of the FCC's traditional goals.[18] However, a new policy goal can be seen emerging—one that places a greater premium on the innovative potential of new technologies to alleviate spectrum scarcity.[19] The FCC has acted on this policy goal in the past, although tentatively, and with varying degrees of deference to affected incumbents. The transition from analog to digital television, the creation of MedRadio and Medical Body Area Network (MBAN) wireless services, and the various narrowbanding initiatives of the previous decade have all tested the FCC's willingness to push for greater efficiency on the part of incumbents and entrants alike.

The regulatory framework that has emerged out of the Incentive Auction represents a significant development in the FCC's ongoing policy shift, one that downplays the need for technical certainty as a predicate for implementing tougher standards and mandating greater efficiency. Although this shift emerges out of proposals to permit unlicensed wireless microphone operations in the guard bands of postauction spectrum, the underlying goals of efficiency and innovation extend beyond licensing classifications.[20] By requesting input on newer, more efficient, access models for spectrum allocation,[21] and by challenging all wireless users to adapt to an evolving technological landscape,[22] the FCC appears to value innovation, particularly in the form of more spectrally efficient technology, as a guiding principle of spectrum policy. In turn, this principle may provide a convenient, public interest justification for commanding change to alleviate scarcity.

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18. *See* Ellen P. Goodman, *Spectrum Rights in the Telecosm to Come*, 41 SAN DIEGO L. REV. 269, 310 (2004).

19. *See* Fostering Innovation & Inv. in the Wireless Comm. Mkt, *Notice of Inquiry*, 24 FCC Rcd 11322, paras. 26-27 (2009) [hereinafter *National Broadband Plan*] (noting that the FCC has on occasion "reallocated spectrum from one service to another and required incumbent licensees to relocate any continuing operations as necessary to a reduced or modified frequency band.").

20. *See Promoting Spectrum Access for Wireless Microphone Operations Final Rule*, *supra* note 15, at 71,704.

21. *See National Broadband Plan*, *supra* note 19, at para. 31 (2009).

22. *See Unlicensed Use of TV Band and 600 MHz Band Spectrum Proposed Rule*, *supra* note 14, at para. 63 ("[T]he [FCC] notes that there is a lack of real world testing.").

1. Why the FCC Regulates Spectrum Use

The FCC generally adheres to a framework of increasing capacity, promoting competition, and advancing the public's interest whenever it regulates the use of spectrum.[23] However, such an expansive framework often yields to more specific considerations, such as the need to promote innovation or efficiency.[24] Arguably the most significant decision to be made when crafting an appropriate spectrum regulation involves deciding how to avoid interference between users while respecting existing rights and expectations of incumbent operators.

Radio spectrum encompasses the range of frequencies over which telecommunications may travel.[25] Frequencies are grouped into different bands which have different propagation characteristics.[26] One constant, however, is the existence of interference, which is what makes spectrum scarce.[27] FCC Rule 2.1(c) defines "interference" as "[t]he effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radio communication system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy."[28] Interference results when energy sources radiate on the frequencies used to carry transmissions, such that a receiving device cannot parse its intended signal from additional background radiation.[29] There are different methods for avoiding interference which could involve frequency separation, altering the power level of a device, or improving the ability of a device to mitigate interference through either contention-based protocols (e.g., "listen before talk") or frequency-agile technology, such as smart radios that can shift their operating frequency in response to external conditions.[30]

These techniques are important insofar as interference prevents full exploitation of every available band of spectrum. Furthermore, interference mitigation is a constantly evolving field, and major stakeholders have acknowledged that current allocations of spectrum could be better utilized.[31]

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23. *See* Expanding the Econ. & Innovation Opportunities of Spectrum Through Incentive Auctions, *Notice of Proposed Rulemaking*, 27 FCC Rcd 12357, paras. 1, 4 (2012) [hereinafter *Innovation Opportunities*].

24. *See id.* at paras. 2, 23, 232.

25. *See* Kathryn A. Watson, *White Open Spaces: Unlicensed Access to Unused Television Spectrum Will Provide an Unprecedented Level of Interconnectivity*, 2010 U. ILL. J.L. TECH. & POL'Y 181, 181, 184.

26. *Id*.

27. *See* Arthur S. De Vany, et. al, *A Property System for Market Allocation of the Electromagnetic Spectrum: A Legal-Economic-Engineering Study*, 21 STAN. L. REV. 1499, 1504 (1969).

28. 47 C.F.R. § 2.1 (2015).

29. *See id.*

30. *See* Goodman, *supra* note 18, at 367, 373.

31. *See, e.g.*, Comments of Verizon and Verizon Wireless at 69-70, A National Broadband Plan for Our Future, WT 09-51 (June 8, 2009), https://ecfsapi.fcc.gov/file/6520220110.pdf (supporting a spectrum inventory carried out by the FCC to discover inefficiently used spectrum bands).

To address this scarcity problem, the FCC has tried to maximize the amount of spectrum available by promoting economic and technological efficiency.[32] The FCC's approach follows from its statutory authority to promote "efficient and intensive use of the electromagnetic spectrum,"[33] along with its duty to "study new uses for radio, provide for experimental uses of frequencies, and generally encourage the larger and more effective use of radio in the public interest."[34]

The FCC's implementation of frequency separation through the use of guard bands and duplex gaps is just one example of how it might achieve spectrum efficiency.[35] Guard bands serve as a buffer to prevent interference between adjacent services and duplex gaps separate the uplink and downlink frequencies a device uses to send and receive data.[36] However, with the right technology, guard bands and duplex gaps can do more than just separate. In the FCC's view, WSDs such as wireless microphones can operate within these bands and coexist with adjacent wireless services.[37]

2. Statutory Basis for Regulating Spectrum and Interference Standards

Section 157 of the Communications Act of 1934 as amended (the Act) grants the FCC power to "encourage the provision of new technologies and services to the public" in all areas of wire and radio communication.[38] Furthermore, anyone who opposes the proposed introduction of a new technology or service bears the burden of demonstrating that such a proposal would be inconsistent with the public interest.[39] The problem the FCC faces when administering Section 157 involves striking a balance between the public's interest in new wireless technologies (which requires that spectrum be available in the first place) and the rights of incumbents, particularly licensees.

The FCC enjoys some degree of flexibility whenever it must strike a compromise between innovators and incumbents who want to operate on shared bands of frequency. A spectrum license does not confer a traditional

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32. *See* Douglas W. Webbink, *Frequency Spectrum Deregulation Alternatives* 12 (FCC Office of Plans & Policy, Working Paper No. 2, 1980), http://transition.fcc.gov/Bureaus/OPP/working_papers/oppwp2.pdf (reading Section I of the Communications Act of 1934 to mean that the FCC should promote "economic efficiency" in the use of frequency spectrum).

33. 47 U.S.C. 309(j)(3)(D) (2012).

34. 47 U.S.C. 303(g) (2012).

35. *See Innovation Opportunities*, *supra* note 23, at para. 9.

36. *See id.* at paras. 9, 135.

37. *See Unlicensed Use of TV Band and 600 MHz Band Spectrum Proposed Rule*, *supra* note 14, at para. 199.

38. 47 U.S.C. § 157(a) (2012).

39. *See id.*; *see also* M2Z Networks, Inc. v. FCC, 558 F.3d 554, 562-63 (D.C. Cir. 2009) (finding that the FCC had no obligation to consider every technical piece of evidence challenging its denial of a spectrum license to a petitioner whose services were found to be slower than competitors' and, therefore, not new pursuant to §157(a)).

property right; the user must agree not to cause interference to other licensed users.[40] More importantly, the FCC's powers also permit it "to adjust [frequency] allocations and the terms and conditions governing individual licenses,"[41] and to create regulations "necessary to prevent interference."[42]

For example, adjustments to licenses may occur when the FCC perceives a need to reduce interference in order to promote the "public interest, convenience, and necessity."[43] Though subject to protest, these decisions can be based on the public's interest in new wireless technologies.[44] However, the FCC does not apply a mechanical framework when deciding these questions, partly because its key regulation defining "harmful interference" does not include bright line definitions.[45] The terms "degrades," "obstructs," and "repeatedly interferes" have yet to be clarified by either the FCC or the courts.[46]

Nevertheless, preventing interference between and among devices that transmit across radio frequencies may involve determining how much area a license covers, transmitter power levels, and what degree of frequency separation is needed to avoid harmful interference, however that may be defined.[47] To carry out this mandate,[48] the FCC's powers and duties are once again framed in terms of "encourag[ing] the larger and more effective use of radio in the public interest."[49] The FCC's interpretations of this mandate are considered informal rulemakings, which are generally given considerable deference under the Administrative Procedure Act.[50]

The FCC has previously relied on its authority under Section 157 in conjunction with its power to regulate the terms of licenses to promote "efficient and intensive use of the electromagnetic spectrum."[51] Furthermore, the FCC has interpreted Section 157 to mandate not only the provision of new technologies, but also their "timely" deployment.[52]

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40. *See* 47 U.S.C. § 301(d) (2012).

41. Serv. Rules for 746-764 & 776-794 MHz Bands & Revisions to Part 27 of the Comm'n's Rules, *Memorandum Opinion and Order and Further Notice of Proposed Rulemaking*, 15 FCC Rcd 20845, para. 46 (2000) [hereinafter *Service Rules Order*]; *see also* 47 U.S.C. § 316(a)(1) (2012).

42. 47 U.S.C. § 303(f) (2012).

43. 47 U.S.C. § 316(a)(1) (2012).

44. *See id.*

45. 47 C.F.R. § 2.1 (2015) (defining harmful interference with respect to licensed services as anything that "seriously degrades, obstructs, or repeatedly interrupts").

46. Watson, *supra* note 25, at 202-03.

47. *See* STUART MINOR BENJAMIN ET AL., TELECOMMUNICATIONS LAW AND POLICY 62-63 (2001).

48. *See* 47 U.S.C. § 302a (2012).

49. 47 U.S.C. § 303(g) (2012).

50. *See* Home Box Office, Inc. v. FCC, 567 F.2d 9, 35 (D.C. Cir. 1977); *see also* 5 U.S.C. § 706(a)(2) (2012) (articulating the standard of review for agency rulemaking).

51. *See Service Rules Order*, *supra* note 41, at para. 51; 47 U.S.C. § 309(j)(3)(D) (2012).

52. *See Service Rules Order*, *supra* note 41, at para. 51 n.96 (emphasis added) (finding that 47 U.S.C § 157 directs the FCC "to encourage the reasonable and *timely* deployment of advanced telecommunications capability to all Americans").

The Incentive Auction is one example of how spectrum management policy implicates the FCC's Section 157 mandate. Generally, the FCC's authority to promote innovation and efficiency gives it the ability to determine what is reasonable in terms of frequency separation.[53] In the context of the Incentive Auction, 47 U.S.C. § 1454 grants the FCC specific authority to determine the size of guard bands in repackaged broadcast spectrum, with the only limitation being that the FCC must create bands that are "no larger than is technically reasonable to prevent harmful interference."[54] The FCC also has the authority to permit unlicensed operations in the post-auction guard bands.[55] In its Final Rule for migrating wireless microphones to repackaged spectrum, the FCC explained that its regulations were calibrated to promote long-term technological advances and efficiency notwithstanding current technological difficulties.[56]

Innovation in the field of interference mitigation could resolve many of the uncertainties surrounding the proposed repackaging, to the extent that Congress has specifically called for additional research improve spectrum utilization.[57] Section 6408 of the Middle Class Tax Relief and Job Creation Act requires the Comptroller General to study ways in which spectrum use can be made more efficient.[58] The same section requires that the Comptroller General consider narrowing guard bands between adjacent users of repackaged spectrum.[59]

B. Approaches to Regulating Spectrum

The FCC's framework for addressing spectrum scarcity in the Incentive Auction and in its Final Rule embraces the notion that efficient technology can alleviate the uncertainties inherent in the auctioning and repackaging process.[60] Perhaps due to the novelty of the auction itself as the government's first attempt to purchase back unused spectrum, the FCC has approached the problem of interference differently than in the past. Instead of deferring generously to incumbent rights or insisting on the availability of workable technological solutions, the FCC has required both incumbents and entrants to keep pace with the evolving status quo.[61] However, the

53. *See* 47 U.S.C. § 303(f) (2012).

54. 47 U.S.C. § 1454(b) (2012).

55. *See* 47 U.S.C. § 1454(c).

56. *See Promoting Spectrum Access for Wireless Microphone Operations Final Rule*, *supra* note 15, 71,702, 71,711.

57. *See* Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, § 6408(a)-(b), 126 Stat. 156, 232.

58. *Id.*

59. *Id.*

60. *See Promoting Spectrum Access for Wireless Microphone Operations Final Rule*, *supra* note 15, at 71,703.

61. *See id.* at 71,704 (proposing secondary, licensed wireless microphone operation in the 1435-1525 GHz band, which is shared by the federal government and industry for aeronautical mobile telemetry (AMT), so long as incumbent AMT operators could agree on a method to referee spectrum interference).

creation of new guard bands and duplex gaps in the repackaged spectrum will necessitate more stringent technical standards, and the burden will fall on all users to find ways to meet them. Accordingly, the FCC faces a dilemma that goes beyond licensed versus unlicensed spectrum allocation: how can the FCC promote innovative solutions to spectrum scarcity without creating so much uncertainty as to stifle investment?

1. The FCC Has Traditionally Favored Incumbents over New Entrants

Previous spectrum policies advanced by the FCC have typically aligned with incumbent concerns that new entrants should bear the burden of preventing harmful interference.[62] One example of such deference was the FCC's sluggish development of final rules for new, ultra-wideband services.[63] In a sequence of prolonged, proposed rulemakings, incumbent business interests asked for study after study to explore essentially unanswerable questions about the interference risk posed by novel technologies – all while delaying the introduction of competitor services.[64]

The negative effects of such deference have not gone unnoticed by the FCC.[65] Former Commissioner Michael Copps suggested in 2009 that when government sponsorship of research and development declines, and corporate consolidation takes priority over innovation, the FCC should intervene to ensure that technology is being developed to improve spectrum efficiency.[66] However, for much of the last decade, the FCC's approach to regulating interference between newcomers and incumbents has involved deference to the latter group by settling disputes according to a first-in-time principle.[67]

While reconciling incumbent and entrant interests can be tricky enough, introducing unlicensed wireless usage presents its own set of problems. Although Congress dictates the scope and terms of spectrum auctions, the FCC often faces a choice when it repackages old spectrum left vacant: license all of it for exclusive use or reserve a portion for unlicensed operations.[68] When the FCC reserved spectrum for unlicensed use after the

62. *See* Goodman, *supra* note 18, at 309 ("The FCC has demonstrated a solicitude to the ongoing operations and investment-backed expectations of incumbent licensees that exceeds the obligations of due process or the Administrative Procedures Act."); Stuart Minor Benjamin, Arti K. Rai, *Fixing Innovation Policy: A Structural Perspective*, 77 GEO. WASH. L. REV. 1, 51 (2008).

63. *See* 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, 449-451 (2001).

64. *Id.*

65. *See National Broadband Plan*, *supra* note 19 (statement of Comm'r Copps). *But see id.* (statement of Comm'r McDowell) (arguing that free-market principles should govern future spectrum allocations).

66. *Id.*

67. *See* Goodman, *supra* note 18, at 310.

68. *See infra* Section II.B.2.

digital television (DTV) transition in 2009,[69] part of its rationale was that unlicensed spectrum would promote wireless innovation.[70] However, in the spectrally crowded environment of TVWS bands, the FCC faced the difficult task of convincing incumbent TVWS users, like licensed wireless microphone operators, that innovation would not occur at their expense.[71]

After the DTV transition, incumbent microphone operators faced new competition in the form of unlicensed WSDs operating on the remaining vacant television channels.[72] Yet the FCC's rules for WSDs were deferential toward incumbents insofar as they prohibited WSDs from causing harmful interference to licensed services, such as broadcast television stations, and required WSD operators to accept any interference received from these users.[73]

Despite this stringent toll on unlicensed usage, TVWS licensees wanted even greater protection and claimed that spectrum was so limited that the FCC's proposed safeguards would be ineffectual.[74] By contrast, manufacturers and users of unlicensed devices believed that adequate safeguards could be developed to prevent harmful interference.[75] The debate between the two groups eventually crystallized around proposed detection thresholds for interference mitigation, with incumbents cherry-picking FCC lab data to argue that prototypes for unlicensed WSDs were not perfectly reliable.[76]

Despite incumbent concerns, the FCC eventually considered the potential for harmful interference acceptably low based on the adaptability of currently available technology and the confidence of the Institute of Electrical and Electronics Engineers (IEEE) that a standard for WSDs could be developed to permit sharing of TVWS.[77] The FCC also believed that rules promoting unlicensed use could lead to the adoption of more efficient power transmitters and future spectrum gains.[78] The view that unlicensed

69. *See* Lazarus, *supra* note 4.

70. *See* Unlicensed Operation in the TV Broad. Bands, *Notice of Proposed Rulemaking*, 19 FCC Rcd 10018, para. 1 (2004). The [FCC], in order to account for potential interference issues during the DTV transition, proposed strict rules on WSDs. "We propose to define when a TV channel is 'unused' and to require these unlicensed devices comply with significant restrictions and technical protections." *See also* Unlicensed Operation in the TV Broad. Bands, *First Report and Order and Further Notice of Proposed Rulemaking*, 21 FCC Rcd 12266, para. 29 (2006) [hereinafter *Spectrum for Unlicensed Devices Order*].

71. *See* Watson, *supra* note 25, at 181, 182.

72. *See* Lazarus, *supra* note 4.

73. *See* 47 C.F.R. 15.5(b) (2015).

74. *See Spectrum for Unlicensed Devices Order*, *supra* note 68, at para. 9 (2006) ("The comments received in response to the *Notice* are divided between existing spectrum users of the TV bands, who are concerned about potential interference, and manufacturers and users of unlicensed devices who believe adequate safeguards can be put in place to prevent harmful interference to authorized services.").

75. *See id.*

76. *See* Meinrath & Calabrese, *supra* note 7, at 512-13.

77. *See Spectrum for Unlicensed Devices Order*, *supra* note 70, at para. 17.

78. *Id.* at app. C, para. A.2.

spectrum has an outsize effect on innovation has since gained traction with at least one FCC Commissioner.[79]

The FCC's spectrum policy in the Incentive Auction places less of a premium on technological certainty. At the time the FCC proposed accommodations for unlicensed users in the guard bands of repackaged spectrum, the agency did not know how much spectrum it would recover through the Incentive Auction, nor how it would interpret congressional language limiting guard bands to a "technically reasonable" size.[80] The FCC invited proof of technological advances aimed at improving spectral efficiency and solicited comment on the feasibility of allowing unlicensed WSD operations before it could reliably answer questions about future interference.[81] In this regard, the FCC appears to have embraced its role as a proponent of innovation rather than of the status quo, all while politely sidelining opponents who either insist that current technology cannot accommodate allocation of unlicensed spectrum in the guard bands or who believe that mandated progress would prove detrimental to cost and efficiency.[82]

2. The FCC's Spectrum Policy Has Changed over Time to Reflect the Values of Innovation and Efficiency

To understand how the FCC's spectrum policy has evolved to place greater emphasis on innovation and efficiency (as opposed to incumbent rights), one can begin by looking to the approach taken by the FCC when deciding whether to allocate spectrum on a licensed or unlicensed basis, given that allocation of unlicensed spectrum can be a rough proxy for gauging the FCC's level of commitment to promoting innovation as a discrete goal.[83]

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79. *See* Jessica Rosenworcel, Comm'r, FCC, Remarks at the National Press Club: Wi-Fi in the 5 GHz Fast Lane, (Mar. 7, 2014), https://apps.fcc.gov/edocs_public/attachmatch/DOC-325938A1.pdf.

80. *See* Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, § 6407(b), 126 Stat. 156, 231.

81. *See* Promoting Spectrum Access for Wireless Microphone Operations, *Notice of Proposed Rulemaking*, 29 FCC Rcd 12343, paras. 61-67 (2014); Amendment of Part 15 of the Comm'n's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 Mhz Band, 600 Mhz Guard Bands & Duplex Gap, & Channel 37, *Notice of Proposed Rulemaking*, 29 FCC Rcd 12248, para. 10 (2014) [hereinafter *Amendment of Part 15 of the Comm'n's Rules NPRM*].

82. *See Unlicensed Use of TV Band and 600 MHz Band Spectrum Proposed Rule*, *supra* note 14, at para. 64 (noting Qualcomm's objection to unlicensed guard band use by WSDs on grounds that the current technology for frequency separation would probably result in interference); *Promoting Spectrum Access for Wireless Microphone Operations Final Rule*, *supra* note 15, at 71, 704.

83. *See generally* Goodman, *supra* note 18, at 361-62.

Congress has empowered the FCC to make available and regulate spectrum for unlicensed use,[84] provided that users abide by special anti-interference provisions that generally favor the rights of licensed and incumbent users.[85] For example, the FCC might create a "spectrum commons" open for unlicensed use,[86] such as the 2.4 GHz band that Wi-Fi devices occupy. However, under the FCC's rules, these devices must accept interference from within the band and not interfere with licensed users operating outside the band. Alternatively, the FCC may, in certain circumstances, auction bands of spectrum to licensed users who are willing to pay a premium for exclusive usage rights.[87]

Choosing between licensed and unlicensed use is often a source of contention within the FCC and among industry stakeholders, and the FCC has recently taken the stance of attempting to please both sides.[88] Principles of laissez-faire economics often clash with command-and-control theories of market regulation when proponents of exclusivity confront advocates of greater unlicensed spectrum allocations.[89] The FCC has previously acknowledged the possibility that a rigid command-and-control approach to spectrum allocation might deter innovation in some circumstances.[90]

While some academics expound on the innovative potential of unlicensed spectrum,[91] the FCC has, for the past decade, taken a market-based stance that favors licensed use.[92] One policy view that encapsulates the market-based vision for spectrum regulation articulates a four-factor test for determining the appropriateness of licensed versus unlicensed allocation:

> The licensed model is more efficient in many cases, and tends to work best when spectrum rights are (1) clearly defined, (2) exclusive, (3) flexible, and (4) transferable. When spectrum rights lack these attributes, potential licensees face uncertainty and may lack incentive to invest in a license or offer service. In those circumstances, the unlicensed model may better optimize spectrum access and utilization.[93]

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84. *See* 47 U.S.C. § 307(e) (2012).

85. *See* 47 C.F.R. §§ 15.109, 15.5 (2015) (requiring lower power emission).

86. *See* Goodman, *supra* note 18, at 362-63.

87. *See* 47 U.S.C. § 309(j)(1) (2012).

88. *See* FCC SPECTRUM POLICY TASK FORCE, REPORT OF THE SPECTRUM RIGHTS AND RESPONSIBILITIES WORKING GROUP 7 (2002) [hereinafter FCC SRRWG REPORT], https://transition.fcc.gov/sptf/files/SEWGFinalReport_1.pdf (recognizing that allegations of interference by incumbents may simply be a tactical effort to block the entry of competitors).

89. *See id*. at 8-9, 12.

90. *See id*. at 11 ("From the [FCC's] experience with command-and-control regulation, it is apparent that overregulation can deter both efficiency and innovation.").

91. *See* Watson, *supra* note 25 at 206; *see also* Yochai Benkler, *Open Wireless vs. Licensed Spectrum: Evidence from Market Adoption*, 26 HARV. J.L. & TECH. 69, 95-96 (2012).

92. *See* Benkler, *supra* note 91, at 78.

93. *Spectrum for Unlicensed Devices Order*, *supra* note 70, at para. 27.

Congress wants to maximize revenue from the sale of licensed spectrum in the Incentive Auction, but the guard bands in the repackaged 600 MHz band tend to lack the characteristics conducive to licensing enumerated above.[94] Although the FCC has sometimes equated efficient spectrum usage with gains in licensing opportunities,[95] the FCC's decision to promote spectrally efficient wireless microphone technology has not yet translated into proposals to reserve the guard bands for purely licensed use.[96]

Arguably, the tension between protecting the rights of licensees and promoting innovative uses of unlicensed spectrum concerns the question of whether spectrum will always remain scarce, and whether technological efficiency can make spectrum so accessible as to obviate the need for a system of private rights.[97] Although compelling arguments exist on both sides, the FCC's approach toward displaced TVWS users suggests a third way forward based on the principle that efficiency can alleviate scarcity,[98] even if it means abandoning the old view that incumbent users deserve at least the certainty that a technological solution is at hand rather than evolving with the rulemaking.[99] Comments made by Commissioner Jessica Rosenworcel advocating for greater utilization of the guard bands in the repackaged 600 MHz spectrum would appear to support this concept.[100]

While pressuring incumbent users to become more spectrally efficient may implicate issues of command-and-control allocation, the FCC has general statutory authority to modify the rights of licensees to reduce interference and improve efficiency in order to benefit the public interest.[101] When the FCC allocated spectrum for MBANs, a form of wireless medical service, it took the approach of maximizing incumbent rights by placing several restrictions on MBAN licensees, such as low-power requirements

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94. *See Unlicensed Use of TV Band and 600 MHz Band Spectrum Proposed Rule*, *supra* note 14, at paras. 15-17 (noting that unlicensed wireless microphones in the guard bands of the 600 MHz spectrum may have to vary their power levels based on the probability of interference with adjacent television stations); *see also* Joe Ciaudelli, *Issues That Will Impact Wireless Mic Operators*, SENNHEISER (2016), http://en-us.sennheiser.com/spectrum (claiming that the probability of interference from out of band emissions will be high for devices in the proposed guard bands).

95. *See Implementation of Sections 309(j) & 337 Second Order*, *supra* note 13, at para. 26 ("[W]e note that use of more efficient technology creates additional channels that become available for licensing.").

96. *See* Expanding the Econ. & Innovation Opportunities of Spectrum Through Incentive Auctions, *supra* note 17, at para. 126.

97. *See* Goodman, *supra* note 18, at 380 ("Thus, it is mainly a view of technology, not of economics or law, that divides private and commons property theorists.").

98. *See Spectrum for Unlicensed Devices Order*, *supra* note 70, at para. 27.

99. *See* Goodman, *supra* note 18, at 309.

100. *See* Phil Goldstein, *FCC's Rosenworcel looks to 5 GHz band, 600 MHz guard bands for unlicensed wireless*, FIERCE WIRELESS (Mar. 7 2014), http://www.fiercewireless.com/story/fccs-rosenworcel-looks-5-ghz-band-600-mhz-guard-bands-unlicensed-wireless/2014-03-07; Rosenworcel, *supra* note 79 ("We should move beyond old dichotomies that pit licensed versus unlicensed spectrum. Because across the board we need to choose efficiency over inefficiency and speed over congestion.").

101. *See* 47 U.S.C. § 303(f) (2012).

and indoor limits on certain types of MBAN operations.[102] The FCC was willing to adopt a framework of spectrum sharing between MBAN licensees and incumbents in the same frequency range, but with the caveat that MBAN operate on a secondary basis.[103]

The FCC took a similar approach of protecting incumbent rights when introducing MedRadio, which is used in wireless healthcare applications. The FCC urged MedRadio operators to assume the burden of developing and implementing technology to mitigate interference received from federal services in the same spectrum.[104] The FCC's spectrum policy framework for the Incentive Auction has yielded the most radical position to date: advocating that users develop technologies in anticipation of yet-to-be-determined rules and standards. However, requiring efficiency raises questions of whether efficiency is realistically attainable and whether the FCC can impose its own predictions about what is technically reasonable.

a. *The FCC Considers Both Technological Capability and the Need for Innovation When Seeking Gains in Spectrum Efficiency*

The FCC has encouraged efficiency through a variety of methods, such as flexible leasing arrangements of licensed spectrum,[105] spectrum sharing, or mandated improvements at a technological level.[106] The FCC's rationale for ordering improvements in spectrum efficiency relies on a public interest argument that efficiency conserves a valuable national resource, frees up spectrum for licensing, and benefits the ambitions of industry.[107] The statutory language that grants the FCC its broad powers to regulate the rights of licensees rests upon on the same rationale.[108] The FCC

102. *See* Amendment of the Comm'n's Rules to Provide Spectrum for the Operation of Medical Body Area Networks, *First Report and Order and Further Notice of Proposed Rulemaking*, 27 FCC Rcd 6422, paras. 39, 47 (2012).

103. *Id*. at 19.

104. *See* Investigation of the Spectrum Requirements for Advanced Med. Techs., *Report and Order*, 24 FCC Rcd 3474, paras. 4, 6 (2009) [hereinafter *Spectrum Requirements for Advanced Med. Techs. Amendment*].

105. *See* Promoting Efficient Use of Spectrum, *Report and Order and Further Notice of Proposed Rulemaking*, 18 FCC Rcd 20604, para. 59 (2003).

106. *See* Service Rules for Advanced Wireless Services H Block—Implementing Section 6401 of the Middle Class Tax Relief and Job Creation Act of 2012 Related to the 1915-1920 MHz and 1995-2000 MHz Bands, *Final Rule*, 78 Fed. Reg. 50,214, 50,243, 50,252 (to be codified at 47 C.F.R. pts. 1, 27).

107. *See Implementation of Sections 309(j) & 337 Second Order*, *supra* note 13, at para. 26 n.84.

108. *See* 47 U.S.C. § 303(f) (2012) ("Changes in the frequencies, authorized power, or in the times of operation of any station, shall not be made without the consent of the station licensee unless the [FCC] shall determine that such changes will promote public convenience or interest or will serve public necessity.").

has even suggested recently that it is willing to orient its technical specifications around its own predictions about the future state of the art.[109]

To pursue its goal of promoting technological efficiency, the FCC has solicited comments on "How should receiver standards be taken into account for purposes of repurposing spectrum, such as the case where protected incumbents are using legacy receivers that could be replaced with newer, state-of-the-art equipment offering superior performance that would facilitate the introduction of new services?"[110] The FCC has also acknowledged that licensees may lack incentive to pursue efficiency on their own when operating on "shared" spectrum, because "[a] licensee operating in a shared use environment does not necessarily directly accrue the benefits of its own investment in narrowband technology."[111]

b. *The FCC Has Ordered Technological Changes to Increase Spectrum Efficiency*

Section 332(a) of the Act charges the FCC with encouraging technologically efficient use of mobile spectrum.[112] Pursuant to this mandate, the FCC has required Part 90 Private Land Mobile Radio (PLMR) services, which include private licensed communications services of public safety and industrial users, to make their equipment more spectrally efficient.[113] In 2013, the FCC implemented planned improvements in spectral efficiency by ordering a migration of PLMR services to narrower bands of spectrum.[114]

The result of the FCC's commitment to promote more efficient and innovative uses of spectrum has predictably resulted in pushback from incumbent stakeholders who feel that the burden of adaptation is too onerous. After the PLMR narrowbanding order in 2004, several petitioners

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109. *See Unlicensed Use of TV Band and 600 MHz Band Spectrum Proposed Rule*, *supra* note 14, at para. 66.

110. *National Broadband Plan*, *supra* note 19, at para. 36; JULIUS KNAPP, FCC WORKSHOP: SPECTRUM EFFICIENCY AND RECEIVER PERFORMANCE 7 (2012), http://transition.fcc.gov/bureaus/oet/receiver-workshop1/Session1/Receiver-Workshop-Knapp-Opening-Remarks-w-Notes.pdf.

111. *Implementation of Sections 309(j) & 337 Second Order*, *supra* note 13, at para. 13 (noting that efficiency gains may benefit new or existing applicants who want to gain increased access to the shared spectrum instead of the licensee choosing to use more efficient technology).

112. *See* 47 U.S.C. § 332(a)(2) (2012).

113. *See* Implementation of Sections 309(j) & 337 of the Comm. Act of 1934 as Amended, *Third Memorandum Opinion and Order, Third Further Notice of Proposed Rulemaking and Order*, 19 FCC Rcd 25045, paras. 4-5 (2004) [hereinafter *Implementation of Sections 309(j) & 337 Third Order*].

114. *See* FCC Pub. Safety & Homeland Sec. Bureau, *VHF/UHF Narrowbanding Information*, FCC, http://transition.fcc.gov/pshs/public-safety-spectrum/narrowbanding.html (last visited July 30, 2016); *see also Implementation of Sections 309(j) & 337 Third Order*, *supra* note 113, at para. 4 ("In an effort to promote the transition to a more efficient narrowband channel plan, the [FCC] adopted certain market-based incentives in the PLMR service. The [FCC] stated that 'only increasingly efficient equipment' would be type certified.").

complained that migration of services to a smaller band of spectrum would take longer than the FCC had predicted given the difficulty of adopting industry standards and bringing hardware to market.[115] The FCC's response in that instance was to grant a stay on the deadline for the proposed narrowbanding.[116] However, the FCC has not always been so deferential.

In 2009, the FCC's proposed rules for MedRadio, a service intended for low-power medical devices, required certain industry stakeholders to accept more technical constraints than they wanted.[117] Simultaneously, the FCC required major stakeholders, namely Medtronic, to accommodate smaller industry petitioners who wanted to operate less sophisticated devices in bands adjacent to prime spectrum.[118] In permitting this degree of interference, the FCC expressed optimism that the device manufacturers would work out any potential conflicts at the engineering level.[119]

However, the exact method of achieving spectrum efficiency has varied in terms of scope and regulatory pressure. The narrowbanding of PLMR services to free up spectrum involved a decade-long transition period "where equipment certification represent[ed] the limit of inducement to migrate to narrowband technology" before the statutory deadline of 2013.[120] In other words, the FCC had already identified available technology that would make the transition possible. Prior to its order setting final deadlines, the FCC noted that the "current pace of migration to more spectrally efficient technology has not been sufficiently rapid" and determined that the best way to accelerate the process involved prohibiting the manufacture or importation of equipment that failed to meet certain efficiency criteria.[121]

115. *See Implementation of Sections 309(j) & 337 Third Order*, *supra* note 113, at para. 45.

116. *Id*. at para. 47.

117. The FCC determined that certain vendors would be permitted to operate their devices in the narrower "wing bands" of MedRadio's core spectrum subject to more restrictive power limits. *See Spectrum Requirements for Advanced Med. Technologies Amendment*, *supra* note 104, at paras. 1, 13-14 (2009).

118. *See Spectrum Requirements for Advanced Med. Techs. Amendment*, *supra* note 104, at para. 64 ("We decline to impose more restrictive limits on emissions from MedRadio wing band devices into the existing core band in the manner indicated by Medtronic in its petition…We find no compelling reason to place wing band devices on such an unequal footing with core band devices…[w]e are confident that manufacturers of wing band devices are capable of designing their products to be compatible with and to protect core band devices.").

119. *Id*.

120. *Implementation of Sections 309(j) & 337 Second Order*, *supra* note 13, at paras. 22, 27.

121. *Id.* at para. 9.

c. *The FCC Has Eased Back on Traditional Deference Granted to Incumbent Interests*

Over the past decade, the FCC has entertained a gradual shift in policy that places more of the burden of spectrum scarcity onto incumbent users.[122] This shift has reached its most significant point with the FCC's proposal to allow unlicensed operations in the guard bands of repackaged broadcast spectrum. However, the FCC had already demonstrated in proceedings for MedRadio and the DTV transition that it is willing to deny licensees and incumbents unfettered access to interference-free spectrum when innovation is at stake.

During the creation of the MedRadio rules, the FCC was willing to accommodate smaller stakeholders developing MedRadio products by permitting flexible use of spectrum instead of deferring to dominant licensees seeking to maximize the value of their core MedRadio licenses.[123] The FCC also demonstrated a willingness to set the pace of innovation by limiting how long one petitioner could delay implementation and design of spectrum-compliant devices.[124]

During the DTV transition, the FCC gave proponents of WSDs a chance to demonstrate that their technological solutions could prevent harmful interference to incumbent users who claimed that harmful interference was inevitable.[125] Despite the spectrum's many constraints (low-power requirements, operation on a secondary basis, lack of nation-wide clear channels),[126] companies were willing to invest in technology that would allow them to squeeze their operations into TVWS.[127]

The FCC has also dismissed attempts by incumbents to overstate technological uncertainty as a barrier to proposed spectrum-sharing arrangements. In a rulemaking to amend antenna requirements in the 10.7-11.7 GHz band, the FCC dismissed incumbent concerns about interference

122. The FCC has entertained the idea of setting the pace for technological improvements in contexts outside of narrowbanding, most recently by proposing a system whereby the FCC would increase required broadband speeds automatically over time to account for evolving technology. *See* Development of Nationwide Broadband Data to Evaluate Reasonable & Timely Deployment of Advanced Servs. to All Americans, Improvement of Wireless Broadband Subscribership Data, & Dev. of Data on Interconnected Voice over Internet Protocol (VoIP) Subscribership, *Notice of Proposed Rulemaking*, 22 FCC Rcd 7760, para. 20 (2007) [hereinafter *Development of Nationwide Broadband Data NPRM*].

123. *See Spectrum Requirements for Advanced Med. Techs. Amendment*, *supra* note 104, at para. 64 (denying Medtronic's request to impose restrictive non-interference requirements on "wing band" devices outside the core MedRadio spectrum).

124. *See id.* at para. 73.

125. *See* Meinrath & Calabrese, *supra* note 7, at 496, 500; *see also* Comments of Verizon Wireless at 21, Int'l Comparison & Consumer Survey Requirements in the Broadband Data Improvement Act, GN 09-47 (Oct. 23, 2009), https://ecfsapi.fcc.gov/file/7020143218.pdf.

126. *See* Meinrath & Calabrese, *supra* note 7, at 508.

127. *Id.*

when they were unsubstantiated by "engineering analysis."[128] Yet, according to one incumbent protestor, the entrant who had successfully petitioned for new antenna standards had failed to provide any "hard engineering analysis" of its own.[129] In the absence of any concrete data as to whether aggregate interference would doom proposed antenna standards, the FCC decided that new rules did not require complete certainty; incumbents could protest whatever interference might result from adoption of the new rules, but until then, their premature concerns could not preempt the public's interest in promoting "efficient use of spectrum."[130]

The FCC's response to claims of interference during the amendment of antenna requirements for the 10.7-11.7 GHz band also confronted a broader, informational issue that often faces the agency. Although the FCC can produce its own analysis of technical solutions, frequently it must rely on predictions by prospective licensees about the true cost to the public of adopting new standards or efficiency requirements.[131] The FCC's present study of guard band usage in repackaged broadcast spectrum raises the same issue.[132] Nonetheless, the FCC expects that evolving technology will permit both future users of the 600 MHz guard bands and licensees of the repackaged spectrum to coexist.[133]

This shift toward rolling back incumbent protections has surfaced in statements issued by Commissioner Mignon Clyburn, who argues for distributing the burden of spectrum scarcity equally among licensees, incumbents (whether licensed or not), and unlicensed stakeholders.[134] Commissioner Clyburn has also expressed guarded optimism about the ability of engineers to create standards that allow for greater sharing of spectrum.[135]

C. The FCC's Decisions to Promote Efficiency Are Entitled to Judicial Deference

Judicial review presents a major obstacle for the FCC when promoting spectrum policy that values adaption and efficiency over entrenched rights. For such a policy to survive legal challenges brought by

128. *See Amendment of Rule to Modify Antenna Requirements Final Rule*, *supra* note 13, at para. 8.

129. Comments of Intelsat, Ltd. at 5, Amendment of Part 101 of the Comm'n's Rules to Modify Antenna Requirements for the 10.7-11.7 GHz Band, WT 07-51 (May 25, 2007), https://ecfsapi.fcc.gov/file/6519417294.pdf.

130. *See Amendment of Rule to Modify Antenna Requirements Final Rule*, *supra* note 13, at paras. 8, 12.

131. *See* Ellen P. Goodman, *Spectrum Auctions and the Public Interest*, 7 J. TELECOMM. & HIGH TECH. L. 343, 344 (2009).

132. *See Unlicensed Use of TV Band and 600 MHz Band Spectrum Proposed Rule*, *supra* note 14, at para. 63 ("[T]he [FCC] notes that there is a lack of real world testing.").

133. *See id*. at para. 66.

134. *See Amendment of Part 15 of the Comm'n's Rules NPRM*, *supra* note 81 (statement of Comm'r Clyburn).

135. *See id*.

incumbents aghast that they must "share the burden" of potential interference with new entrants, the FCC must think carefully about how greatly it desires aspirational levels of efficiency. While tossing displaced and new users into a demanding regulatory environment might promote creative solutions that yield incredible results, like Wi-Fi in the 2.4 GHz band,[136] an alternative scenario might involve disinterest and underutilization of spectrum. However, the FCC has an advantage should it choose to advance an aspirational policy framework – courts treat the agency's expertise in making technological predictions with great deference.

When the FCC mandates spectrum efficiency by proposing new technical standards, it generally does so through notice-and-comment rulemaking as governed by the Administrative Procedure Act.[137] At the end of the rulemaking process, the resulting rule may be protested by an affected party, such as an incumbent user who claims, for example, that new technical standards are arbitrary and capricious.[138] When a court reviews the FCC's rulemaking to determine if the resulting rule was, in fact, arbitrary and capricious, it affords deference to an agency's interpretation of its rulemaking authority so long as the interpretation is reasonable and not preempted by Congress.[139] With respect to technical rules governing interference standards, the FCC has traditionally received considerable deference.

Courts have afforded deference to the FCC's interpretation of Section 301 of the Act, which governs licenses for wireless use. In *Capitol Broadcasting v. FCC,* the Court of Appeals for the District of Columbia Circuit (D.C. Circuit) held that matters of engineering that were factual predicates in the FCC's decision to allow construction of a broadcast transmitter, despite concerns over interference, should not be second-guessed by the court.[140] The court also asserted that if the FCC found that an objecting licensee faced no additional interference from the novel deployment of an advanced transmitter in close proximity to its base station, then the decision to waive mandatory spacing requirements for that transmitter did not amount to modification of the objector's license.[141]

The FCC has also enjoyed great latitude when adopting policies that reflect predictions about future technological improvements and the market's likelihood of adopting new technology.[142] Moreover, the FCC has

136. *See* Rosenworcel, *supra* note 79.

137. *See* 47 U.S.C. § 154(i) (2012); *see also* 5 U.S.C. § 553 (2012).

138. *See* 5 U.S.C. § 553(e).

139. *See* Chevron, U.S.A., Inc. v. Nat'l Res. Def. Council, Inc., 467 U.S. 837, 845 (1984).

140. *See* Capitol Broad. Co. v. FCC, 324 F.2d. 402, 404-05 (D.C. Cir. 1963) (finding that waiver of minimum spacing distance for a type of transmitter was in accordance with the public interest, provided additional coverage, and afforded "[e]quivalent protection from interference…thought to be adequate as of the present time").

141. *See id.* at 404-05.

142. *See* AT&T Co. v. FCC, 832 F.2d 1285, 1291 (D.C. Cir. 1987) (citations omitted) ("When . . . 'an agency is obliged to make policy judgments where no factual certainties exist . . . ,' we require only that the agency 'so state and go on to identify the considerations it

wide discretion to make predictions about the future state of the art.[143] When the FCC proposed displacing fixed terrestrial services to make way for new satellite services, the D.C. Circuit held in *Teledesic LLC v. FCC* that:

> The [FCC] correctly conceives of its role in prophetic and managerial terms: it must predict the effect and growth rate of technological newcomers on the spectrum, while striking a balance between protecting valuable existing uses and making room for these sweeping new technologies . . . . Its decisions about how best to strike this balance thus involve both technology and economics. The [FCC] is therefore entitled to the deference traditionally accorded decisions regarding spectrum management.[144]

Nearly twenty years earlier, the D.C. Circuit had likened the FCC's role in predicting the development of new technologies to that of a "seer."[145] In *Telocator Network of America v. FCC*, the court defended the FCC's power to take risks when making technical predictions:

> In view of the increasing congestion on the radio spectrum and the continued growth in demand for communication services, we cannot fault the [FCC's] policy determination that novel methods evincing the potential for greater efficiency ought be tried. Nor can we brand a clear error of judgment the [FCC's] conclusion that its frequency-sharing plan possessed that potential. To insist upon concrete proof that a proposed innovation will succeed without undesirable side effects would be effectively to relegate the [FCC] to preserving the status quo.[146]

The FCC recognizes that it is entitled to deference when making determinations about the potential for interference.[147] The FCC's position is consistent with the view of the D.C. Circuit, which has held that "where a 'highly technical question' is involved, 'courts necessarily must show

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found persuasive.'"); *see also* Melcher v. FCC, 134 F.3d 1143, 1151-52 (D.C. Cir. 1998) ("[O]ur review of the FCC's exercise of its predictive judgment is particularly deferential" because where "the FCC must make judgments about future market behavior with respect to a brand-new technology, certainty is impossible").

143. S*ee* Consumer Elecs. Ass'n v. FCC, 347 F.3d 291, 303 (D.C. Cir. 2003); *see also* EarthLink, Inc. v. FCC, 462 F.3d 1, 12 (D.C. Cir. 2006) ("[A]n agency's predictive judgments about areas that are within the agency's field of discretion and expertise are entitled to *particularly deferential* review as long as they are reasonable.").

144. Teledesic LLC v. FCC, 275 F.3d 75, 84 (D.C. Cir. 2001).

145. *See* Telocator Network of Am. v. FCC, 691 F.2d 525, 538 (D.C. Cir. 1982).

146. *Id*. at 542.

147. *See* Service Rules for Advanced Wireless Serv. H Block—Implementing Section 6401 of the Middle Class Tax Relief and Job Creation Act of 2012 Related to the 1915-1920 MHz and 1995-2000 MHz Bands, *Report and Order*, 28 FCC Rcd 9483, para. 19 (2013).

considerable deference to an agency's expertise.'"[148] Accordingly, when the FCC makes predictions about the potential for interference, it need only articulate a "rational connection between the facts found and the choice made"[149] to survive a "modicum of reasoned analysis" upon judicial review.[150]

The FCC must, however, disclose to interested parties the studies upon which it intends to rely in notice-and-comment rulemaking procedures.[151] Consequently, the FCC may be free to make predicative judgments about the evolving state of technology and what degree of interference mitigation technology can be expected in the future, but it cannot furnish such predictions without disclosing the studies and data it uses to derive its conclusions.[152]

Despite the latitude it receives when deciding questions of a technical nature, the FCC cannot easily backtrack once it has committed itself to a particular technological solution. When the FCC defended its position that currently available technology could accommodate guard band sharing in *Telocator*, the court chastised the FCC for characterizing the technical viability of its analysis as an "irrelevant issue."[153] Nevertheless, the court found that the FCC's last-minute reversal was superseded by an ample record that that could have reasonably led it to conclude that the band sharing was, in fact, technically feasible.[154] However, the court also suggested that the FCC's lack of courage in its technological predictions could potentially lend itself to accusations of capriciousness fatal to the rulemaking.[155]

III. ANALYSIS

A. The FCC Has Indicated a Willingness to Shift More of the Burden of Spectrum Efficiency onto Licensed Incumbents by Placing Less of a Premium on Technological Certainty

The FCC's policy trajectory from the DTV transition to the Incentive Auction can be characterized as successive attempts to de-emphasize what has traditionally been a focal point in many incumbent complaints: the need for technological certainty.[156] By embracing the language of innovation to

148. Am. Radio Relay League, Inc. v. FCC, 524 F.3d 227, 233 (D.C. Cir. 2008) (quoting MCI Cellular Tel. Co. v. FCC, 738 F.2d 1322, 1333 (D.C. Cir. 1984)).

149. Motor Vehicle Mfrs. Ass'n of the U.S., Inc. v. State Farm Mut. Auto. Ins. Co., 463 U.S. 29, 43 (1983).

150. Hispanic Info. & Telecomms. Network, Inc. v. FCC, 865 F.2d 1289, 1297-98 (D.C. Cir. 1989); s*ee also Am. Radio Relay League*, 524 F.3d at 233.

151. *See Am. Radio Relay League*, 524 F.3d 227 at 237 (citing Portland Cement Ass'n v. Ruckelshaus, 486 F.2d 375, 392–93 (D.C.Cir. 1973)).

152. *See id.*

153. *See* Telocator Network of Am. v. FCC, 691 F.2d 525, 540-41 (D.C. Cir. 1982).

154. *See id.* at 541.

155. *See id.*

156. *See supra* notes 128-29.

urge adoption of newer, more efficient technologies, the FCC has effectively told incumbents that they must become adaptable and shoulder more of the burden of spectrum scarcity. This is for the best. The FCC cannot forever cater to established interests that would delay the introduction of new technologies merely because the technical feasibility of anti-interference standards remains foggy.[157]

The FCC's decision to allow wireless microphones and other WSDs to operate in the 600 MHz guard bands on an unlicensed basis after the Incentive Auction does not go as far as erasing incumbent licensees' rights to be free from harmful interference, but nevertheless encourages them to be more spectrally efficient as the margins of interference protection shrink to accommodate new guard band usage.[158] Similarly, the FCC's optimism about permitting licensed microphone usage in the aeronautical mobile telemetry (AMT) band arises from its expectation that device manufactures representing both AMT users and microphone users will coordinate the adoption of new, interference-mitigating technologies.[159] In sum, the FCC has effectively signaled to both licensees and displaced wireless microphone users that they have an obligation to adapt to less spectrum by innovating and cannot simply demand greater protection because their technology is outdated.[160]

Commissioner Clyburn's optimism about the potential for efficient spectrum sharing and Commissioner Rosenworcel's belief that adoption of efficient technologies by all wireless users is essential to progress represent new ways of thinking about the rights of licensees in a spectrum-scarce environment.[161] In fact, the FCC has been tentatively pushing towards this policy framework with its previous decisions, especially those concerning PLMR services, MedRadio, and antenna rules for the 10.7-11.7 GHz band. The common thread in these previous rulemakings was the FCC's interest in setting the pace of innovation at a reasonable enough rate to promote the introduction of new technology despite the complaints of incumbent users who either harbored interference concerns or feared the costliness of adaptation.[162] In these decisions, the FCC rationalized its decision to push

157. *See* Hazlett, *supra* note 63, at 449-451 (2001).

158. *See Unlicensed Use of TV Band and 600 MHz Band Spectrum Proposed Rule*, *supra* note 14, at paras. 61-66.

159. *See Promoting Spectrum Access for Wireless Microphone Operations Final Rule*, *supra* note 15, at 71,716 (finding that the successful migration of microphone users into the AMT band will require "the cooperation of the AMT community in recognizing opportunities to share use of the band in those locations and times that will not interfere with the critical existing primary use, and the implementation of a coordination process to allow for such determinations in a timely and effective manner").

160. *See id.* at paras. 91, 94.

161. *See Amendment of Part 15 of the Comm'n's Rules NPRM*, *supra* note 81 (statement of Comm'r Clyburn); Rosenworcel, *supra* note 79 ("We should move beyond old dichotomies that pit licensed versus unlicensed spectrum. Because across the board we need to choose efficiency over inefficiency and speed over congestion.").

162. *See* Amendment of Part 101 of the Comm'n's Rules to Modify Antenna Requirements for the 10.7 – 11.7 GHz Band, *Notice of Proposed Rulemaking*, 22 FCC Rcd 6057, paras. 3, 16-17 (2007) [hereinafter *Amendment of Part 101 NPRM*]; *Spectrum*

for efficiency on grounds of public interest.[163] Although the FCC did not explicitly rely in these instances on its authority under Section 157 to encourage the provision of new technologies to the public, the way it framed its decision implies a conceptual link between promoting innovation and requiring efficiency.[164]

The FCC has adopted a similar framework in its discussion of guard band operations in the repackaged TVWS spectrum, particularly through its insistence that an evolving technological landscape will eventually validate its technical rules for interference.[165] The FCC's request that opponents of guard band operations propose potential uses for those bands also suggests a willingness to force incumbents to come up with ideas for innovative uses of spectrum before deferring to their rights as license holders.[166]

Although the FCC's goal of requiring greater efficiency may shift some of the burden onto incumbent users to improve their own interference mitigation technology, the greater share is fixed firmly on the shoulders of those operating in the narrow guard bands. A more restrictive spectrum environment may promote innovation to gain entry, but it does not guarantee sustained improvements in technology. As the FCC observed when ordering spectrum efficiency requirements for PLMR services in "shared" frequency bands, "[a] licensee operating in a shared use environment does not necessarily directly accrue the benefits of its own investment in narrowband technology."[167] Consequently, imposing a technological hurdle may incentivize a one-time investment to conform technology to guard band operating requirements, but will not spur future innovation thereafter.

Taking a pessimist's view, continued innovation in an environment where technological adaptability is a barrier to entry may in fact be unlikely. On the other hand, the examples of MBAN and MedRadio show that FCC rules to protect incumbent license holders from interference can still yield

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Requirements for Advanced Med. Techs. Amendment, *supra* note 104, at para. 73; *Implementation of Sections 309(j) & 337 Second Order*, *supra* note 13, at para. 9; *see also Development of Nationwide Broadband Data NPRM*, *supra* note 122, at para. 20.

163. *See, e.g.*, *Amendment of Rule to Modify Antenna Requirements Final Rule*, *supra* note 13, at 55,676.

164. *See Spectrum for Unlicensed Devices Order*, *supra* note 70, at paras. 1-2 (finding that proposed rules for WSDs would promote adoption of low power transmitters which would in turn lead to efficiency gains and more innovation uses of spectrum).

165. *See Unlicensed Use of TV Band and 600 MHz Band Spectrum Proposed Rule*, *supra* note 14, at paras. 62, 66.

166. *See Amendment of Part 15 of the Comm'n's Rules NPRM*, *supra* note 81, at para. 86; *see also Promoting Spectrum Access for Wireless Microphone Operations Final Rule*, *supra* note 15, at para. 71,716 - 17.

167. *Implementation of Sections 309(j) & 337 Second Order*, *supra* note 13, at para. 13 (noting that efficiency gains may benefit new or existing applicants who want to gain increased access to the shared spectrum instead of the licensee choosing to use more efficient technology).

innovative technologies.[168] In fact, the FCC has specifically invoked the success of MBAN to promote its view that entrants and incumbents should embrace a cooperative form of technological evolution to maximize available spectrum.[169] The FCC may be hoping for a similar result in the Incentive Auction by placing the burden of adaptation more squarely on the shoulders of displaced wireless microphone users than future licensees of repacked TVWS spectrum.[170]

B. The FCC Should Feel Empowered to Rely More Heavily on Its Mandate to Innovate and Promote Efficiency Given Judicial Deference to Technical Predictions

The FCC should leverage its ability to command efficiency by invoking its roles as a predictor of technological progress and herald of innovation.[171] Because reviewing courts tend to avoid second-guessing the FCC's judgments about the pace of technological evolution, the FCC has an incentive to pressure licensees and incumbent users to find ways to become more efficient sooner rather than later. The FCC can do this by replicating the approach it took for guard bands in the Incentive Auction: advocate technical standards based on predictions about the future state of the art,[172] then rely on the statutorily ambiguous definition of harmful interference to craft a standard just strict enough to spur technological change.[173]

Although the FCC may occasionally need to rely on the studies or data from prospective licensees to justify its predictions about the limits of efficiency or interference potential, as it did when it amended antenna requirements for the 10.7-11.7 GHz band,[174] it should nonetheless feel confident that courts will review its interpretation of industry studies with considerable deference.[175] The FCC's only meaningful constraint when assuming the role of a technology "seer" is to maintain a consistent position about its expectations for particular technological developments.[176]

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168. *See* Amendment of the Comm'n's Rules to Provide Spectrum for the Operation of Medical Body Area Networks, *supra* note 102, at paras. 16, 21-22; *Spectrum Requirements for Advanced Med. Techs. Amendment*, *supra* note 104, at para. 23.

169. *See Promoting Spectrum Access for Wireless Microphone Operations Final Rule*, *supra* note 15, at 71,715-16 ("The [FCC] also expects wireless microphone manufactures to continue to innovate and find further operational efficiencies, and believe that they will be able to draw on the experiences of MBAN proponents as they develop equipment designed to operate in the AMT space.").

170. *See Unlicensed Use of TV Band and 600 MHz Band Spectrum Proposed Rule*, *supra* note 14, at para. 62.

171. *See* AT&T Co. v. FCC, 832 F.2d 1285, 1291 (D.C. Cir. 1987); Melcher v. FCC, 134 F.3d 1143, 1151-52 (D.C. Cir. 1998).

172. *See Unlicensed Use of TV Band and 600 MHz Band Spectrum Proposed Rule*, *supra* note 14, at 69,719-20.

173. *See* 47 C.F.R. § 2.1 (2015); *see also* Watson, *supra* note 25, at 181, 202-03.

174. *See Amendment of Part 101 NPRM*, *supra* note 162, at paras. 22-23.

175. *See* Am. Radio Relay League, Inc. v. FCC, 524 F.3d 227, 233 (D.C. Cir. 2008) (quoting MCI Cellular Tel. Co. v. FCC, 738 F.2d 1322, 1333 (D.C. Cir. 1984)).

176. *See* Telocator Network of Am. v. FCC, 691 F.2d 525, 540-41 (D.C. Cir. 1982).

Furthermore, the decision of the D.C. Circuit in *Capitol Broadcasting* suggests that if FCC policies can yield genuinely efficient technologies to alleviate concerns of harmful interference, the FCC will have more flexibility to continue allocating unlicensed spectrum in duplex gaps and guard bands. The minimum separation distances for broadcast transmitters that were at issue in *Capitol Broadcasting* have, in principle, the same function as guard bands—both provide a minimum distance between signals to avoid interference.[177] Although *Capitol Broadcasting* involved questions of law particular to television stations, the court made a powerful point in holding that a license is not automatically modified by the FCC's waiver of certain anti-interference rules for users with spectrally efficient technology.[178]

An extrapolation of this reasoning could not only guide the FCC's interpretation and creation of "technically reasonable" guard bands for repackaged spectrum,[179] but also establish a baseline principle that if a device does not exceed technically reasonable levels of interference, it may operate however close to the margins of another frequency as technology permits. Although this may seem intuitive, incumbent licensees would likely reject the idea of packing guard bands with novel technology since it would subject them to the predictive judgments of the FCC and, if challenged in court, the established judicial deference given to such aspirational standards.[180] Indeed, the downside of such a framework is that it tends to erode the core principle the FCC celebrates in the licensed model of spectrum allocation: certainty.[181]

However, when too much of a premium is placed on certainty it can become the enemy of innovation, a sentiment echoed by Commissioner Michael Copps in 2009 when he suggested that the FCC intervene when private sector research and development fails to yield the new technologies necessary to improve services to the public.[182] Of course, Commissioner Copps was not without opposition in this view,[183] but his suggestion is one the FCC has heeded at times when concerned with a slow pace of innovation.[184]

The FCC should not hesitate to demand that both incumbent and prospective users of spectrum pursue technological efficiency at a more

177. *See* Capitol Broad. Co. v. FCC, 324 F.2d. 402, 403-05 (D.C. Cir. 1963).

178. *See id.*

179. *See* 47 U.S.C. § 1454 (2012).

180. *See Am. Radio Relay League*, 524 F.3d at 233.

181. *See Spectrum for Unlicensed Devices Order*, *supra* note 70, at para. 27.

182. *See National Broadband Plan*, *supra* note 19 (statement of Comm'r Copps).

183. *See id.* (statement of Comm'r McDowell) (arguing that free-market principles should govern future spectrum allocations).

184. *See Amendment of Part 101 NPRM*, *supra* note 162, at para. 3; *Spectrum Requirements for Advanced Med. Techs. Amendment*, *supra* note 104, at paras. 72-73; *Implementation of Sections 309(j) & 337 Second Order*, *supra* note 13, at para. 9.

aggressive pace.[185] There is ample statutory authority to augment the FCC's duty under Section 157 to encourage the provision of new technologies to the public.[186] Moreover, the FCC's interpretations of its powers and duties under Section 303 are considered informal rulemakings, which are given considerable deference by courts applying the Administrative Procedure Act.[187] Making use of this deference, the FCC could potentially expand its authority under Section 303(g) by interpreting "more effective use of radio" to mean more *efficient* use of radio. The FCC could then employ Section 157, in conjunction with Section 303(f),[188] to set the boundaries of interference in a fashion that encourages the public interest in efficiency. While this may seem like a radical proposition, the FCC has slowly gravitated toward this reasoning by expressing its expectation that technological developments will eventually validate the FCC's technical predictions for guard band operations in repackaged 600 MHz spectrum.[189]

The FCC may also employ the ambiguous statutory language of the Middle Class Tax Relief and Job Creation Act of 2012 to pressure incumbents to adopt more substantial interference mitigation technology. This legislation requires the FCC to establish guard bands of "technically reasonable" size in the repackaged TVWS spectrum but stops short of explaining how much unlicensed use can occur within the band or what "technically reasonable" means.[190]

Given that a question of what is technically reasonable is probably subject to considerable judicial deference (because it is necessarily a technical question), the FCC could construe the term broadly to pressure incumbent license holders to adapt to reduced frequency separation without fear of excessive judicial scrutiny.

IV. CONCLUSION

The FCC's proposal to permit wireless operations in the guard bands of repackaged broadcast spectrum may represent a promising framework for addressing the issue of spectrum scarcity, but demanding efficiency may not work in every scenario. Technical limitations present real barriers that the FCC cannot simply ignore, and requiring technological change prematurely may frustrate the investment-backed expectations of both licensed and

185. The FCC itself has interpreted its innovation mandate under 47 U.S.C. § 157 to include the "timely" deployment of advanced technologies to the public. *See Service Rules Order*, *supra* note 41, at para. 51.

186. *See, e.g*. 47 U.S.C. §§ 157(a), 303(g), 309(j)(3)(B) (2012).

187. *See* Home Box Office, Inc. v. FCC, 567 F.2d 9, 34-35 (D.C. Cir. 1977).

188. *See* 47 U.S.C. § 303(f) (2012) (authorizing the FCC to make "such regulations not inconsistent with law as it may deem necessary to prevent interference between stations and to carry out the provisions of this chapter").

189. *See Unlicensed Use of TV Band and 600 MHz Band Spectrum Proposed Rule*, *supra* note 14, at para. 66.

190. 47 U.S.C. § 1454(b) (2012).

unlicensed users. If the FCC wishes to fully assume its role as a technology "seer," its predictions must be reasonable and fair.

Beyond fairness lies the question of accountability. While this Note attempts to describe a strategic policy framework for promoting spectrally efficient technologies, it does not address who in the FCC will make the technological predictions necessary to advance the state of the art. A policy centered around aspirational requirements may invite technocratic overreach, since many key questions would be shrouded in the language of engineering analysis, something that courts have been reluctant to address.

Another question that remains to be answered is whether a liberally interpreted innovation mandate can guarantee technological neutrality—the principle that the FCC does not pick winners or losers in the marketplace. What happens when there is only one technology that can accommodate the sort of shared spectrum environment the FCC wants to promote? When there is no time to research alternatives, must the FCC necessarily endorse a certain type of interference mitigation technology or wireless operator? Before the FCC can fully enjoy the flexibility of the framework described in this Note, it must think carefully about the consequences of requiring change too soon.