THE WASTELAND: ANTICOMMONS, WHITE SPACES, AND THE FALLACY OF SPECTRUM

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Nearly fifty years after Federal Communications Commission Chairman Newton Minow notoriously labeled television a "vast wasteland," the FCC has an opportunity to transform the barren terrain of broadcast spectrum into a verdant oasis of connectivity. The long-dormant "white spaces" around broadcast television channels may soon be opened, creating major opportunities for wireless broadband access as well as innovative new communications systems. The white spaces also illustrate persistent misunderstandings about property rights. TV broadcasting today represents a tragedy of the anticommons: a government-engendered misallocation of property rights, resulting in under-consumption of a valuable resource. Advocates of exclusive spectrum rights go astray by insisting that spectrum itself is the scarce resource, and assuming a centralized service delivery model. The FCC's unlicensed approach will best unlock the potential of the white spaces. However, both the exclusive and unlicensed models have a place in the broadcast bands. A hybrid approach can avoid gridlock and maximize the value of "the people's airwaves."

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INTRODUCTION

> *I urge you, I urge you to put the people's airwaves to the service of the people and the cause of freedom. You must help prepare a generation for great decisions. You must help a great nation fulfill its future. Do this! I pledge you our help.*
>
> *– Newton Minow, 1961*

Federal Communications Commission (FCC) Chairman Newton Minow's 1961 address to the National Association of Broadcasters is legendary for its caustic dismissal of television as a "vast wasteland."[1] Yet Minow intended to emphasize a different two-word phrase: "public interest."[2] Television was the most prominent use of "the people's airwaves"—the government-defined capacity for wireless communication—and it was failing to serve national interests.[3] As insipid as TV programming was (and is), however, Minow's own agency was at least

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1. Newton N. Minow & Fred H. Cate, *Revisiting the Vast Wasteland*, 55 FED. COMM. L.J. 407, 408 (2003) ("With that one speech, Minow altered the American vocabulary forever."); *see also* MARY ANN WATSON, THE EXPANDING VISTA: AMERICAN TELEVISION IN THE KENNEDY YEARS 21–25 (1990); James L. Baughman, *Minow's Viewers: Understanding the Response to the "Vast Wasteland" Address*, 55 FED. COMM. L.J 449, 449–450 (2003).

2. Minow & Cate, *supra* note 1, at 413 ("Particularly astonishing was the importance the press placed upon two words—'vast wasteland'—which I didn't think were that important. But somehow that stuck in the public mind. I had two different words in mind: 'public interest.'"). The title of the speech, after all, was "Television and the Public Interest."

3. Newton N. Minow, Address to the Nat'l Ass'n of Broad.: Television and the Public Interest (May 9, 1961), *available at* http://www.americanrhetoric.com/speeches/newtonminow.htm.

partly to blame. FCC rules effectively limited the market to three major broadcast networks delivering least-common-denominator content.[4] The true wasteland was the space where transmissions *were not* happening.

Nearly fifty years after Minow stood before his stunned audience, the FCC has an opportunity, amid the vast wasteland of broadcasting, to create a verdant oasis of connectivity.[5] The long-dormant "white spaces" around broadcast TV channels may soon be opened to new forms of communication.[6] Transmission in the white spaces was prohibited decades ago to protect broadcasters, but modern wireless devices can operate there transparently. The question is how the regulator should allocate these spaces: through more flexible versions of the exclusive licenses granted to broadcasters, or through inclusive mechanisms that allow for broader access. The FCC has decided to make the white spaces available on an unlicensed basis, meaning that any device meeting technical requirements could operate there.[7] This was a wise choice. The best way to maximize the benefit of the white spaces, however, is to consider holistically the problem of gridlock in the broadcast bands. Both exclusive property rights and unlicensed allocation can play synergistic roles.

The debate over what to do with the white spaces illustrates persistent misunderstandings about both wireless spectrum and property rights. Communications policy scholars agree that broadcasting represents a tragedy of the anticommons: a government-engendered misallocation of property rights, resulting in under-consumption of a valuable resource.[8] Those scholars disagree about almost everything else. Advocates of exclusive spectrum rights insist, incorrectly, that spectrum itself is the scarce physical resource. The anticommons model sheds light on why this viewpoint is flawed. Both exclusion and inclusion have a place in spectrum policy, but only a commons approach can unlock the potential of the white spaces.

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4. *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, 416–17 (2001).

5. I apologize to the reader for the large number of metaphors, similes, and analogies in this Article. Spectrum is tough to conceptualize directly. Analogical reasoning is often the best means to see clearly the nature of this phenomenon, especially if care is taken to identify the limits of the analogies.

6. *See infra* Part I.B.

7. *See* Unlicensed Operation in the TV Broadcast Bands, Second Report and Order and Memorandum Opinion and Order, 23 FCC Rcd. 16807 (Nov. 14, 2008) [hereinafter White Spaces Order]; Unlicensed Operation in the TV Broadcast Bands, Second Report and Order and Memorandum Opinion and Order, 51 Commc'ns Reg. (P&F) 578 (Sept. 23, 2010) [hereinafter White Spaces Implementation Order].

8. *See* Michael A. Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 HARV. L. REV. 621 (1998) [hereinafter Heller, *Anticommons*]; MICHAEL HELLER, THE GRIDLOCK ECONOMY: HOW TOO MUCH OWNERSHIP WRECKS MARKETS, STOPS INNOVATION, AND COSTS LIVES (2008) [hereinafter HELLER]. In this paper, I use Heller's "anticommons" formulation from his academic writings, rather than the more colloquial term, "gridlock," from his book.

This Article uses broadcast white spaces to analyze the nature of spectrum property rights and the potential for tragedies of the commons and anticommons. Part I describes the conflicts over the white spaces and spectrum policy generally. Part II passes the spectrum policy debate through the filter of the anticommons analysis. Part III offers a proposal to overcome the current gridlock.

I. THE DEATH AND LIFE OF GREAT AMERICAN SPECTRUM

The broadcast white spaces are unused frequencies within the spectrum allocations for television broadcasting throughout the United States.[9] The FCC has proposed to give these dead channels new life. The white spaces are likely to be the only low-frequency "beachfront" spectrum to be made available in the United States for the foreseeable future.[10] With wireless demand skyrocketing, unlocking the white spaces is an important opportunity that should not be missed.[11]

Like the states entering the Union prior to the American Civil War, the white spaces are uniquely poised between two potential models: property rights and commons. The white spaces could be subject to exclusive property rights, or they could be made available on an unlicensed basis. The FCC has proposed allowing unlicensed devices to operate in the white spaces, but it faces opposition from advocates of exclusive property rights, as well as from broadcasters and other incumbent users.[12] The FCC should continue on its path. The limitations of the white spaces make an unlicensed allocation superior to alternative models. To

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9. *See* Susan P. Crawford, *The Radio and the Internet*, 23 BERKELEY TECH. L.J. 933, 999 (2008); Sascha D. Meinrath & Michael Calabrese, *"White Space Devices" & the Myths of Harmful Interference*, 11 N.Y.U. J. LEGIS. & PUB. POL'Y 495, 497–99 (2008); Michael Calabrese, *The End of Spectrum 'Scarcity': Building on the TV Bands Database to Access Unused Public Airwaves* (New Am. Found., Working Paper No. 25, 2009), *available at* http://www.newamerica.net/files/Calabrese_WorkingPaper25_EndSpectrumScarcity.pdf; J.H. Snider, *Reclaiming the Vast Wasteland: The Economic Case for Re-Allocating the Unused Spectrum (White Space) Between TV Channels 2 and 51 to Unlicensed Service* 1 (New Am. Found., Working Paper No. 13, 2006), *available at* http://www.newamerica.net/files/WorkingPaper13.UnlicensedEconCase.Snider.pdf; Pierre de Vries, *Populating the Vacant Channels: The Case for Allocating Unused Spectrum in the Digital TV Bands to Unlicensed Use for Broadband and Wireless Innovation* 3 (New Am. Found., Working Paper No. 14, 2006), *available at* http://www.newamerica.net/files/WorkingPaper14.DTVWhiteSpace.deVries.pdf.

10. *See* Crawford, *supra* note 9, at 934 (calling the January 2008 auction of 700 MHz frequencies, "probably the last competitive auction for a substantial amount of spectrum for the next few decades . . . ."); *see also* HELLER, *supra* note 8, at 92–93; Meinrath & Calabrese, *supra* note 9, at 499–501.

11. AT&T Wireless estimates that mobile data traffic in the United States will increase by a factor of 250 to 600 between 2008 and 2018. *See* RYSAVY RESEARCH, MOBILE BROADBAND SPECTRUM DEMAND 12 (2008), *available at* http://www.rysavy.com/Articles/2008_12_Rysavy_Spectrum_Demand_.pdf. This will overload existing networks, and create demand for use of the white spaces. New devices such as the iPhone are already overloading existing mobile data networks. *See* Leslie Cauley, *iPhone Gulps AT&T Network Capacity*, USA TODAY, June 17, 2009, at 1B.

12. White Spaces Order, *supra* note 7, ¶ 18; White Spaces Implementation Order, *supra* note 7, ¶ 3.

show this superiority, the starting point of the inquiry must be the context for the rights being allocated.

A. Context Matters in Allocating Property Rights

Draw an imaginary line northward from the bottom tip of Manhattan.[13] Record the average building height on each block. You will generate a graph with a wide distribution: tall buildings downtown, shorter ones in SoHo and Greenwich Village, skyscrapers again in midtown, virtually nothing in Central Park, and modest heights through Harlem and the Bronx.

Once data is gathered, the task for experts is to provide interpretations. A property law scholar, viewing this graph of New York City, with no knowledge of what it represented, could easily formulate an explanation for the variance. The peaks would represent intensive use of some resource. Perhaps insufficient property rights produced a tragedy of the commons, where users overconsumed a scarce asset to a ruinous degree. The graph might represent the daily harvest of the wondrous Truffula trees in the Dr. Seuss story *The Lorax*, which were clear-cut to oblivion in a parable of environmental degradation.[14] The long trough in the middle would be evidence of the opposite problem: an anticommons of underuse, where too many owners exercised blocking rights against each other.[15] And the moderate zones could represent well-functioning pockets of market-mediated private property.

This story would represent reality about as much as Dr. Seuss's Bar-Ba-Loot Bears. The true explanations are more mundane. Buildings are taller on Wall Street than in the Village because the latter lacks bedrock near the surface for underground support columns. They are shorter in Harlem than Midtown because the two neighborhoods, though only a few miles apart on the same island, experience very different economic conditions. And the anomalous development-free zone in Central Park is not a tragedy but a triumph. That mandatory open space amid the concrete canyons not only increases the value of all nearby real estate, it enhances the welfare of virtually everyone who lives in, works in, or visits Manhattan.[16]

The lesson from this example is that the implications of property rights regimes can be understood only with careful attention to context. Whether there is "a little" or "a lot" of usage is an absolute question, not a relative one, unless there is evidence that the two examples are sufficiently isomorphic in other respects. And the more important issue, whether there is "too much" or "not enough" usage, is even harder to pin down in the abstract. The story of the slow rollout of "golden rice" to combat blindness in the developing world resonates because it clearly

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13. Strictly speaking, Manhattan Island is oriented to the Northeast. For these illustrative purposes, assume the stylized Manhattan map familiar to millions of New York City subway riders.

14. DR. SEUSS, THE LORAX (1971).

15. Heller, *Anticommons*, *supra* note 8, at 668–69.

16. *See* Abraham Bell & Gideon Parchomovsky, *Of Property and Antiproperty*, 102 MICH. L. REV. 1, 20–23 (2003).

juxtaposes a thicket of blocking patents against a life-saving innovation.[17] And incentivizing innovation is the stated rationale for the very patent system creating that blockage. Otherwise, it is not so clear why seventy legitimate rights holders should bow before a new strain of rice.[18] In assigning legal rights, the first task is to understand the phenomenon under consideration. Nowhere is this more apparent than for wireless spectrum.

Wireless communication—including broadcast uses such as television and radio, as well as mobile phones, wireless data systems, sensors, and other applications—supports a massive amount of economic activity and social interaction.[19] Companies spend billions of dollars for licenses authorizing them to transmit in certain frequencies, and billions more to erect networks in order to do so.[20] Yet a graph of wireless spectrum utilization looks strikingly like the Manhattan building height chart.[21] A few frequencies are intensively used, some have moderate usage, and a surprising percentage show hardly any use at all. What are we to make of this pattern? A good answer must focus not on the graph, but on what it represents.[22] The proper allocation of property rights depends on a clear understanding of the environment in which those rights are assigned.[23] And first impressions are often incorrect.

This was, in fact, the original insight upon which Michael Heller developed his theory of the tragedy of the anticommons.[24] Heller sought to explain the paradoxical juxtaposition in 1990s Russia between empty storefronts and sidewalk stalls filled with goods, despite privatization of formerly state-owned assets.[25] His explanation was that not all property rights are equally exploitable in practice. Even when boundaries are clear, property rights may be effectively unusable where the content of the endowments are poorly defined, and core rights are split among multiple owners who can exercise veto power.[26] In assigning property rights, therefore, governments must examine the real world conditions in which they will operate. A structure that might have generated transactions to produce an efficient allocation in the United States, with a strong commitment to

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17. *See* HELLER, *supra* note 8, at 55–56. As Heller states, "With Golden Rice, the humanitarian benefits were clear, moral outrage at patent gridlock was high, and the private owners could contribute their patents for third world health without imperiling profits in their first world markets." *Id.* at 55.

18. *See id.* at 55.

19. *See generally* MORGAN STANLEY, THE MOBILE INTERNET REPORT (2009), http://www.morganstanley.com/institutional/techresearch/pdfs/mobile_internet_report.pdf.

20. *See* HELLER, *supra* note 8, at 91.

21. *See id.* at 80.

22. To be fair, Heller notes the problem, but suggests the data are "highly suggestive" of gridlock, and proceeds on that assumption. *Id.* at 81.

23. Here, I agree with Thomas Hazlett's and Matthew Spitzer's argument that a decision in favor of one or the other allocation method should be based on a careful analysis of costs and benefits, rather than an abstract preference for one regime. *See* Thomas W. Hazlett & Matthew L. Spitzer, *Advanced Wireless Technologies and Public Policy*, 79 S. CAL. L. REV. 595, 603–04 (2006).

24. *See* Heller, *Anticommons*, *supra* note 8.

25. *See id.* at 633–58.

26. *See id.* at 666.

the rule of law and long-standing institutional foundations for private property, created a tragedy in post-Soviet Russia.[27]

The fall of communism was a rare opportunity to implement a welfare-maximizing property rights system consciously, coherently, and on a (seemingly) blank slate. That opportunity was missed, although it is fair to ask whether the process could have realistically been better under the circumstances. The main lesson for legal scholars is that, in allocating new property rights, governments should strive to avoid grants that are too restricted or too fragmented to enable effective use. And they should exercise care in defining substantive bundles of rights. Instead of privatizing the bundle of rights associated with a retail store in the West, Russian bureaucrats granted different recipients overlapping partial entitlements to sell, lease, and manage.[28] Each owner could prevent productive use of the property. In short, the government "propertized" the wrong things.

B. Recovering the White Spaces

The broadcast white spaces offer an opportunity similar in kind (if not in magnitude) to the fall of the Soviet Union. The government has the opportunity to manage a transition to functional property rights. The question is how to avoid the ruinous fragmentation of an anticommons and other indicia of a dysfunctional regime. The FCC has two choices: grant exclusive property rights in the spectrum itself (the "property" position), or grant each owner of a compliant wireless device the right to transmit in the white spaces (the "commons" position).[29]

The property and commons labels are somewhat misleading.[30] A commons is also a structure of property rights, only those rights are inclusive rather than exclusive.[31] Exclusive ownership of the right to transmit with certain frequency, power, location, time, or other criteria is not the only way to employ property rights in wireless communication. However, "property" and "commons"

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27. *See id.* at 658–59.

28. *See* HELLER, *supra* note 8, at 145–46.

29. *See* Yochai Benkler, *Overcoming Agoraphobia: Building the Commons of the Digitally Networked Environment*, 11 HARV. J.L. & TECH. 287 (1998) [hereinafter Benkler, *Agoraphobia*]; Yochai Benkler, *Some Economics of Wireless Communications*, 16 HARV. J.L. & TECH. 25 (2002) [hereinafter Benkler, *Some Economics*]; Gerald R. Faulhaber, *The Question of Spectrum: Technology, Management, and Regime Change*, 4 J. TELECOMM. & HIGH TECH. L. 123, 129–130 (2005); Ellen P. Goodman, *Spectrum Rights in the Telecosm to Come*, 41 SAN DIEGO L. REV. 269, 280–88 (2004); Thomas W. Hazlett, *Spectrum Tragedies*, 22 YALE J. ON REG. 242, 260–61 (2005); Kevin Werbach, *Open Spectrum: The Paradise of the Commons*, RELEASE 1.0, Nov. 20, 2001, at 1, *available at* http://cdn.oreilly.com/radar/r1/11-01.pdf; Kevin Werbach, *Supercommons: Toward a Unified Theory of Wireless Communication*, 82 TEX. L. REV. 863, 867–77 (2004) [hereinafter Werbach, *Supercommons*].

30. Advocates of the property position have acknowledged this fact as well. *See* Hazlett & Spitzer, *supra* note 23, at 597 n.1 (2006) ("'Property rights' exist under any regime, so describing any single approach this way can be misleading.").

31. *See* HELLER, *supra* note 8, at 1. *See generally* ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION (1990); Carol Rose, *The Comedy of the Commons: Custom, Commerce, and Inherently Public Property*, 53 U. CHI. L. REV. 711 (1986).

have become shorthand for the two approaches,[32] and they capture essential elements of the conflict.

The white spaces are an artifact of command-and-control spectrum allocation.[33] The FCC historically specified not only who could use particular frequencies, but also how they could do so.[34] The services to be offered were written into the licenses. The technical attributes of these frequency allocations are similarly tied to the designated service offering and the state of technology at the time. For the bands used for television broadcasting, this meant that frequencies were locked into the assumptions of 1940s technology.[35] Even when newer devices would allow for more efficient allocation, and business shifts made over-the-air broadcasting less economically valuable, the allocations were trapped in amber.[36]

Specifically, the broadcast allocations deliberately left many channels dark in order to avoid interference.[37] The analog television bands were divided into six-megahertz slots for very high frequency (VHF) channels 2 to 13 and ultra high frequency (UHF) channels 14 to 83.[38] Broadcasting is an omni-directional, one-way service. A transmitter sends out a signal that can be received by any TV set within a radius defined primarily by the power level and local topography.[39] TVs are passive receivers. They display channels based on frequency and signal strength. Sixty years ago, TVs could easily display a poor-quality picture, or no picture at all, if another broadcast was too close in either frequency. Moreover, since broadcast licenses were issued for each market, a channel for one city would

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32. *See, e.g.*, Conference at Stanford Law School, *Spectrum Policy: Property or Commons?*, STANFORD CENTER FOR INTERNET & SOC'Y, Mar. 1–2, 2003, http://cyberlaw.stanford.edu/spectrum (framing the debate in these terms).

33. The FCC's Spectrum Task Force identified three mechanisms for spectrum allocation: command-and-control, exclusive rights, and commons. *See* FCC: UNLICENSED DEVICES AND EXPERIMENTAL LICENSES WORKING GROUP, ET DOCKET NO. 02-135, SPECTRUM POLICY TASK FORCE REPORT (2002) [hereinafter SPECTRUM TASK FORCE REPORT].

34. *See* JONATHAN E. NUECHTERLEIN & PHILIP J. WEISER, DIGITAL CROSSROADS: AMERICAN TELECOMMUNICATIONS POLICY IN THE INTERNET AGE 239 (2005) (discussing the FCC's spectrum allocation process). *See generally* Ronald H. Coase, *The Federal Communications Commission*, 2 J.L. & ECON. 1 (1959) (analyzing the flaws in the FCC's spectrum allocation mechanism).

35. *See* Crawford, *supra* note 9, at 942.

36. *See* Thomas W. Hazlett, *A Law & Economics Approach to Spectrum Property Rights: A Response to Weiser and Hatfield*, 15 GEO. MASON L. REV. 975, 982 (2008) ("[T]he TV Band supplies virtually no incremental value to society despite being capable of generating tens of billions of dollars annually in consumer surplus.").

37. NUECHTERLEIN & WEISER, *supra* note 34; Meinrath & Calabrese, *supra* note 9, at 497.

38. The fact that the channels in the 700 MHz range were labeled "ultra high frequency" at the time, and are now considered desirable because their frequencies are so low, should be an indication of how much things have changed since the broadcast bands were allocated. Channels 70 to 83 were later reallocated to first-generation mobile phone service, and channels 52 to 69 were reallocated and auctioned in 2008 for mobile data services.

39. This is known as the "Grade B Contour" of the station.

function as interference in a nearby city, if the two stations were on the same frequency.

Because of these technical constraints, the band plan for TV broadcasting required that a significant number of potential channels remain unoccupied. Each channel had vacant space on each side, and nearby cities had non-overlapping channels. So, for example, Los Angeles had stations on channels 2, 4, and 7, while San Diego had channels 3, 6, and 10, but not the reverse. The empty channels this produced were the initial components of the broadcast white spaces. There is even more open capacity than that, however, because not all available channels are licensed in every city. And today, when the vast majority of Americans get their television from cable and satellite systems, most of the value broadcasters receive comes through their "must carry" rights on those platforms.[40] Overall, a majority of TV broadcast channels today are not in use.[41]

Obviously, communications technology has come a long way since the 1940s. Every iPhone packs more computing power than the entire Apollo space program had at its disposal.[42] A TV set built today could distinguish channels well enough to allow far denser packing of the broadcast bands. Moreover, the United States recently completed a shift from analog to digital television.[43] Digital TV compresses signals far more efficiently, while still delivering higher-quality pictures, than the old analog technology. And digital sets can be far smarter about which signal they are supposed to receive. Even with the digital transition and associated "repacking" of channel allocations, however, there remain massive amounts of white space in the broadcast bands because there are a limited number of broadcast licensees in each metropolitan area.[44]

The massive inefficiency of the white spaces was not lost on the FCC. The problem was that that inefficiency was locked into the licensing structure. The FCC could not allocate new licenses to the white spaces because those new transmissions would create difficulties for the incumbent broadcasters. The broadcasters had settled expectations from half a century of license renewals, even if their use of the spectrum was wildly inefficient. Moreover, capacity for additional fixed, one-way, city-specific, over-the-air television broadcast channels is no longer in demand.[45] What users want is two-way mobile communications, for

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40. *See* de Vries, *supra* note 9, at 6.

41. *See id.* at 5.

42. *See* Grant Roberston, *How Powerful Was the Apollo 11 Computer?*, SWITCHED DOWNLOAD SQUAD (July 20, 2009), http://www.downloadsquad.com/2009/07/20/how-powerful-was-the-apollo-11-computer/.

43. *See* Rob Pegoraro, *After Bouts of Static, Digital TV Takes Over*, WASH. POST, June 13, 2009, at A11; Brian Stelter, *The Changeover to Digital TV Gets Off to a Smooth Start, Mostly*, N.Y. TIMES, June 14, 2009, at A16; *see also* JOEL BRINKLEY, DEFINING VISION: THE BATTLE FOR THE FUTURE OF TELEVISION (1997) (recounting the history of the digital TV transition); Crawford, *supra* note 9, at 961–63 (describing implications of the changeover for spectrum policy).

44. *See* Meinrath & Calabrese, *supra* note 9, at 497–98, 497 n.7 (pointing out that even after the digital transition, 30–80% of channels 2 to 51 will be vacant).

45. Television is more efficiently and commonly delivered over wired (cable and fiber) and satellite connections anyway. *See* Thomas W. Hazlett, *The U.S. Digital TV*

voice and, increasingly, for data, video, and other services.[46] Since wireless licensees have been given the freedom to deliver virtually any service they choose after winning FCC auctions, this is universally what they have built. Until wireless devices were sufficiently adaptive, however, there was no obvious way to fit this dynamic square peg into the fixed round holes of the white spaces.

The success of Wi-Fi in the unlicensed 2.4 GHz band convinced the FCC that the white spaces could finally be unlocked.[47] Wi-Fi took an underutilized set of frequencies with a patchwork of incumbent users and created a wildly successful environment for investment and innovation.[48] The unlicensed approach allowed for entry and creative solutions, even though the competing uses of the band would deter any exclusive rights holder. In 2002, the FCC established a spectrum task force to investigate new opportunities for increasing usable wireless capacity.[49] One concept that emerged from the process was the idea that unlicensed devices could be allowed to transmit in the broadcast white spaces. The FCC issued a Notice of Proposed Rulemaking in 2004, seeking comment on this idea.[50]

Though broadcasters and wireless microphone operators expressed concerns about interference, the FCC decided to move forward with the idea.[51] It issued an initial conclusion in 2006 that unlicensed devices could operate without generating excessive interference.[52] The FCC's Office of Engineering and Technology (OET) began a testing process to reinforce this conclusion.[53] A number of equipment vendors and other technology companies, including

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Transition: Time to Toss the Negroponte Switch 12–13 (AEI-Brookings Joint Center for Regulatory Studies, Working Paper No. 01-15, 2001), *available at* http://regulation2point0.org/wp-content/uploads/downloads/2010/04/working_01_15.pdf.

46. *See* Andrew Odlyzko, *Content Is Not King*, FIRST MONDAY, Feb. 2001, http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/833/742.

47. *See* Benkler, *Agoraphobia*, *supra* note 29, at 330; Hazlett & Spitzer, *supra* note 23, at 622 n.99, 623; *Wi-Fi: It's Fast, It's Here – and It Works*, BUS. WEEK, Apr. 3, 2002; Kenneth R. Carter, Ahmed Lahjouji & Neil McNeal, *Unlicensed & Unshackled: A Joint OSP-OET White Paper on Unlicensed Devices and their Regulatory Issues* (FCC Office of Strategic Policy Working Paper Series, No. 39, May 2003), *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-234741A1.pdf.

48. *See* Faulhaber, *supra* note 29, at 139–40; Kevin Werbach, Comments at Spectrum Policy Conference: Property or Commons (Mar. 1, 2003) (transcript available at http://werbach.com/docs/spectrum_conf_comments.html).

49. *See* SPECTRUM TASK FORCE REPORT, *supra* note 33; FCC, Notice of Inquiry, Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band, ET Docket No. 02-380 (Dec. 20, 2002).

50. FCC, Notice of Proposed Rulemaking, Unlicensed Operation in the TV Broadcast Bands, ET Docket No. 04-186, FCC 04-113 (2004) [hereinafter White Spaces Notice].

51. Randy Hoffner, *White Space Devices: Threat to Broadcast TV?*, TV TECH. (Dec. 5, 2007), http://www.tvtechnology.com/pages/s.0079/t.10086.html.

52. FCC, ET DOCKET NOS. 04-186, 02-380, FIRST REPORT AND ORDER AND FURTHER NOTICE OF PROPOSED RULE MAKING IN THE MATTER OF UNLICENSED OPERATION IN THE TV BROADCAST BANDS (2006) [hereinafter WHITE SPACES FURTHER NOTICE].

53. *See id.*

Microsoft, Philips, and Motorola, created prototype devices.[54] OET concluded that these prototypes confirmed unlicensed white space devices could operate alongside licensed television stations and other systems.[55]

The FCC issued an order authorizing unlicensed use of the white spaces in November 2008.[56] It allowed for both fixed and mobile devices, but required that all such devices query an online geolocation database to verify available channels in their current location prior to transmitting.[57] It put into place various other mechanisms, such as power limits and sensing requirements, in order to protect incumbent broadcasters, wireless microphone operators, and others.[58] Some unlicensed white spaces proponents, such as Google, argue that these limits are so strict they may constrain the financial viability of white space devices.[59] Important implementation details also remain to be addressed, including the mechanics of the geolocation database.[60] The order has yet to go into effect because broadcasters have sued to block it.[61]

In response to the FCC action, technical standards bodies and companies have begun to develop technologies to exploit the newly accessible white spaces. As with Wi-Fi, the FCC specified only general parameters; it left the technical implementation decisions to the private sector. The significant level of standardization activity around the FCC's proposal, well before it was ratified, shows that the technical community believes an unlicensed approach is viable for the white spaces. Many of the participants in the standards process, as well as those who developed prototypes for the FCC testing process, work for commercial vendors such as Microsoft and Motorola. Companies are willing to invest time and resources based on their expectation that unlicensed white spaces will generate significant usage.

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54. FCC, OFFICE OF ENGINEERING AND TECH., FCC/OET 08-TR-1005, EVALUATION OF THE PERFORMANCE OF PROTOTYPE TV-BAND WHITE SPACE DEVICES PHASE II, 6–8 (2008), *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-08-2243A3.pdf.

55. *Id.* at vi–viii.

56. *See* White Spaces Order, *supra* note 7; *see also* Kevin J. Martin, *Balancing Deregulation and Consumer Protection*, 17 COMMLAW CONSPECTUS, at i, iv (2008) ("Our action opening the white spaces will encourage the creation of a Wi-Fi on steroids. It has the potential to improve wireless broadband connectivity and inspire an ever-widening array of new innovative Internet based products and services for consumers.").

57. The database holds the potential to be the basis for a broader approach to dynamic spectrum sharing. *See* Kevin Werbach, *Castle in the Air: A Domain Name System for Spectrum*, 104 NW. U. L. REV. 613, 627–28 (2010).

58. *See* White Spaces Order, *supra* note 7, ¶¶ 71, 105.

59. *See* Opposition and Comments of Google Inc. Submitted to the FCC, ET Docket No. 04-186, Unlicensed Operation in the TV Broadcast Bands, at 13–14 (May 8, 2009).

60. *See id.* at 4–8. An industry group has been formed to address these issues. *See Ex Parte* Filing of the White Spaces Database Group, ET Docket No. 04-186 (Apr. 10, 2009).

61. *See* Matthew Lasar, *Broadcasters Sue FCC over White Space Broadband Decision*, ARS TECHNICA (Mar. 3, 2009, 11:56 AM), http://arstechnica.com/tech-policy/news/2009/03/broadcasters-sue-fcc-over-white-space-broadband-decision.ars.

The Institute of Electrical and Electronic Engineers (IEEE) formed a standards body, known as 802.22, shortly after the FCC issued its initial white space proposal in 2004.[62] The 802.22 standard uses cognitive radio techniques that sense and adapt to the surrounding environment.[63] The IEEE working group is focusing initially on supporting regional area networks in rural areas where other technologies are not commercially viable.[64] These areas have the most available white space channels, the least potentially competing transmissions, and a significant market need for broadband alternatives. A lesson from Wi-Fi, though, is that deployment scenarios can be unpredictable. Wi-Fi was developed for local area networks between computers inside corporations, but it migrated to consumer and retail "hotspot" scenarios, among others.[65] Researchers are now proposing technical mechanisms for coordination among independent 802.22 mesh networks, which could further enhance the efficiency of white space utilization.[66]

A group of Microsoft researchers recently announced a complementary technical solution for unlicensed white spaces called WhiteFi.[67] WhiteFi is a complete system architecture for a Wi-Fi-like usage scenario operating within the white spaces. An access point could support multiple client devices, such as laptop computers or mobile phones. WhiteFi networks could operate as local distribution points for 802.22 regional-area connections to neighborhoods.[68] The Microsoft

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62. *See IEEE Starts Standard to Tap Open Regions in the TV Spectrum for Wireless Broadband Services* (Oct. 12, 2004), http://web.archive.org/web/20041028142130/http://standards.ieee.org/announcements/pr_80222.html (accessed by entering "http://standards.ieee.org/announcements/pr_80222.html" in the Internet Archive).

63. *See* Carl R. Stevenson et al., *IEEE 802.22: The First Cognitive Radio Wireless Regional Area Network Standard*, IEEE COMM., Jan. 2009, at 130. This represents perhaps the first commercial application of the cognitive radio concept. *See* Werbach, *Supercommons*, *supra* note 29, at 896; Carlos Cordeiro et al., *IEEE 802.22: An Introduction to the First Wireless Standard Based on Cognitive Radios*, 1 J. COMM., no. 1, Apr. 2006, at 38, 38 ("Cognitive radios (CRs) are seen as the solution to the current low usage of the radio spectrum."); Joseph Mitola III & Gerald Q. Maguire, Jr., *Cognitive Radios: Making Software Radios More Personal*, 6 IEEE PERSONAL COMM., no. 4, 1999, at 13.

64. *See* Stevenson et al., *supra* note 63, at 138 ("The developing IEEE 802.22 standard will allow broadband access to be provided in sparsely populated areas . . . by using cognitive techniques . . . in the VHF/UHF TV broadcast bands. This will increase the efficiency of utilization of that spectrum, and provide large economic and societal benefits.").

65. *See* Kevin J. Negus, *History of Wireless Local Area Networks (WLANs) in the Unlicensed Bands*, 11 INFO, no. 5, 2009, at 36.

66. *See* Shamik Sengupta et al., *A Coordinated Distributed Scheme for Cognitive Radio Based IEEE 802.22 Wireless Mesh Networks*, Proceedings of IEEE International Conference on Communications Workshops, ICC CogNet Workshop (May 19–23, 2008), at 461–65.

67. *See* Paramvir Bahl et al., *White Space Networking with Wi-Fi Like Connectivity*, MICROSOFT RES. (Aug. 1, 2009), http://research.microsoft.com/apps/pubs/default.aspx?id=80952; Erica Naone, *Wi-Fi via White Spaces*, TECH. REV. (Aug. 18, 2009), http://www.technologyreview.com/communications/23271/?a=f.

68. *See* Bahl et al., *supra* note 67, at 12.

research group has received an experimental license from the FCC to deploy a test WhiteFi network on Microsoft's corporate campus.[69]

In September 2010, the FCC issued a further order resolving the remaining issues for authorization of white space devices.[70] The order finalized the rules for white space devices and disposed of several reconsideration petitions.[71] The FCC made minor technical modifications to ensure that white space devices could operate opportunistically alongside incumbent broadcasters, wireless microphones, and other systems.[72] It rejected claims by broadcasters and others that opportunistic access would produce interference or lead to underutilization of the bands. The Commission observed that several white space systems were already operating on an experimental basis, for functions such as low-cost broadband access, environmental monitoring, and smart grid energy systems.[73] With the FCC decision, device manufacturers can begin developing equipment to be deployed after passing the FCC's certification process.

C. The White Spaces and Spectrum Policy

There is no dispute that spectrum in general, and the white spaces in particular, are catastrophically underutilized. Many studies have shown that most spectrum is simply not in use most or all of the time.[74] Shared Spectrum Company measured activity in the 30 MHz–3 GHz bands most suitable for communications applications across several cities in the United States.[75] It found that, on average, 94% of frequencies were not in use.[76] Even in New York City, during the high activity period of the Republican National Convention, 87% of frequencies showed virtually no activity.[77] In the case of the white spaces, such studies are not necessary to show the lack of usage. The white spaces are deliberately empty. Transmission has been expressly forbidden, with a handful of small exceptions, in a majority of the television broadcast frequencies.[78]

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69. *See* Naone, *supra* note 67.

70. White Spaces Implementation Order, *supra* note 7.

71. *Id.* ¶ 1 ("By this action, we are finalizing rules to make the unused spectrum in the TV bands available for unlicensed broadband wireless devices.").

72. *Id.* ¶ 3.

73. *See id.* ¶ 14.

74. *See, e.g.*, MARK MCHENRY, DUPONT CIRCLE SPECTRUM UTILIZATION DURING PEAK HOURS (2003), http://www.newamerica.net/files/archive/Doc_File_183_1.pdf; MARK MCHENRY ET AL., SPECTRUM OCCUPANCY MEASUREMENTS: CHICAGO, ILLINOIS, NOVEMBER 16–18, 2005 (2005), at 52–53, *available at* http://www.sharedspectrum.com/wp-content/uploads/NSF_Chicago_2005-11_measurements_v12.pdf [hereinafter MCHENRY ET AL., MEASUREMENTS]; Michael Calabrese, *The End of Spectrum 'Scarcity': Building on the TV Bands Database to Access Unused Public Airwaves* 3 (New Am. Found. Wireless Future Program, Working Paper No. 25, 2009).

75. *See* MCHENRY ET AL., MEASUREMENTS, *supra* note 74, at 53.

76. *See* Calabrese, *supra* note 74, at 3.

77. *See id.*

78. *See generally* Michael Calabrese, *Measuring the TV "White Space" Available for Unlicensed Wireless Broadband*, NEW AM. FOUND. (2006), http://www.newamerica.net/publications/policy/measuring_tv_white_space_available_for_unlicensed_wireless_broadband.

This represents a truly epic waste. Spectrum is not an end in itself, like the scenic vistas of Central Park. It is a means to enable communication.[79] The existence of so much unused spectrum means that innovative, productive, and informative communications are not taking place, and the spectrum actually being used is more congested and expensive than it should be. This gap in spectrum utilization is not a technological or market failure; it is a regulatory failure. All parties to the spectrum policy debate, including the FCC itself, acknowledge that the traditional approach of "command and control" allocation, subject to strict service limits and restraints on alienation, is the central impediment to more efficient spectrum utilization.[80] In *The Gridlock Economy*, Michael Heller calls this the "zone of agreement."[81]

There is also widespread agreement that the solution to the tragic inefficiency of spectrum underutilization is a combination of approaches. Yochai Benkler advocates ten-year experiments with both property and commons approaches.[82] David Farber and Gerald Faulhaber suggest a "non-interfering easement" around exclusive rights.[83] I have proposed a universal communications privilege mediated by tort law for open access amid zones of property.[84] Lawrence Lessig crystallizes the consensus as getting centralized decisionmakers such as the government out of the allocation process, so spectrum utilization can become more dynamic: "The solution is to eliminate the need to ask permission."[85] Even the government seems to agree.[86]

Unfortunately, this harmonious situation exists only on the surface. Spectrum property advocates seemingly cannot reconcile themselves to the idea that the commons approach can work. Faced with the proof of the existence of Wi-Fi, which took effectively unusable spectrum in the congested "Industrial, Scientific, and Medical" band and made it ground zero for a massive and highly

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79. *See infra* Part II.C.

80. *See* SPECTRUM TASK FORCE REPORT, *supra* note 33; *see also* Faulhaber, *supra* note 29, at 123 ("There is general agreement that the traditional command-and-control regulation of radio spectrum by the FCC (and NTIA) has failed.").

81. *See* HELLER, *supra* note 8, at 93.

82. *See* Benkler, *Some Economics*, *supra* note 29, at 35.

83. Gerald R. Faulhaber & David Farber, *Spectrum Management: Property Rights, Markets, and the Commons*, *in* RETHINKING RIGHTS AND REGULATIONS: INSTITUTIONAL RESPONSES TO NEW COMMUNICATION TECHNOLOGIES 193, 213–14 (Lorrie Faith Cranor & Steven S. Wildman eds., 2003).

84. *See* Werbach, *Supercommons*, *supra* note 29, at 863.

85. LAWRENCE LESSIG, THE FUTURE OF IDEAS: THE FATE OF THE COMMONS IN A CONNECTED WORLD 84 (2001).

86. *See* SPECTRUM TASK FORCE REPORT, *supra* note 33. Technically, the Spectrum Task Force report was a staff report and not an official statement by the FCC. However, the Task Force was created by the FCC Chairman and its conclusions had a significant impact in shaping FCC decisions. *See* Press Release, Michael K. Powell, Chairman, Spectrum Policy Task Force, Status Report (Nov. 2003), *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-241195A2.pdf ("The Commission has considered and incorporated the Task Force's findings and recommendations in a number of spectrum allocation and licensing proceedings . . . .").

innovative market,[87] property advocates marginalize it as an edge case or belittle its economic significance.[88] Worse still, they seek to redefine the commons approach as centralized state allocation in disguise.[89] I address these claims in Part II.

Let us return to the Manhattan analogy. Zoom in from the map to the ground-level interactions in one of those medium-density neighborhoods in Greenwich Village. As urban activist Jane Jacobs brilliantly demonstrated, the seeming chaos of the checkerboard development and dense intermingled population hides a remarkable emergent order.[90] The powerful New York urban planner Robert Moses wanted to replace the cacophony of SoHo lofts and narrow streets with the smooth aggregation of massive highways.[91] Jacobs and her allies showed that the city's fragmentation and distributed authority was also its strength, at least within the context of close-knit neighborhoods.[92]

The advocates of spectrum property rights are like Robert Moses, while proponents of the commons are like Jane Jacobs. Moses emerges as a tragic figure in Robert Caro's classic study, *The Power Broker*, because his lack of trust in people's ability to self-organize leads him to exercise power for its own sake.[93] Rather than a central manager, real communities are messy collections of individual actors. Yet they manage to coordinate and share far more than might be expected.[94]

Returning to the significance of context, there is reason to believe that the particularities of the white spaces lend themselves well to an unlicensed allocation, and poorly to a property rights approach. The 2.4 GHz "junk" bands where Wi-Fi operates were considered useless for commercial licensing because of incumbent industrial and medical users, not to mention microwave ovens that radiated in the band.[95] The absence of guaranteed protection against interference is what

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87. *See* Om Malik, *How Smartphones Are Making Wi-Fi Hot Again*, GIGAOM (Aug. 18, 2009), http://gigaom.com/2009/08/18/how-smartphones-are-making-wi-fi-hot-again/.

88. *See* Hazlett & Spitzer, *supra* note 23, at 603–04.

89. *See* HELLER, *supra* note 8, at 94; Hazlett, *supra* note 29, at 244–46.

90. *See generally* JANE JACOBS, THE DEATH AND LIFE OF GREAT AMERICAN CITIES (1961) (describing the hidden vitality of neighborhoods in New York City).

91. *See generally* ROBERT A. CARO, THE POWER BROKER: ROBERT MOSES AND THE FALL OF NEW YORK (1974) (detailing the life and impact of Robert Moses).

92. *See generally* ANTHONY FLINT, WRESTLING WITH MOSES: HOW JANE JACOBS TOOK ON NEW YORK'S MASTER BUILDER AND TRANSFORMED THE AMERICAN CITY (2009) (summarizing the history).

93. *See* CARO, *supra* note 91.

94. *See* Yochai Benkler, *Sharing Nicely: On Sharable Goods and the Emerging of Sharing as a Modality of Economic Production*, 114 YALE L.J. 273 (2004). The Internet and related technologies make such bottom-up coordination more feasible. *See* YOCHAI BENKLER, THE WEALTH OF NETWORKS (2006) [hereinafter BENKLER, WEALTH OF NETWORKS].

95. *See* Werbach, *Supercommons*, *supra* note 29, at 958; *see also* Michael J. Marcus, *Wi-Fi and Bluetooth—The Path from Carter and Reagan-Era Faith in Deregulation to Widespread Products Impacting Our World*, 11 INFO, no. 5, 2009, at 19–35

encouraged engineers and device manufacturers to build systems that could function in such a wireless wasteland.[96] Because vendors needed only to justify the business case for selling equipment, not for an area-wide service offering, they could experiment and deliver solutions even amid the imperfections of the environment.[97] The same will be true of the white spaces.

The white spaces are not suitable for the license auctions the FCC now uses as its primary spectrum allocation mechanism, because they are geographically fragmented and subject to overlapping rights of incumbent broadcasters, wireless microphone users, and others. Moreover, there would be serious practical difficulties in granting exclusive rights in the white spaces. As Meinrath and Calabrese note, "[White Space Devices]—whether licensed or unlicensed—would need to operate at very low power and on a secondary basis to DTV and wireless microphone licensees."[98] These constraints would be strongest in the dense urban markets where the economic demand for additional wireless capacity is greatest. The fragmentation and lack of priority for white space devices would likely make any auction of these rights unattractive to significant bidders.[99]

The incumbent users of the broadcast bands are particularly inhospitable neighbors. Wireless microphones, for example, operate only in geographically defined areas, but support high-profile activities such as theatre and live sporting events.[100] Older television receivers are cheap, unintelligent devices with little ability to separate out unassociated transmissions. Given the option, a service provider looking to invest substantial capital in an infrastructure network might seek alternatives rather than take a chance on a licensed version of the white spaces. Equipment vendors and providers using other business models, however, would benefit from the low entry barriers under an unlicensed regime.

The FCC gave extensive consideration to the question of whether to allocate the white spaces as licensed or unlicensed.[101] It gave several reasons for its decision to take the unlicensed approach. First, an unlicensed allocation allows the existing licensed services to remain in place[102]: "Because unlicensed operations are not allowed to cause interference to authorized services, the interference protection status of existing services operating in these bands will not be affected, consistent with the Commission's goals in this proceeding."[103] A license to operate in the white spaces would be contingent on the existing broadcasters, which would make

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(recounting the history of the FCC's decision to authorize unlicensed use in the Industrial, Scientific, and Medical (ISM) bands).

96. *See generally* Carter et al., *supra* note 47.

97. *See* Benkler, *Some Economics*, *supra* note 29, at 36–38.

98. Meinrath & Calabrese, *supra* note 9, at 508.

99. *Id.*

100. *Id.* at 504, 515.

101. *See* White Spaces Notice, *supra* note 50, ¶ 14; WHITE SPACES FURTHER NOTICE, *supra* note 52, ¶¶ 26–32; White Space Order, *supra* note 7, ¶¶ 35–51.

102. This approach parallels the "universal transmission privilege" I proposed in an earlier paper. *See* Werbach, *Supercommons*, *supra* note 29.

103. White Space Order, *supra* note 7, ¶ 44.

it subject to shutdown due to factors beyond the licensee's control.[104] It is hard to see such rights being substantial enough to attract licensees.[105] As the FCC summarizes, "the stability normally provided by exclusive licensing would be difficult to achieve for TV band device operation."[106]

Incentives are also misaligned for exclusive property rights to work in the white spaces. The geographic and frequency boundaries of the existing broadcast band allocations were designed with television in mind. A provider seeking to use those frequencies for a different kind of service might not need the same coverage area. A large national service provider such as AT&T or Verizon Wireless, for example, might be able to assemble the components for a national footprint, or the pieces that address their greatest needs for additional capacity. A smaller provider would have a harder time. For example, a rural wireless provider seeking to offer competitive broadband access through the white spaces would need to negotiate with existing rights holders, some of whom would be current or potential competitors. A property system forecloses even the option of gaining market entry through unlicensed spectrum and shifting over to licensed frequencies.[107] The only option would be to negotiate with those who hold blocking rights.

A variant of the spectrum property approach would be to transform the existing broadcast allocations into exclusive property rights, encompassing the white spaces, and then depend on market forces to foster transactions to reallocate those rights into efficient bundles.[108] There are several problems with such a proposal. It would be politically unpopular because it involves granting incumbent broadcasters a "windfall," giving them licenses they have not paid for. Putting that concern aside, though, it is difficult to envision how such a scheme would work.

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104. White Space Order, *supra* note 7, ¶ 46. This is because licenses would have to be geographically or frequency divided. An unlicensed device can switch to another frequency when the contours of the protected broadcasters' signals changes. A licensed device has no such option if its licensed frequency turned into an unauthorized zone when a broadcaster changes its footprint. Even if the FCC issued a single licensed allocation for the entire White Space, this issue would arise. And such an approach would either create too much centralized control in the single operator for efficient activity, or would require massive transactions to reallocate the spectrum.

According to the FCC, "licensing TV band devices is not practicable while also protecting the present and future use of the band for broadcasting and other incumbent uses. Allowing licensed TV band devices to negotiate interference requirements with licensed users as Jackson/Robyn suggest would signal a fundamental shift from our stated goal to avoid disruption of TV and other authorized services by TV band devices." *Id.* ¶ 49.

105. *See* Michael Calabrese & Gregory Rose, There Is No Windfall in the White Space (New Am. Found., Working Paper No. 22, 2008) ("Unlike the recent 700 MHz auction, or the 2006 AWS-1 auction, TV white space spectrum is so fragmented and encumbered that an auction is likely to produce outcomes not unlike the recent failure of the 700 MHz 'D Block' auction.").

106. White Space Order, *supra* note 7, ¶ 48.

107. *See* Faulhaber, *supra* note 29, at 143 (describing such a model in which "new innovators may deploy a trial service in unlicensed spectrum, and upon demonstration that the business model works the entrepreneur could migrate the service to licensed spectrum").

108. *See* Hazlett, *supra* note 4, at 403–05; Hazlett, *supra* note 36, at 1020.

Where a channel between two broadcasters is unoccupied, which one gets it? Would broadcasters lose their traditional ironclad interference protection, and how would boundary disputes be resolved?[109] What if the dispute arises from the different propagation and interference characteristics of a non-broadcast service, if a licensee merely changes from broadcasting to two-way cellular wireless data?[110] And what happens when a broadcaster's newly expansive rights impinge on a wireless microphone system, cable television head-end, or other incumbent user of the white spaces? Spectrum property rights are exclusive; any rights in the white spaces cannot be, unless the incumbents are somehow cleared out of the bands.

As tempting as it may be to consider the broadcast bands as a blank sheet of paper, a realistic approach must take into account the current allocations. The policy question is how to evolve away from the current regime that combines extreme limits on the available frequencies, with many frequencies blocked entirely. Exclusive property rights and inclusive commons are the two options. The debate in recent years between property and commons advocates illuminates the implications of that choice.

II. SPECTRUM AS ANTICOMMONS

The white spaces debate illustrates broader issues about the nature of spectrum and property rights. Advocates of exclusive-use spectrum licenses employ the tragedies of the commons and anticommons to attack unlicensed allocations. These claims do not withstand scrutiny because they rest on a mistaken view of spectrum as a natural resource. The best way to avoid a wireless anticommons is to limit the blocking rights inherent in exclusive licenses.

A. Applying the Model

An anticommons is "a property regime in which multiple owners hold effective rights of exclusion in a scarce resource."[111] Whereas a situation in which too many users possess *inclusive* rights (a commons) poses a risk of overconsumption, a situation in which too many users possess *exclusive* rights to the same resource can lead to underconsumption.[112] Fragmentation of property rights alone does not produce an anticommons.[113] There are thousands of car dealers with exclusive local territories for their brands, but that is not the reason

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109. *See* Philip J. Weiser & Dale Hatfield, *Spectrum Policy Reform and the Next Frontier of Property Rights*, 15 GEO. MASON L. REV. 549, 559–60 (2008) ("[T]he contours of a licensed Grade B signal are based on a statistical judgment about the likely propagation of the relevant radio transmissions. The FCC defines the relevant boundary based on a statistical judgment about whether, *in theory*, the signal would reach 50% of the locations at least 50% of the time."). The fact that CMRS disputes are resolved privately does not prove these will be. Here we have not new rights but rights that impinge on longstanding systems.

110. *See* White Space Order, *supra* note 7, ¶ 46.

111. *See* Heller, *Anticommons*, *supra* note 8, at 668.

112. *See id.* at 668–69.

113. Hazlett seems to think it does. *See* Hazlett, *supra* note 29, at 245 ("With an anticommons, private ownership rights are well-established, but the are so fragmented that efficient aggregation is difficult—under-use prevails."). Focusing on fragmentation alone minimizes the hold-out problems that conspire to produce anticommons.

auto manufacturers are in trouble. Problems arise when too many rights holders have the capability to block others.[114] Two conditions, both of which are relevant for spectrum, must be met for an anticommons situation to arise. The ability to exclude must be effective, whether legally enforceable or not.[115] And the object of exclusion must be a scarce resource.[116]

Not all lightly-used spectrum, therefore, constitutes an anticommons. The white spaces, for example, are unused not because multiple owners exclude entry, but because a single governmental entity forbids it. Whether the patchwork structure of these frequencies might produce an anticommons is a moot point because no effective property rights exist. The frequencies where broadcasters do operate are also not anticommons. These bands may be used less intensively than if they were transferred to wireless carriers, but that means only that the government has placed too many limits on alienability. An anticommons involves multiple rights holders, each of whom holds core rights in the same property, and no clear hierarchy or dispute resolution process exists.[117]

The broadcast bands are akin to a collection of small homesteads adjacent to a national park, all of which are discovered to sit on top of valuable mineral resources. The homeowners cannot exploit the mineral wealth because deed restrictions prohibit them from turning over their land for resource extraction. And the park land is unexploited because any commercial activity there is forbidden. An important point here is that the limitations on property rights have both positive and negative consequences. Whether the scenario is akin to the natural wonder of Central Park or the depressing waste of Soviet Russia is a substantive judgment for policymakers. In the case of broadcasting, arguments for the value of special rights to protect over-the-air television, and to preclude more intensive uses, can quickly be rejected.[118] The legacy rules have outlived their usefulness. The question is what to do now.

The FCC now recognizes that it must remove its artificial constraints on spectrum utilization.[119] It has already shifted its default mechanism for new licenses to "exclusively assigned, flexible-use" terms,[120] and opened up several

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114. *See* Heller, *Anticommons*, *supra* note 8, at 670.

115. *See infra* Part II.C.

116. *See infra* Part II.C.

117. Heller, *Anticommons*, *supra* note 8, at 670. In fact, the current regime is very clear in providing a hierarchy of competing uses. Incumbent broadcasters are at the top, other authorized uses such as licensed wireless microphones are secondary, and anything else is tertiary. *Cf.* Jon M. Peha & Sooksan Panichpapiboon, *Real-Time Secondary Markets for Spectrum*, TELECOMM. POL'Y, Aug. 2004, at 603 (outlining a model for secondary access to licensed frequencies).

118. *See* Thomas W. Hazlett, *The Rationality of U.S. Regulation of the Broadcast Spectrum*, 33 J.L. & ECON. 133 (1990); Stuart Minor Benjamin, *Roasting the Pig to Burn Down the House: A Modest Proposal*, 7 J. TELECOMM. & HIGH TECH. L. 95 (2009).

119. *See* Spectrum Task Force Report, *supra* note 33.

120. Hazlett & Spitzer, *supra* note 23, at 626–31.

new opportunities for unlicensed access in recent years.[121] Wireless communication in the United States is thus in the midst of a regime change, with all the messiness that typically implies.

Whenever it engages in wireless allocation, the FCC establishes a set of initial property rights with associated freedom for secondary transactions. The Commission's goal should be to maximize the productive communications capacity associated with that allocation. The important public policy question is thus how the initial configuration of rights promotes or retards utilization. Law and economics scholars such as Ronald Coase[122] and Harold Demsetz[123] offer theories to show that, with no transaction costs, property rights will settle into an efficient allocation through the operation of market incentives. The anticommons model explains why some real-world situations never reach that point: initial property rights were improperly allocated. Property rights with too many opportunities for exclusion on the part of too many parties will fall victim to hold-ups and never reach their efficient level of aggregation.[124]

Any time the state creates new property rights, it can do so well or poorly. If it does so poorly, the result will be either a tragedy of the commons (too much use) or a tragedy of the anticommons (too little use). Effective property rights must be clear in order to minimize enforcement costs. And they must be substantively structured to avoid gridlock.

The FCC's proposal to allow unlicensed use in the white spaces is a first step toward salvaging the broadcast bands. In making this proposal, the FCC could rely on the success story of Wi-Fi, as well as scholarship suggesting that a spectrum commons can, like common access regimes in other domains, mediate the potential for ruinous overuse without exclusivity.[125] As the FCC concluded in its 2008 order authorizing unlicensed white space devices, "there has been tremendous growth in the development of new technologies and the introduction of new services that rely on unlicensed devices, which belies the assertion that a licensing regime is needed to encourage investment in spectrum development."[126]

Proponents of more expansive property rights in spectrum have been unwilling to concede that a licensing regime is not necessary. In fact, they refuse to

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121. Harold Feld, *From Third Class Citizen to First Among Equals: Rethinking the Place of Unlicensed Spectrum in the FCC Hierarchy*, 15 COMMLAW CONSPECTUS 53, 67 (2006).

122. *See* Ronald H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960).

123. *See* Harold Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347 (1967).

124. Heller, *Anticommons*, *supra* note 8, at 668–69.

125. *See* Benkler, *Some Economics*, *supra* note 29, at 25; Stuart Buck, *Replacing Spectrum Auctions with a Spectrum Commons*, 2002 STAN. TECH. L. REV. 2, 31; Carol M. Rose, *The Several Futures of Property: Of Cyberspace and Folk Tales, Emission Trades and Ecosystems*, 83 MINN. L. REV. 129 (1998); Weiser & Hatfield, *supra* note 109; Werbach, *Supercommons*, *supra* note 29, at 879; Mark Cooper, *The Economics of Collaborative Production in the Spectrum Commons*, IEEE.ORG (2005), http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1542656&userType=inst.

126. White Space Order, *supra* note 7, ¶ 48.

acknowledge that spectrum commons are commons at all.[127] Michael Heller sides with this position, describing spectrum commons as "a special kind of state spectrum."[128] Yet Heller's own formulation of commons and anticommons suggests otherwise. What distinguishes commons from anticommons is whether rights of exclusion or privileges of inclusion dominate, not the degree to which the state regulates uses.[129] Spectrum commons are indeed "vested with a group of users who jointly manage them."[130] That group is the collection of users whose devices employ technical protocols to manage interference.[131]

Moreover, the claim that unlicensed bands involve heavier regulation than licensed bands does not hold up. There is no substantial difference between the kinds of limits the FCC today places on different allocations and the regulations that would be required for unlicensed bands.[132] Yes, unlicensed devices must "meet[] government specifications"[133] and so do the mobile phones used in licensed spectrum.[134] Regulators "impose limits on the power used to emit signals and restrict technology choices,"[135] as they do with licenses auctioned for exclusive use.[136] The FCC could certainly adopt overly specific and intrusive restrictions on an unlicensed spectrum band if it so chose, but that would be a failure of regulation rather than a failure of the allocation model.[137] The same

127. *See, e.g.*, Hazlett & Spitzer, *supra* note 23, at 598. "[Unlicensed] radio spectrum does not constitute a 'commons,' which connotes ownership by a group of responsible economic agents, but rather constitutes de facto state property." *Id.* at 621.

128. *See* HELLER, *supra* note 8, at 84.

129. Heller, *Anticommons*, *supra* note 8, at 673.

130. HELLER, *supra* note 8, at 84.

131. The conceptual confusion may be that anyone can in theory transmit in an unlicensed band, in contrast to the well-delimited social groups that most studies of commons examine. *See, e.g.*, ROBERT ELLICKSON, ORDER WITHOUT LAW: HOW NEIGHBORS SETTLE DISPUTES (1991). However, while anyone can purchase and turn on an unlicensed radio transmitter, not everyone can build one. Entry into a spectrum commons requires a device, and a device distributed at scale requires a vendor with the incentive to sell as many devices as possible. *See* Werbach, *Supercommons*, *supra* note 29, at 875. This dynamic limits entry into spectrum commons in practice, even where there are no formal restrictions.

132. A variant of this argument is the claim that unlicensed allocations are only useful for short-range, low-power systems. This claim is addressed below. *See infra* Part II.B.1.

133. Hazlett & Spitzer, *supra* note 23, at 598.

134. *See, e.g.*, Eric Zeman, *FCC Approves CDMA Version of HTC Hero*, INFO. WEEK, Aug. 20, 2009, *available at* http://www.informationweek.com/blog/main/archives/2009/08/fcc_approves_cd_1.html.

135. Hazlett & Spitzer, *supra* note 23, at 598.

136. *See, e.g.*, Press Release, FCC, Broadband PCS Regulatory Structure Affirmed, with Minor Modifications (Oct. 19, 2004), *available at* http://www.fcc.gov/Bureaus/Wireless/News_Releases/nrwl4019.txt; Press Release, FCC, FCC Modifies PCS and AWS Power Limit Rules to Facilitate Broadband Wireless Technologies (Mar. 21, 2008).

137. *See* Marcus, *supra* note 95, at 33; Philip J. Weiser & Dale Hatfield, *Policing the Spectrum Commons*, 74 FORDHAM L. REV. 663 (2005).

regulatory failure could occur for an exclusively licensed band. There is simply no *ex ante* reason to think an unlicensed band will necessitate more regulation.[138]

One should be skeptical of a classification that labels one set of FCC power limits and interference protections as "private" (the Personal Communications System bands) and another set of FCC power limits and interference rules as "state" (the unlicensed bands).[139] That the outcome of such an analysis is a recommendation for greater use of the "private" approach is no surprise.

The only reason to think commons require extensive government regulation is a lack of trust that commons will function without it. If it is inconceivable that an unlicensed environment can avoid degenerating into a ruinous tragedy of the commons, then well-functioning unlicensed bands must be heavily regulated. This analysis puts the cart before the horse, though. The fact of the matter is that unlicensed bands such as 2.4 GHz *do* function smoothly without excessive regulation.[140]

Hazlett offers an interesting claim that spectrum commons will actually produce anticommons when expectations are factored in. Anticipating that commons will produce a tragedy of overuse, he claims financial markets will underinvest, resulting in the opposite scenario of underuse.[141] There are several problems with this line of reasoning. First, it is circular. Private actors and governments will only overreact to a perceived tragedy of the spectrum commons if they heed the warnings of exclusive rights advocates such as Hazlett himself. Second, it assumes an infrastructure service model, rather than the user-capitalized model likely to prevail for open wireless systems.[142] Financial markets regulate investment in centralized communications infrastructure because of the high upfront capital costs, which are not necessary in an unlicensed environment. Finally, while overreactions are possible, they are no more likely under a commons approach than under an exclusive rights approach. During the 2001 telecommunications crash, wireless providers such as Teligent and Windstar saw their access to capital dry up despite using licensed frequencies.[143] On the other side, the 2004 failure of Cometa, a high-profile Wi-Fi hotspot venture with substantial funding from Intel, IBM, and AT&T, shows that capital markets will sometimes even overfund initiatives based on unlicensed spectrum.[144] Companies

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138. *See* William Lehr & Jon Crowcroft, Managing Shared Access to a Spectrum Commons (Sept. 2005) (unpublished manuscript), *available at* http://cfp.mit.edu/docs/lehr-crowcroft-sept2005.pdf. The existing unlicensed bands do have lower power limits than licensed bands, but this is at most a difference in degree rather than kind.

139. *See* HELLER, *supra* note 8, at 84–86.

140. *See supra* note 47 and accompanying text.

141. *See* Hazlett, *supra* note 29, at 245–46. Hazlett further argues that governments will make the same mistake, putting excessive limits on unlicensed bands because they fear a tragedy of the commons. *See id.*

142. *See* Benkler, *Some Economics*, *supra* note 29, at 31–35.

143. *See* Michael Martin, *Fixed Wireless No Wipeout, Despite Recent Troubles*, NETWORK WORLD FUSION, June 4, 2001, at 38.

144. *See* Hazlett & Spitzer, *supra* note 23, at 648. Cometa failed not because the power limits on Wi-Fi devices were too strict, as Hazlett and Spitzer imply, but because the

such as Dell, Microsoft, and Philips would not be advocating unlicensed allocation of the broadcast white spaces if they did not anticipate economic returns. Those anticipated returns depend on expectations of substantial usage.

Various approaches to spectrum allocation all have a role. Even the much-maligned command-and-control mechanism still serves a purpose for applications such as radio astronomy and, perhaps, some critical defense or public safety uses.[145] The notion that the FCC should put more of its effort into spectrum property rights because the pendulum has shifted too far towards commons overstates the reality.[146] Far more frequencies are subject to legacy government or restricted allocations than to either of the newer models.[147] And the FCC hardly abandoned efforts to create flexible exclusive access rights in spectrum when it moved forward on various unlicensed proposals. It adopted new secondary markets rules[148] and initiated a major series of auctions for licensed access to the 700 MHz band[149] during the period when it was supposedly infatuated with spectrum commons. It recently sought comment on several further initiatives involving licensed spectrum.[150] The FCC should consider the best approach for any new allocation or reallocation it examines, and in doing so, should, again, remember that context matters.[151]

B. Rehabilitating Spectrum Commons

Opponents of the spectrum commons approach attack unlicensed allocations with two arguments: they will suffer a tragedy of the commons; and

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business model for a centrally managed, national network of hotspots proved unsustainable. Matt Richtel, *Wi-Fi Providers Rethink How to Make Money*, N.Y. TIMES, June 7, 2004, at C1. Cometa was a misguided effort to apply infrastructure models from licensed spectrum to a spectrum commons.

145. More flexibility could, however, enhance the government's use of spectrum in many areas. *See* Victor W. Pickard & Sascha D. Meinrath, *Revitalizing the Public Airwaves: Opportunistic Unlicensed Reuse of Government Spectrum* 14 (New Am. Found., Working Paper No. 24, 2009), *available at* http://www.newamerica.net/files/Pickard_Meinrath_WorkingPaper24_RevitalizingPublicAirwaves.pdf.

146. HELLER, *supra* note 8, at 88–94.

147. "[O]f the 'beachfront' spectrum below 2 GHz, only 26 MHz is available for unlicensed broadband use, as opposed to 1974 MHz for federal or licensed use. Indeed, there is absolutely no unlicensed spectrum available for wireless broadband in the spectrum below 900 MHz . . . ." Reply Comments of Dell, Inc., Google, Inc., Hewlett-Packard Co., Intel Corp., Microsoft Corp., & Philips Elecs. N. Am. Corp. Submitted to the FCC, ET Docket No. 04-186, Unlicensed Operation in the TV Broadcast Bands, at 30 (Mar. 2, 2007); *see also* de Vries, *supra* note 9, at 4 ("Currently, more than six times as much spectrum is allocated to flexible licensed use as to unlicensed below 3 GHz . . . .").

148. Press Release, FCC, FCC Takes Steps to Make More Spectrum Available Through the Development of Secondary Markets (Nov. 9, 2000), *available at* http://www.fcc.gov/Bureaus/Engineering_Technology/News_Releases/2000/nret0012.html.

149. Serv. Rules for the 698–746, 747–762 & 777–792 MHz Bands, 22 FCC Rcd. 15289 (Aug. 10, 2007) (second report and order).

150. *See Innovation NOI Provides Surprisingly Granular Focus on Spectrum*, COMM. DAILY, Aug. 31, 2009, at 1.

151. *See supra* Part I.A.

they will generate lesser economic benefits than exclusive licensing. In this section, I respond to each in turn.

1. Overuse of Unlicensed Bands

Critics of the spectrum commons approach continue to assert that a wireless commons will be overused, because economic theory and common sense dictate that result.[152] Heller dismisses Wi-Fi as subject to "congestion and overuse," ignoring the continued growth of the Wi-Fi market.[153] Similarly, Hazlett simply asserts there will be congestion without heavy-handed governance or exclusive rights, as though the point is self-confirming.[154] Hazlett's only data are a handful of anecdotal complaints from small wireless internet service providers (WISPs).[155] Generalizing from these scattered examples to a pervasive tragedy of the commons is a stretch, especially when several thousand companies have made the financial commitment to build their businesses on unlicensed frequencies.[156] Moreover, disputes among unlicensed users are public, whereas conflicts including licensed frequencies are internal to the licensees. So the number of WISP complaints is not indicative of more difficulties in unlicensed frequencies.

An unlicensed device does not enjoy ironclad protection against interference, so there will be occasional examples of conflicts. However, allusions to substantial problems in the unlicensed bands today are simply unsupported by data. Between 2000 and 2004, the FCC's Enforcement Bureau dealt with 3838 interference complaints.[157] Of these, only 1.7%, or a total of sixty-five, involved unlicensed devices.[158] Fully 98% of the FCC's interference caseload involved licensed devices.[159]

Many of the anecdotes about Wi-Fi interference turn out to be business and security concerns rather than real technical difficulties.[160] Efforts by the authority controlling Boston's Logan Airport to block Continental's free in-terminal Wi-Fi hotspot is a good example.[161] The fact that the most serious of these

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152. *See* Hazlett, *supra* note 29, at 269–73.

153. *See* HELLER, *supra* note 8, at 85.

154. *See, e.g.*, Hazlett, *supra* note 29, at 262 (asserting that "bandwidth lacking exclusivity or governance will predictably generate into suboptimal deployment when scarcity conditions apply," but offering no reference to support this claim).

155. *See id.* at 266–68.

156. There are approximately 2000 to 3000 WISPs operating in the United States. *See* Meinrath & Calabrese, *supra* note 9, at 501.

157. Kenneth R. Carter, Policy Lessons from Personal Communications Services: A Hohfeldian Analysis of Licensed vs. Unlicensed Spectrum Access 53 (2004) (unpublished manuscript), *available at* http://web.si.umich.edu/tprc/papers/2004/321/CarterTPRCPaper.pdf (presented at the 2004 TPRC conference).

158. *See id.*

159. Moreover, all interference cases together represented less than 10% of the Enforcement Bureau's caseload. *See id.*

160. *See, e.g.*, W. David Gardner, *FCC Chairman Martin Favors Dropping Wi-Fi Ban at Boston Airport*, INFO. WEEK, Sept. 21, 2006, *available at* http://www.informationweek.com/news/internet/webdev/showArticle.jhtml?articleID=193004513.

161. *See id.*

disputes have generally been resolved suggests the problem may not be as great as it seems to the spectrum property advocates.[162]

Similarly, the decisions of providers such as Clearwire to shift from unlicensed to licensed frequencies prove nothing about the relative merits of the two approaches.[163] Any provider must balance the costs and benefits of different technical choices. For a centralized operator such as Clearwire, licensed frequencies provided better reassurance to its investors, and provided the coverage areas it desired. Clearwire's business model is the same service provider structure as AT&T or Verizon Wireless; it is not the user-capitalized model of open wireless systems.[164] The fact that a centralized service provider chose a spectrum allocation model conducive to centralized service providers is a tautology, not evidence that the model is superior.

This is the same argument as the claim that businesses would never use the Internet because there is no guarantee that any packet will arrive at its destination, and that open source software would never meet commercial standards because the developers have no financial or contractual obligations to deliver.[165] Both predictions were false. Sometimes practice trumps theory.

A commons does not always function well; nor does a regime of exclusive property rights. Without the adaptive potential of modern computational wireless devices to negotiate interference dynamically, an unlicensed wireless allocation could easily produce a tragic morass of overuse. This was, to some extent, what occurred with CB radio, although the real story is more complicated.[166] The boom and bust of CB is of little relevance to current unlicensed allocations, except to state the obvious: that a tragedy of the commons can sometimes occur. Data communications networks, such as the Internet, can also become overly congested. That does not prove that, as the distinguished network engineer Bob Metcalfe predicted, the Internet would never be able to keep up with demand.[167] (Metcalfe later literally ate his words.)[168] What actually happens depends on the real life conditions of the system in question.[169]

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162. *See supra* note 47.

163. *See* Faulhaber, *supra* note 29, at 144.

164. *See* Benkler, *Some Economics*, *supra* note 29, at 31 (distinguishing the investment models of spectrum property-based and open wireless networks).

165. *See* BENKLER, WEALTH OF NETWORKS, *supra* note 94.

166. *See* Carol Ting, Johannes M. Bauer & Steven S. Wildman, *The U.S. Experience with Non-Traditional Approaches to Spectrum Management: Tragedies of the Commons and Other Myths Reconsidered* (Quello Ctr., Working Paper No. 05-03, 2003), *available at* http://web.si.umich.edu/tprc/papers/2003/216/Ting-Bauer-Wildman2.pdf.

167. Bob Metcalfe, *Predicting the Internet's Catastrophic Collapse and Ghost Sites Galore in 1996*, INFOWORLD, Dec. 4, 1995, at 61.

168. *See Eating My Collapse Column*, Posting by Bob Metcalfe to North American Network Operators Group mailing list (Apr. 16, 1997), *available at* http://www.merit.edu/mail.archives/nanog/1997-04/msg00192.html.

169. *See supra* Part I.A.

An unlicensed band can also be choked by excessively restrictive regulation. This was the story of unlicensed PCS,[170] and it may be partly the story with ultra wideband.[171] Overly tight restrictions on unlicensed use of the white spaces to protect incumbent users could prevent those unlicensed systems from being commercially viable.[172] The fault there, however, lies not with the commons approach, but with the regulators who did not trust it sufficiently. If one assumes a commons will produce overuse, and therefore imposes excessive restrictions *ex ante*, the result may well be underuse. Once again, this is the anticommons story in action. The problem is a poor allocation of property rights.

A variant of the objection that unlicensed bands will necessarily become congested is the claim that unlicensed allocations only work because they involve very low power and therefore short-range transmissions.[173] The argument is that, in an unlicensed environment, there is no possibility for coordination to internalize spillover externalities, so short-range transmissions are the only option.[174] In reality, a scan of the technical literature in this area shows significant work on protocols to effectuate just such coordination.[175]

The IEEE 802.22 standard is being designed specifically for longer-range transmissions than Wi-Fi supports.[176] The anticipated transmission range is between seventeen and thirty-two kilometers.[177] These distances will be easier to achieve in rural areas where population densities are low and the business case for 802.22 as a primary broadband service is strongest.[178] However, they show that unlicensed techniques need not be strictly limited to short-range transmissions at low power.

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170. *See* Kenneth R. Carter, *Policy Lessons from Personal Communications Services: Licensed vs. Unlicensed Spectrum Access*, 15 COMMLAW CONSPECTUS 93 (2006); Dewayne Hendricks, *Powerpoint: What Went Wrong with U-PCS* (on file with author).

171. *See* Mark Hachman, *Ultrawideband Standards Group Shuts Down*, PC MAG., Mar. 17, 2009.

172. *See supra* note 59 and accompanying text.

173. *See* Hazlett, *supra* note 29, at 246.

174. *See* Faulhaber, *supra* note 29, at 143.

175. *See, e.g.*, Vladimir Brik et al., *DSAP: A Protocol for Coordinated Spectrum Access*, IEEE XPLORE (Nov. 8–11, 2008), http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1542680; Milind M. Buddhikot et al., *DIMSUMnet: New Directions in Wireless Networking Using Coordinated Dynamic Spectrum*, SIXTH IEEE INT'L SYMPOSIUM (June 2005), *available at* http://www.bell-labs.com/user/mbuddhikot/psdocs/dimsum-wowmom05-revised.pdf; T. Maseng & T. Ulversoy, *Dynamic Frequency Broker and Cognitive Radio*, IEEE XPLORE (Sept. 18, 2008), http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=4656355; Peng Qihang et al., *A Distributed Spectrum Sensing Scheme Based on Credibility and Evidence Theory in Cognitive Radio Context*, IEEE XPLORE (Sept. 11–14, 2006), http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=4022496.

176. *See supra* notes 63–64 and accompanying text.

177. *See* David Wright, *Dynamic Spectrum Access in the IEEE 802.22 Wireless Regional Area Network*, IEEE XPLORE (Aug. 22–24, 2007), http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4447115&isnumber=4447087 ("This is an extremely long range for an unlicensed technology . . . .").

178. *See id.*; Stevenson et al., *supra* note 63, at 183.

There are also uses for unlicensed systems that blur the distinction between high-power and low-power services. Consider the case of using Wi-Fi as an offload mechanism for wide-area wireless data services. The massive growth in demand for wireless data and smartphone devices is straining carriers' wireless networks. When the phone is near a Wi-Fi access point, routing the data over that short range connection is much more efficient than sending it across the wide-area licensed wireless network.[179] Wireless carriers used to fight Wi-Fi, but now they embrace it.[180] Unlicensed devices are not a poor substitute for licensed wireless broadband systems; they are a fundamentally different use of wireless capacity.

2. Lies, Damn Lies, and Statistics

Hazlett and Heller argue that the success of the flexible licenses the FCC has auctioned since 1993 proves the superiority of the property approach.[181] Hazlett and Matthew Spitzer call the CMRS market "the most compelling example of [the property rights] regime."[182] To do so, however, they subtly but significantly redefine the terrain.

What Hazlett actually defends are "exclusive bandwidth rights with liberal regulatory constraints."[183] Note the two components of this definition. The rights in question are exclusive but are subject to few regulatory constraints. Spectrum property advocates jump to the conclusion that the first of these conditions has been the key to their success, but there is no obvious reason to make this leap. After all, the old service specific licenses, such as those given to broadcasters, also provided "exclusive bandwidth rights."[184] What has changed is that the new licensees can offer any service they wish, and therefore also have more freedom to aggregate and manipulate licenses in an efficient manner. It is the

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179. *See, e.g.*, Jon Fortt, *iPhone Overload!*, FORTUNE, Sept. 14, 2009, at 37; Matt Kapklo, *AT&T Acquires Wi-Fi Operator Wayport for $275 Million; Opportunity to Offload More Traffic*, MOCONEWS.NET (Nov. 6, 2008), http://moconews.net/article/419-att-acquires-wi-fi-operator-wayport-for-275-million-opportunity-to-offl. The dirty little secret of "wireless" networks is that they are usually mostly wired backhaul and backbone systems with wireless tails at the edges.

180. *See* John Cox, *AT&T's Wi-Fi Guy Targets Smartphone Transactions, Wi-Fi Growth*, NETWORK WORLD (Mar. 12, 2009, 04:17 PM), http://www.networkworld.com/news/2009/031209-att-wifi-williams.html; W. David Gardner, *Verizon Offers Free Wi-Fi to Broadband Customers*, INFO. WEEK (July 28, 2009, 11:49 AM), http://www.informationweek.com/news/mobility/wifiwimax/showArticle.jhtml?articleID=218700166.

181. *See* Hazlett & Spitzer, *supra* note 23, at 597–98; HELLER, *supra* note 8, at 90–94.

182. Hazlett & Spitzer, *supra* note 23, at 597–98.

183. *Id.* at 597. Hazlett and Spitzer call this exclusively assigned, flexible-use (EAFUS). *See id.* at 596–97.

184. Both television broadcasters and CMRS providers receive licenses that, on their face, do not constitute full ownership. However, they have many of the indicia of property rights, including expectations of exclusivity. *See* Howard A. Shelanski & Peter W. Huber, *Administrative Creation of Property Rights to Radio Spectrum*, 41 J.L. & ECON. 581, 585 (1998).

absence of intrusive regulation, not the presence of exclusive property rights, which unleashed the valuable activity within the CMRS bands.

Saying, as Heller does, that "[t]he premium that companies continue to pay for private spectrum . . . suggests that privatizing more should be a higher priority now"[185] confuses the market price of the ostensible resource with the economic value it represents. Spectrum is artificially scarce. So much of the potential capacity for communications is precluded under restrictive government rules that the prices for the few exclusive licenses made available are inherently artificial. Moreover, focusing on the auction price overemphasizes the one asset sold through such a mechanism. The retail price of a mobile phone is not a good proxy for value because a substantial component of the device cost is embedded in a service contract. In the spectrum case, there is no "premium" for licensed over unlicensed frequencies, because the latter have no price.

The other reason to hesitate before prioritizing licensed service based on auction revenues is that there are reasons for companies to bid on spectrum other than to use it themselves.[186] In particular, the bidders may wish to block new entrants from gaining access to the frequencies. It was for this reason that the FCC barred incumbent cellular licensees from bidding in the first flexible use license auctions in 1994, for personal communications service (PCS).[187] The limitation on bidders may have depressed the auction prices, but it increased the potential for new competition. In the 700 MHz auction, Google bid the reserve price for the C block, subject to certain open access conditions it advocated, to ensure those conditions would go into effect.[188]

Were incumbents to buy spectrum licenses to prevent competitive entry, it would represent an effective exclusion from a scarce resource. The property rights system would in effect be creating that resource, by defining wireless frequencies as the object to be auctioned. A spectrum regime that generated

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185. HELLER, *supra* note 8, at 91.

186. To say that "slow broadband transmission rates, dropped calls, and the like" result from lack of available spectrum is highly misleading. *Id.* at 81. And the issue is not just the technical tradeoff in providing mobile service. *See id.* at 227 n.12. First, most broadband access in the United States today is on wired systems, not wireless. Second, "dropped calls" relate to voice service, rather than broadband data.

There are many other reasons for the poor quality of today's mobile phone services. For example, mobile communications systems require towers to mount antennas. Tower siting has become extremely difficult due to zoning rules, objections from local communities, and other hold-ups. So even when a network operator has the available frequencies, it may not be able to use them. *See* Erwin G. Krasnow & Henry A. Solomon, *Communications Towers: Increased Demand Coupled with Increased Regulation*, 18 MEDIA L. & POL'Y 45, 52–61 (2008). Moreover, the United States allowed carriers to choose their own wireless transmission technology, leading to incompatible networks. Most other major markets have a single standard that allows operators to share networks more easily. *See* Kathleen M.H. Wallman, *The Role of Government in Telecommunications Standard-Setting*, 8 COMMLAW CONSPECTUS 235, 246–47 (2000).

187. *See* Simon Wilkie, *Issue Brief: Open Access for the 700 MHz Auction*, NEW AM. FOUND. (July 23, 2007), http://www.newamerica.net/publications/policy/open_access_700_mhz_auction.

188. *See* Crawford, *supra* note 9, at 978.

auction revenues but little competition would not constitute a well-functioning market. It would be, by definition, an anticommons. This is not to suggest that the auction results in the AWS and 700 MHz auctions necessarily represent blocking moves to protect the status quo.[189] The market price could well be an indication that the market values the object of the auction highly, and the purchasers will aggressively invest in creating more capacity. We simply cannot say a priori that the price represents one or the other.

Another concern arises from the financial opportunity cost of unlicensed allocation for the white spaces. In theory, the financial output of spectrum auctions is a byproduct only.[190] Requiring licensees to bid real money for licenses is a mechanism for revealed preferences. Doing so creates incentives for the licensee that values the spectrum most, and will therefore put it to the highest and best use, to obtain the license. If there were a means to do so without forcing that company to pay a huge fee on top of the costs of building its network and offering service, that would be preferable as a matter of economic theory. The government's interest should be in the total level of investment, innovation, service delivery, job creation, and other social welfare benefits that arise from the license, not in maximizing the upfront payment.

Hazlett estimates benefits of $120 billion annually from "private" spectrum, compared to $4 billion annually from "commons" spectrum.[191] Here we come to the nub of the problem. Even if one accepts these descriptions of the two categories, the numbers provided are incommensurable. Hazlett's data compare service and infrastructure revenue, on the one hand, with equipment revenue, on the other. He fails to estimate any of the other benefits that accrue to users, laptop and mobile phone vendors, retail site owners, and even licensed wireless operators from the existence of Wi-Fi.[192] Licensed or propertized spectrum tilts toward particular business models, which are not necessarily better.[193] Counting the revenues of one model and not of the other is misleading. It would be equivalent to comparing Microsoft's revenues from the proprietary Windows operating system against Red Hat's from open source Linux, and declaring Microsoft's approach inherently superior for economic efficiency.[194]

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189. On the other hand, the fact that the two primary wireless incumbents won most of the 700 MHz spectrum is at least a subject of concern. *See id.* at 996.

190. *See* Eli Noam, *Spectrum Auctions: Yesterday's Heresy, Today's Orthodoxy, Tomorrow's Anachronism: Taking the Next Step to Open Spectrum Access*, 41 J.L. & ECON. 765, 787 (1998).

191. *See* HELLER, *supra* note 8, at 90 (citing Hazlett, *supra* note 29); *see also* RYSAVY RESEARCH, *supra* note 11, at 4 (forward by Prof. William Webb) (claiming that common usage generated only 1% of the total value from use of spectrum in the United Kingdom).

192. *See* de Vries, *supra* note 9, at 9–11.

193. *See* Benkler, *Some Economics*, *supra* note 29, at 30; de Vries, *supra* note 9, at 10–11.

194. *See generally* Yochai Benkler, *Coase's Penguin, or, Linux and the Nature of the Firm*, 112 YALE L.J. 369 (2002) (explaining how open source software generates diffuse benefits for both creators and users of software that may equal or exceed the direct revenues of traditional proprietary software distribution). Only Microsoft can sell Windows, so the

To put a finer point on it, it should not be shocking that one can make more money from spectrum by selling it than giving it away. The goal is not to maximize the economic value of spectrum, or to maximize the economic value of network operators who use spectrum. The goal is to maximize the economic activity based upon spectrum. Ignoring activity at the edge, uncontrolled by an operator, effectively "cooks the books" to prevent one option from winning. It may be harder to estimate the value created through an unlicensed mechanism, but ignoring what cannot easily be measured is not a viable solution.

If "private" licenses really were so much more successful than legacy "anticommons" licenses, one would expect to see the differences not just across service categories, but within them. Flexible allocations would generate more intensive usage than limited licenses for the same service. For example, the original Advanced Mobile Phone System (AMPS) analog cellular licenses granted to incumbent telephone companies and smaller entrants had greater limitations on uses than the later Personal Communications Services (PCS) licenses available through auctions.[195] For example, AMPS operators were required to support analog services until 2007, long after its market viability faded.[196] Yet today, there is no effective difference between utilization of the AMPS and PCS frequencies, nor is there any evidence that companies such as Sprint, which relied on PCS, have been more successful than those such as AT&T, which built from AMPS.[197]

C. The Enduring Spectrum Fallacy

1. Spectrum Is Not a Scarce Physical Resource

There is a bigger problem with the spectrum property position. It assumes what it seeks to prove, namely that spectrum is a "thing" appropriately subject to exclusive property rights. Just because property rights can be associated with anything under the sun does not mean they should be. That lesson should be clear from the role of structured financial instruments in the recent financial crisis. Lawrence Lessig calls this "Coase's first question": do the gains from introducing property rights offset the restrictions they impose on others?[198] An element of this

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price it charges internalizes the full development costs and captures other externalities of the Windows platform. Many developers contribute freely to Linux, and all distributors have access to the same source code, so Red Hat can charge only for integration, support, and related services. The result is that the surplus is diffused more widely among the creators and users of the operating system. *See id.* at 444–45.

195. *See* NUECHTERLEIN & WEISER, *supra* note 34, at 278–79 (noting also that most of the smaller entrants were eventually rolled up into McCaw Cellular).

196. Year 2000 Biennial Regulatory Review - Amendment of Part 22 of the Commission's Rules to Modify or Eliminate Outdated Rules Affecting the Cellular Radiotelephone Service and other Commercial Mobile Radio Services, 17 FCC Rcd. 18401, 18406 (2002) (imposing a five-year sunset period for the AMPS shutdown).

197. The FCC did gradually loosen restrictions on AMPS licenses. *See* HELLER, *supra* note 8, at 89–90. If the property rights story is correct, though, the fact that AMPS licensees had to rely on regulatory sufferance to gain what PCS licensees enjoyed from the start should have been a high hurdle to overcome.

198. Lawrence Lessig, *Coase's First Question*, REGULATION, Fall 2004, at 38.

determination is whether the erstwhile object of property rights is in fact a coherent resource at all.

Spectrum is not a "thing."[199] Neither is it "a scarce natural resource,"[200] despite the prevalence of that label.[201] It is tempting to view spectrum this way. Our brains are hardwired to make abstract concepts tractable through physical analogies,[202] which is why we can see life as a highway, or a game, or a box of chocolates. The mental reference point for spectrum is the frequency dial of an old analog radio, with tickmarks on each kilohertz.[203]

The trouble is that, while frequency is a physical property of electromagnetic radiation, so are amplitude, power, direction, and so forth.[204] The fact that FCC license allocations are based on frequency exclusivity is an artifact of radio technology, not a necessary attribute of communication.[205] Unlike a true scarce resource, spectrum is infinitely renewable from moment to moment. And while competing wireless transmission can prevent communications from being reliably received, this is an attribute of particular devices that cannot distinguish signal from noise, rather than a fundamental limitation of "the spectrum."[206] The two electromagnetic waves pass right through one another.

We envision the wireless spectrum as a huge, single-story hotel, where guests book either single rooms or suites of adjoining rooms. A room is either

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199. *See* Werbach, *Supercommons*, *supra* note 29, at 863, 882, 883 n.105.

200. HELLER, *supra* note 8, at 80. The other problem with Heller's discussion of spectrum is his tendency to conflate poor performance of wired and wireless broadband networks in the United States with inefficient spectrum utilization. Both are consequences of poor telecommunications policy decisions, but the connection between them is not causal. Countries such as South Korea with much faster and cheaper broadband service, or those in Europe with more reliable mobile phone systems, do not have higher overall spectrum utilization than the United States. The differences in broadband performance come from other aspects, such as the ability to gain competitive access to incumbent telecommunications networks and the use of a single technical standard with shared infrastructure for mobile phones.

201. *See* HARVEY J. LEVIN, THE INVISIBLE RESOURCE: USE AND REGULATION OF THE RADIO SPECTRUM (1971); Werbach, *Supercommons*, *supra* note 29, at 865–66; Lawrence J. White, *"Propertyzing" the Electromagnetic Spectrum: Why It's Important, and How to Begin*, 9 MEDIA L. & POL'Y 19, 21 (2000) (comparing spectrum to real estate, a finite natural resource).

202. *See* GEORGE LAKOFF & MARK JOHNSON, METAPHORS WE LIVE BY 3 (1980); Dan Hunter, *Cyberspace as Place and the Tragedy of the Digital Anticommons*, 91 CALIF. L. REV. 439, 458–469 (2003).

203. Patrick S. Ryan, *Questioning the Scarcity of the Spectrum: The Structure of a Spectrum Revolution*, J. INTERNET L., Mar. 2005, at 21.

204. *See* Robert J. Matheson, *Principles of Flexible-Use Spectrum Rights*, 8 J. COMM. & NETWORKS 144, 144–45 (June 2006) (proposing a seven-dimensional "electrospace" model).

205. *See* Werbach, *Supercommons*, *supra* note 29, at 903; Paul Baran, *Is the UHF Frequency Shortage a Self Made Problem*, INTERESTING-PEOPLE.ORG (June 23, 1995), http://www.interesting-people.org/archives/interesting-people/199507/msg00023.html.

206. *See* Werbach, *Supercommons*, *supra* note 29, at 887–88; David Weinberger, *The Myth of Interference*, SALON.COM (Mar. 12, 2003), http://www.salon.com/tech/feature/2003/03/12/spectrum/print.html.

occupied or not. The hotel is full, empty, or something in between. If one wing is crowded and a nearby one is sparsely occupied, the hotel manager might investigate whether prices are too high or décor is outdated in the unpopular wing. It sounds very logical to assert that if rooms in one part of the hotel were free and unlocked, they would quickly be both filled and, not long after, trashed. Similarly, if few rooms are booked because the government charges excessive taxes on hotel rooms, converting the hotel into a condominium might be a more efficient use of the building.

Spectrum, however, is not like a hotel. The fact that we can naturally make such an analogy does not mean that we should.[207] Spectrum is much more like the building heights in Manhattan: something we can measure, but that is only a proxy for the real variables.[208] Advocates of property rights in spectrum continue to make the comparison to physical spaces like the hotel because it seems illogical to discuss ownership of spectrum unless spectrum is a thing that can be owned. That analysis, however, is backwards. Property rights are the means, not the end. Productive markets, well-managed commons, tragic overconsumption environments, and tragic anticommons are all subject to property rights.[209] The normative question is what allocation of rights will maximize social welfare, or any other ultimate goal.

Nobel Laureate Ronald Coase, the originator of the argument for using property mechanisms to mediate wireless allocation, recognized that spectrum was an analogy only. Coase stated categorically that, "what is being allocated by the Federal Communications Commission, or, if there was a market, what would be sold, is the right to use a piece of equipment to transmit signals in a particular way."[210] Property scholars may dismiss this move as a theoretical simplification of historical detritus in the legal system,[211] but it has a simpler rationale: spectrum is not a physical resource. As Coase pointed out:

> The various musical notes correspond to frequencies in sound waves. The various colors correspond to frequencies in light waves. But it has not been thought necessary to allocate to different persons

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207. *Cf.* Hunter, *supra* note 202, at 472–97 (showing how treating cyberspace as a place, and applying doctrines from the physical world such as trespass to digital interactions, creates pernicious legal outcomes).

208. Christopher S. Yoo, *Network Neutrality and the Economics of Congestion*, 94 GEO. L.J. 1847, 1853 (2006) (describing the Coasean approach to proxies). There may be situations where hitching rights to something notional is the efficient solution. But as with everything Coasian, it depends on a preliminary analysis of transaction costs. It is only worth doing so if there is not a simple way to charge boats sailing past the lighthouse in the ocean. Thus, the change in spectrum possibilities due to technology changes the rationale for property rights.

209. *See* HELLER, *supra* note 8, at 151. The book as a whole provides helpful background material.

210. Coase, *supra* note 34, at 33.

211. Thomas W. Merrill & Henry E. Smith, *What Happened to Property in Law and Economics?*, 111 YALE L.J. 357, 375 (2001).

> or to create property rights in the notes of the musical scale or the colors of the rainbow.[212]

The inherent "un-thingliness" of spectrum does not preclude any recourse to property rights. Conceived as a system of legal entitlements governing human interaction, property is a tool that can usefully be applied in many situations. We can suspend our disbelief and treat spectrum as property if we so choose; the question is whether we should.[213]

Treating a non-thing as a scarce resource subject to property rights is dangerous. If rights are misallocated, there is no integral physical asset to fall back on. Anticommons arise when governments mistakenly assign property rights that overlap in inefficient ways, leading to holdups and underuse of resources.[214] Such a scenario is more likely when those rights are inscribed on a substrate that has no independent reality. For example, under long-standing common law doctrine, owners of real property had rights extending from the heavens to the center of the earth.[215] In actuality, this meant rights in a physical volume of space starting a reasonable distance above and below the land in question, plus some notion of anything above and below that for analytical completeness. A cubic volume of air is a thing; "the sky overhead" is not. The rights attached to the notional airspace over real property became problematic when airplanes began flying overhead, at which point the legal doctrine was modified.[216]

Clear evidence that the legal system recognizes the importance of attaching property rights to things can be found in intellectual property law. Every major type of intellectual property contains a division between the "thing" that can be protected and the penumbra that cannot. In copyright, this is the idea/expression dichotomy.[217] In trademark, it is the distinction between the broad notions of brand and goodwill, on the one hand, and the concrete instantiation of a mark, on the other. In patent, it is the division between the idea of an invention and the reduction to practice in a filed patent application. Even for intangibles, the distinction between a nebulous concept and a definite thing is crucial.

If spectrum is not the scarce resource to be allocated, what is? The questions must be broken in half. The valuable scarce resource is the capacity to communicate wirelessly.[218] The "thing" government allocates is the right to operate a wireless device in a particular way. Like the concept of spectrum, devices are means to an end. They are mechanisms to make communication possible, but unlike the frequency rainbow, they have a real physical embodiment that is subject to manipulation through assignment of property rights.

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212. Coase, *supra* note 34, at 32–33.

213. *See* Lessig, *supra* note 198.

214. *See* Heller, *Anticommons*, *supra* note 8, at 668–69.

215. *See* THOMAS W. MERRILL & HENRY E. SMITH, PROPERTY: PRINCIPLES AND POLICIES 13–15 (2007).

216. HELLER, *supra* note 8, at 27–30.

217. *See, e.g.*, 17 U.S.C. § 102(b) (2006) (distinguishing ideas from expressions for purposes of copyrightability).

218. *See generally* Benkler, *Some Economics*, *supra* note 29.

2. Information Costs

If transmitting devices, rather than the spectrum, are the proper loci of property rights for wireless communication, it begs the question of how those rights should be structured. The fundamental difference between the exclusive rights and commons approaches lies in different approaches to information processing.

In Demsetzian terms, property rights are mechanisms for internalizing externalities.[219] A major externality of wireless communication is that other communications will be displaced; this is the phenomenon known as interference. Both licensed and unlicensed approaches internalize the interference externality.[220] The normative question is which approach is superior to achieve public policy goals for any particular spectrum allocation question.

With licensed spectrum, the licensee coordinates the process through mechanisms such as setting technical standards, contracting with device manufacturers, negotiating roaming arrangements, policing congestion, and resolving boundary disputes.[221] As Hazlett and Spitzer note, "[C]arriers effectively purchase spectrum parks for their subscribers" within licensed frequencies.[222] With unlicensed frequencies, the responsibility inures to device manufacturers, service providers, and users.[223] It is not accurate to say, as Hazlett and Spitzer do, that with an unlicensed allocation "no economic entity internalizes gain and losses from airwave use . . . ."[224] There is a whole layer of private agents that have such incentives under a commons regime. A device manufacturer, for example, will sell more units if it economizes on wireless capacity utilization rather than selfishly excluding other users from its equipment.

The technical challenge of efficiently managing wireless communication is similar to the technical challenge of reliably routing data packets across a heterogeneous mesh of global communications networks.[225] The efficient route

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219. *See* Demsetz, *supra* note 123.

220. *See* Benkler, *Some Economics*, *supra* note 29, at 62–63.

221. *See* Hazlett & Spitzer, *supra* note 23, at 629–30.

222. *Id.* at 629.

223. *See generally* Benkler, *Some Economics*, *supra* note 29; Werbach, *Supercommons*, *supra* note 29, at 936–38.

224. Hazlett & Spitzer, *supra* note 23, at 630; *see also* Faulhaber, *supra* note 29, at 143 ("[W]ho would pay for an innovation that conserves on spectrum that is free to all?"); Evan Kwerel & John Williams, *A Proposal for a Rapid Transition to Market Allocation of Spectrum* 5 (FCC, Office of Plans and Policy, Working Paper No. 38, 2002) ("In shared bands, just providing technical and service flexibility would not create the correct incentives for economically efficient use of the spectrum, because licensees can not capture the benefits from deploying spectrum-conserving equipment.").

225. One apparent difference is that a network connected to the Internet can block or disconnect from a bad actor, but there is no way to avoid the radiated energy from a deliberately interfering wireless transmitter. On further examination, this distinction is not so clear. Blocking malware on the Internet is no simple matter, thanks to the complexity of distinguishing "good" from "bad" traffic and the growth of massive distributed botnets that originate attacks from large numbers of otherwise legitimate machines. *See* Lilian Edwards, *Dawn of the Death of Distributed Denial of Service: How to Kill Zombies*, 24 CARDOZO

across a network like the Internet could be computed either by a centralized database with all possible information about real-time global network conditions, or by individual routers with a necessarily partial view and lesser computational capabilities. The intuition that "bigger is better" was the mainstream computer science view for some time.[226] However, the complexities of central management proved overwhelming, and the Internet demonstrated that the decentralized approach could actually work and scaled very well.[227]

Hazlett cites Henry Smith's distinction between governance and exclusion as two different mechanisms of delineating property rights.[228] Smith distinguishes these two endpoints on a spectrum of strategies for measuring the rights to be protected.[229] Exclusion rules, like boundaries around real property subject to trespass recourse, are simple, so they require lower processing costs from the large number of potentially affected parties.[230] Governance rules, like the nuanced practices for appropriate use of a commons, require more particularized determinations, and therefore have higher processing costs but generally apply to a smaller group of defined actors.[231]

Hazlett implies that the governance approach in Smith's framework is less desirable because when government specifies uses the result can be market failure.[232] However, Smith's concepts are two ends of a continuum. The distinction between exclusion and governance is based on how boundaries of property rights are measured.[233] When more precise measurements are costly, the "rough cut" of exclusion makes more sense. And indeed, government's ability to anticipate wireless usage remains suspect. What has changed is that wireless devices now have the computational capability (individually or via intermediary points) to measure and adapt to real-time changes in capacity. The costs of governance have effectively decreased.

In an environment such as the white spaces, property boundaries are uncertain and variable. This structure argues against any centralized management scheme, and against exclusion rules based on identifiable boundaries. Indeed, one theoretical model comparing property and commons approaches found the

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ARTS & ENT. L.J. 23, 48 (2006). And on the wireless side, many factors make the "bad actor" scenario unlikely to occur and, with proper technical mechanisms, easy to police. *See* Cooper, *supra* note 125; Werbach, *Supercommons*, *supra* note 29, at 944.

226. *See* Ryan, *supra* note 203, at 21 (discussing Grosch's law).

227. *See id.*

228. *See* Henry E. Smith, *Exclusion Versus Governance: Two Strategies for Delineating Property Rights*, 31 J. LEGAL STUD. S453, S454 (2002) (cited by Hazlett, *supra* note 29, at 262).

229. *See id.* at S455.

230. *See id.* at S454–55.

231. *See id.* at S455.

232. *See* Hazlett, *supra* note 29, at 262–63.

233. *See* Smith, *supra* note 228, at S455. Smith sometimes refers to governance as "right to use," which means inclusive rights of the sort Heller describes for commons. This is quite different from regulation of uses.

commons strategy superior in situations where government lacked the necessary information to set policy variables.[234]

III. EASING THE GRIDLOCK

A. A Modest Proposal

Perhaps the problem with the white spaces is the way the policy question has been framed. The broadcast bands actually comprise three components: white spaces in which no transmission is permitted, "black spaces" in which broadcasters operate their systems, and "grey spaces" in which transmission is authorized but does not currently occur.[235] The FCC has focused on the white spaces in isolation because it can reallocate those rights without raising the thorny issues involved in reallocating broadcasters' rights.[236] However, a real solution to the gridlock of broadcast frequencies must consider all three components as a whole. As discussed above, turning the entire band into exclusive rights property is not a viable solution. The FCC's approach of making white spaces unlicensed moves the ball forward, but the gridlock of the black and grey spaces remains in place.

There is an opportunity for the FCC to effectuate a more comprehensive solution. The key to this option is that broadcasters have two critical rights as part of their bundle of government-issued entitlements. They have rights to exclude others from wireless transmission in "their" spectrum. They also have inclusive rights for their programming to be transmitted on cable TV systems, a rule known as "must carry."[237] Because the vast majority of Americans get their primary television connection from cable or other non-broadcast platforms, must-carry rights represent the bulk of the economic value in television stations today.[238] There is no theoretical reason to attach an effective easement on the physical infrastructure of cable providers to a license for wireless transmission. The connection arises from the economics and regulatory history of the broadcasting and cable industries.[239] Because broadcasters have these valuable carriage rights, they are unwilling to give them up in order to free the spectrum for other uses.[240]

The solution is to split the two broadcast entitlements. Broadcasters would be granted must-carry rights as a component of their station operating licenses, but these would no longer be associated with spectrum.[241] The wireless

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234. Carol Ting, Steven S. Wildman & Johannes M. Bauer, *Comparing Welfare for Spectrum Property and Spectrum Commons Governance Regime*, 29 TELECOMM. POL'Y 711, 711–30 (2005).

235. Black spaces and grey spaces are my own terms.

236. *See* Hazlett, *supra* note 36, at 1012–14 (criticizing the FCC for opening the white spaces to unlicensed use while leaving the limited broadcast allocations in place).

237. *See* NUECHTERLEIN & WEISER, *supra* note 34, at 365–66.

238. *See* de Vries, *supra* note 9, at 6; Hazlett, *supra* note 118; Hazlett, *supra* note 29, at 254–55.

239. *See* NUECHTERLEIN & WEISER, *supra* note 34, at 366.

240. *See* HELLER, *supra* note 8, at 96–97.

241. A separate question is whether must-carry rights are necessary and efficient in today's multi-channel video distribution marketplace, or if they ever were. Cable operators are unlikely to reject popular channels. The carriage question will come down to

transmission rights associated with broadcast stations would be transformed into standard exclusive rights licenses after expiration of the current license terms.[242] The FCC could then auction the licensed frequencies. A portion of the auction revenues would be designated for relocation of the incumbent broadcasters, and a second portion to subsidize universal access to baseline television programming.[243] The licenses would incorporate clear boundaries with adjacent white spaces, including receiver standards defining acceptable interference tolerance.[244] The white spaces would, as planned, be opened up on an unlicensed basis. Finally, new two-way end-user devices operating in any part of the broadcast bands could be subject to a per-device levy.

The proposal offers several incentives for broadcasters. First, splitting must-carry rights from spectrum would make those rights alienable and divisible, like most other government-granted intangible rights. This flexibility could represent a significant increase in economic value for broadcasters. It would also encourage economic transactions to reallocate carriage rights more efficiently.

Second, broadcasters would receive subsidies from auction revenue. Because broadcasters would receive the subsidy whether they bid on the spectrum themselves or not, they would effectively face a lower cost in winning the auction than competitors. Other potential users, such as wireless operators, might still outbid the broadcasters: the spectrum is very valuable to them and their implementation costs of extending their existing infrastructure to use it for non-broadcast services would be lower. Or broadcasters might purchase the spectrum in the auction and then turn around and resell or repackage it. For example, a broadcaster in possession of a new exclusive-use wireless license could agree with a wireless provider to a particular transition period or to a sharing mechanism that allowed both services to operate.

The reallocation of broadcast frequencies would need to be accompanied by universal service programs to address the small percentage of Americans who still watch broadcasting over the air. These communities disproportionately comprise low-income and other disadvantaged groups.[245] When the United States shifted from analog to digital television broadcasting in June 2009, it provided

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the financial terms, as it does today. Assuming transaction costs can be minimized, the process represents a classic Coasian bargaining situation. The allocation of initial legal rights may change the outcome, but not the welfare calculus. *See* Coase, *supra* note 122, at 4.

242. Despite the expressly temporary nature of the licenses, broadcasters would likely have a takings claim given their settled expectations. *See* Shelanski & Huber, *supra* note 184. Hence the need for compensation. The value of the spectrum ownership rights accrued to broadcasters would not, however, be the value on the open market, but the value of their traditional transmission rights exclusive of must carry. Today, this would be substantially less than the market value of the frequency licenses.

243. *See* Hazlett, *supra* note 45, at 11–13 (advocating a similar proposal).

244. *See* Weiser & Hatfield, *supra* note 109; Interference Immunity Performance Specifications for Radio Receivers, 18 FCC Rcd. 6039, 6042 (2003) (seeking comment on receiver standards).

245. *See* Stelter, *supra* note 43.

$1.5 billion to subsidize converter boxes for these users.[246] The transformation of limited broadcast licenses into more flexible exclusive rights would provide an opportunity to overcome the lingering policy problem of the over-the-air tail wagging the largely cable, fiber, and satellite television dog.

A device levy would also produce several benefits. This element is not necessary for the plan, but it would provide a valuable source of revenue to cut through the policy gridlock. It would better align economic incentives with the actual nexus of property rights: the transmitting device. It would provide an ongoing funding source for the broadcast universal service programs and public media.[247] Other countries, most notably Great Britain, use fees on television sets to fund public service broadcasters.[248] The tax would be independent of any service offerings or business models as to not distort the markets that developed. It would align the government's interest in raising revenue with the business interest of private actors. Both parties would want to see more devices in use.

Maintaining the distinction between licensed black and grey spaces, on the one hand, and unlicensed white spaces, on the other, would produce significant opportunities. At first blush, retaining the checkerboard of local allocations would seem to be inefficient.[249] However, with modern adaptive wireless equipment, a national service no longer requires a single nationwide clear channel. With all the currently allocated broadcast frequencies available to them, providers who wished to aggregate regional or national footprints could do so.

This approach would achieve the benefits of spectrum "zoning," without troublesome government limitations on use. Short-range and long-range wireless transmissions have different characteristics. Transmitting a signal over a longer range requires more signal power, which creates more possibilities for interference across a larger area. Some services, such as television, require a large number of geographically dispersed recipients to receive the same information, whereas others, such as mobile telephony, require each user to receive and send different information, but only to a fixed base station. Both services have value, but create potential difficulties when used simultaneously in the same frequencies.[250] High-power broadcast architectures generally involve exclusive licenses across the entire territory, while short-range mobile transmissions can use lower power and cellular architectures that split the territory into many smaller zones, thus reusing

246. *See id.*; Kim Hart, *Digital TV Ready to Rule the Tube, Leaving Some Viewers in the Dark*, WASH. POST, June 11, 2009, at A1.

247. *See* Ellen P. Goodman, *Media Policy Out of the Box: Content Abundance, Attention Scarcity, and the Failures of Digital Markets*, 19 BERKELEY TECH. L.J. 1389, 1394–1419 (2004) (detailing the benefits of public media, and media policy in general).

248. *See TV License Fee: Facts & Figures*, BBC, http://www.bbc.co.uk/pressoffice/keyfacts/stories/licencefee.shtml (last updated Apr. 2010).

249. *See* HELLER, *supra* note 8, at 91–92.

250. Faulhaber, *supra* note 29, at 144.

the frequencies spatially.[251] The concern is that a high-power signal will overwhelm lower-power transmissions.[252]

One proposal for addressing this conflict is zoning. Dale Hatfield and Phil Weiser propose to segment wireless services under a property rights regime into high-power and low-power frequencies.[253] While this approach avoids overlap, it introduces inefficiencies. As Hazlett explains, zoning requires governments to determine uses ahead of time.[254] If the government gets the allocations wrong, it creates inefficiencies, especially if conditions change. The proper division of high-power and low-power frequencies would depend on the relative demand for those services, which is variable and based on factors beyond the spectrum allocation process.

In reality, the distinction between high-power and low-power uses is not actually as sharp as it appears. As noted above, unlicensed bands can support long-range transmissions, such as those contemplated under IEEE 802.22.[255] Moreover, a short-range, low-power transmission can match the functionality of a long-range, high-power transmission in two ways. Wireless sharing mechanisms such as peer-to-peer transmission can be employed to repeat the signal over several short-range wireless hops.[256] This is essentially how the Internet works: each router only sends traffic along to the next router, but to the users at either end the transmission appears seamless. The limitation of such "bucket brigade" mechanisms, however, is latency. Each of those hops takes time, and, especially given the limitations of wireless transmission, too much delay and too long a distance may make the signal useless.[257] Technical mechanisms such as caching provide some relief, but are not a perfect replacement for long-range transmission.[258]

Another solution to the range challenge is to send the signal a short distance wirelessly, and the remainder across a wired network. This is, in fact, how "wireless" phone service works today. The vast majority of the network is wired backhaul and backbone infrastructure between base stations. Only the communications between mobile phones and nearby towers are exclusively wireless. Wi-Fi is just a shorter-range variant with less inclusive coverage.

If the goal is to provide for broadcast-type services, therefore, it is far from clear that doing so through high-power wireless transmission is the efficient solution. If it is, market transactions could be expected to produce such broadcast-like systems through a well-designed exclusive rights system. This is a reason for

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251. *See* Hazlett, *supra* note 4, at 397.

252. As with any form of interference, the actual behavior of the systems involved is more complicated.

253. *See* Weiser & Hatfield, *supra* note 109, at 554.

254. *See* Hazlett, *supra* note 36, at 1003–04.

255. *See supra* note 63 and accompanying text.

256. *See* Werbach, *Supercommons*, *supra* note 29, at 907–08; Comments of David P. Reed to the Spectrum Policy Task Force on Spectrum Policy, ET Docket No. 02-135 (July 15, 2002), *available at* http://newamerica.net/files/archive/Doc_File_142_1.pdf.

257. *See* Werbach, *Supercommons*, *supra* note 29, at 912 n.227.

258. *See id.* at 907 nn.210–11.

keeping some exclusive rights licenses.[259] It is not a reason for eliminating unlicensed zones, which offer unique benefits the exclusive rights cannot match. After some period of time it may be possible to discern which mechanism is more effective for more of the services that users value, but there is no way to make such a judgment *ex ante*.[260] The best solution is to allow both approaches to coexist.

In fact, adjacent licensed and unlicensed frequencies could be synergistic. Wireless operators today are recognizing that there is a benefit from offloading data-intensive traffic from their licensed networks onto local Wi-Fi nodes whenever possible.[261] Knowing that white spaces are available near licensed frequencies may allow the licensees to develop business plans that take advantage of this hybrid architecture.

B. The Database Dimension

An important tool to facilitate efficient utilization of both licensed and unlicensed spectrum is already required under the FCC's rules.[262] The White Space Order mandated the creation of a real-time database for white space devices as a further check against potential interference.[263] This database would include existing FCC frequency allocations in the broadcast bands, as well as incumbent systems such as wireless microphones that added themselves to the protected list. A white spaces device would need geolocation capability to understand its physical location, and the ability to communicate with a database server over the Internet or another control channel.[264] Before transmitting, the device would need to send its location and desired frequency to the database. It would receive back either an authorization to transmit (if the band was listed as available in the relevant geographic area) or a refusal.

The database changes the structure of the unlicensed white spaces from a purely ad hoc environment to a decentralized but coordinated system, like the Internet.[265] The FCC certifies all wireless devices.[266] Therefore, its service rules for the white spaces can mandate that devices incorporate the database functionality, and also that they comply with directives from the database. The devices can even include a "remote kill switch" to cease transmitting entirely if nearby systems

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259. Although it must be balanced against the displacement effect. *See* Benkler, *Some Economics*, *supra* note 29, at 51–57.

260. *See id.* at 31.

261. *See supra* note 179 and accompanying text.

262. *See* Werbach, *supra* note 57, at 614.

263. White Spaces Order, *supra* note 7. In its recent implementation order, the FCC eliminated a proposed requirement that all white spaces devices engage in spectrum sensing in addition to checking the database. *See* White Spaces Implementation Order, *supra* note 7, ¶ 54.

264. *See* White Spaces Implementation Order, *supra* note 7, ¶¶ 54–62.

265. *See* Werbach, *supra* note 57, at 626–27. In another article, I compare the white spaces database to the Internet's domain name system (DNS). *See id.* at 628–31.

266. *See* Kevin Werbach, *The Federal Computer Commission*, 84 N.C. L. REV 1, 4 (2005).

experience interference or the devices are operating outside their parameters.[267] Each white space device still has the freedom to identify available frequencies, and to transmit in the manner it chooses. The database ensures that incumbent systems such as broadcasters and wireless microphones will be protected, even if the white space devices fail to accurately identify their protected transmissions.

The FCC established the database requirement solely to protect against interference in the white spaces, but it need not be limited to this function.[268] Once a database lookup becomes a part of the transmission process for adaptive wireless devices, that lookup can serve other purposes. The infrastructure for supporting the database, such as the common control channel and other standardized elements, can also serve additional purposes. An industry coalition has already been established to propose technical elements for the white spaces database.[269] As the FCC moves into the implementation phase of the White Spaces proceeding, the database could become an important element for further development.

The white spaces database would support the synergistic uses of licensed and unlicensed frequencies in the broadcast bands. As originally conceived, the database would report only whether a frequency in a particular location is occupied or not. There is no technical reason why the database could not include additional fields to add further granularity.[270] For example, the database could indicate frequencies that are licensed under an exclusive use regime, but available for temporary use on a secondary-market basis.[271] A service provider, application provider, or device manufacturer could use the database to piece together an integrated service with a large or even national footprint, using the efficient combination of owned, leased, and unlicensed frequencies.

A particularly valuable aspect of the database-driven approach is that it is agnostic as to the allocation mechanism. If the database is designed properly, it can support all the approaches, alone or in combination. The database lookup will not be required for transmitters other than white spaces devices operating on a secondary basis, but providers might voluntarily incorporate this capability to enhance other devices. The process does add overhead to the communications path, so there would still be many systems, both licensed and unlicensed, that relied solely on their FCC certification to operate in their specified bands. As the costs of adding geolocation, frequency agility, and other dynamic capabilities to wireless devices continue to drop, however, the database functionality could become more popular.[272]

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267. *See* White Spaces Order, *supra* note 7, ¶ 212.

268. *See* Calabrese, *supra* note 74, at 2.

269. *See Ex Parte* Filing of the White Spaces Database Group, ET Docket No. 04-186 (Apr. 10, 2009). Membership in the group includes Comsearch, Dell, Fox, Google, Microsoft, Motorola, NCTA, sMSTV, NetLogix, Neustar, and the Public Interest Spectrum Coalition.

270. *See* Werbach, *supra* note 57, at 631–34.

271. *See* Peha & Panichpapiboon, *supra* note 117 (describing mechanisms for real-time secondary markets in spectrum).

272. Not all end-user devices would require geolocation capabilities. Devices meant to be fixed in place could be hardwired with their location. Mobile devices that

All this may sound more complicated than making all spectrum into private property or creating an unlicensed commons, but reality is sometimes complicated. The lesson Jane Jacobs taught about cities is relevant here as well.[273] The more complicated pattern may be more successful than the simpler one, even though we cannot easily understand it. The key for wireless systems is to have the flexibility and incentives to maximize usable capacity. Both are lacking under the current allocation system. The white spaces could be the turning point towards a far better use of the "people's airwaves."[274]

CONCLUSION

The white spaces epitomize all that is wrong with the traditional, centrally planned approach to spectrum allocation. For decades, the FCC has locked valuable frequencies into an inefficient patchwork of increasingly insignificant broadcast licenses. As with any transition to market mechanisms, the move to open up the broadcast white spaces will require care to avoid creating tragic inefficiencies. By allowing unlicensed use of the white spaces, the FCC would avoid an anticommons scenario. The white spaces would effectively be a single integrated allocation, lower in priority than either broadcasters or other existing authorized users of the bands.

Despite efforts to dismiss the success of Wi-Fi and the spectrum commons idea generally, there is no reason to believe the unlicensed approach will not succeed in the white spaces. A combined effort to loosen restrictions on broadcast licenses while facilitating unlicensed white space transmitters would further enhance utilization. The broadcast frequencies would finally achieve Newton Minow's dream of serving the public interest.

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connect to a base station, such as short-range Wi-Fi equipment connected to a hotspot, could obtain the necessary geolocation data from the base station.

273. *See* JACOBS, *supra* note 90.

274. *See* Minow, *supra* note 3.