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THE GREAT SPECTRUM DEBATE: A COMMENTARY ON THE FCC SPECTRUM POLICY TASK FORCE'S REPORT ON SPECTRUM RIGHTS AND RESPONSIBILITIES

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Under the Chairmanship of Michael Powell, the FCC has begun to reexamine the basic structure of federal radio regulation that has persisted since the early part of the twentieth century. In 2002, Powell formed the Spectrum Policy Task Force (SPTF) to conduct a systematic review of existing policy and potential alternative approaches. The SPTF engaged a raging academic debate about the basic theoretical models available to the FCC as it thinks about spectrum management. It identified and evaluated three regulatory approaches that have gained currency among scholars and policy leaders: command-and-control, exclusive rights, and open spectrum. This essay examines the SPTF's formulation of the "Great Spectrum Debate." Part I examines the SPTF's conceptual framework in light of its larger historical and intellectual context. Part II evaluates the normative implications of this framework and identifies some limitations. Ultimately, the essay concludes that although the SPTF's framework is a useful tool for making sense of radically different approaches to spectrum management, theoretical deficiencies prevent it from reaching its full potential.

I. INTRODUCTION

In 2002, FCC Chairman Michael Powell announced the formation of the Spectrum Policy Task Force (SPTF), a group of experts whose goal would be "to assist the Commission in identifying and evaluating changes in spectrum policy that will increase the public benefits derived from the use of radio spectrum."[1] This might seem like a vacuous mission statement, considering that just about every action the FCC ever takes involves at least some discussion of the "public benefits derived from the use of radio spectrum." However, two facts point to Powell's strong desire to depart from the status quo. First,

1. Press Release, F.C.C., FCC Chairman Michael K. Powell Announces Formation of Spectrum Policy Task Force (June 6, 2002), *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-223142A1.doc.

Powell indicated as much in his statement announcing the formation of the task force:

> The government has an almost impossible task trying to keep pace with the ever increasing demand for spectrum and continuing advances in wireless technology and applications. In this fast-moving world, the Commission cannot rely on outmoded procedures and policies. We must establish new ways to support innovation and the efficient, flexible use of spectrum.[2]

Second, as two dissenting commissioners pointed out, Powell's decision to use a taskforce rather than the usual notice and comment process might frame the debate "in a manner that is ultimately not consistent with the views of the majority of the Commission."[3] Clearly, Powell's aspiration was no less than to reconsider the very essence of the FCC's role as caretaker of the airwaves.[4]

During the summer of 2002, the SPTF solicited comments, convened workshops, and divided into several working groups, each of which focused on fundamental questions of spectrum policy. In November, the SPTF and its working groups issued a set of reports that articulated a top-to-bottom reconsideration of the FCC's approach to spectrum regulation. The Spectrum Rights and Responsibilities Working Group focused on the legal aspects of spectrum regulation. The SPTF assigned to this working group one of the central aspects of the SPTF's mission, specifically:

> to examine the types of legal rights and responsibilities the FCC assigns to licensees and other users of the spectrum it manages, and to identify alternative approaches to the definition of such rights and responsibilities that might better promote the most efficient and productive use of this spectrum.[5]

In the course of pursuing this goal, the working group embarked upon a far-reaching discussion of the basic principles that should guide spectrum policy in the twenty-first century. Inspired by

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2. *Id.*

3. Press Release, F.C.C., Statement of Kevin J. Martin and Michael J. Copps on the Spectrum Policy Task Force's Public Notice on Spectrum Policies (June 6, 2002).

4. *See* 47 U.S.C. § 151 (2000).

5. F.C.C. SPECTRUM POLICY TASK FORCE, REPORT OF THE SPECTRUM RIGHTS AND RESPONSIBILITIES WORKING GROUP 1 (2002), *available at* http://www.fcc.gov/sptf/files/SRRWGFinalReport.doc. In the interest of brevity, I will also refer to the working group as the SPTF.

dramatic changes currently occurring in wireless technology and by the emergence of new academic approaches to understanding spectrum regulation, the working group did not hesitate to consider radically new visions of how wireless communications will evolve and how they should be regulated.

In Part II of its report, the working group addressed the current academic debate about the basic theoretical models available to the FCC as the Commission thinks about spectrum management. While much of the report considers the practicalities associated with different spectrum bands, given certain physical properties (e.g., propagation characteristics) and statutory facts (e.g., the primacy of television and radio broadcasting), Part II occupies a more theoretical plane. In Part II, the working group summarizes the predominant models of spectrum regulation proposed by economists, technologists, and legal scholars in recent years. The group then proceeds to construct a conceptual framework against which to compare the various models and to determine their relative applicability to different circumstances.

In this Article, I examine the theoretical underpinnings of this "great spectrum debate," as developed by the SPTF. My discussion proceeds in two parts. Part I provides a brief overview of the models of spectrum regulation considered in the SPTF report, drawing on outside historical and academic literature to provide additional context. Part II examines the SPTF's evaluative framework for choosing between the various models. Ultimately, I conclude, the SPTF's theoretical exercise is a valiant effort, but falls short of the mark.

II. THREE WAYS TO LOOK AT THE SPECTRUM

The Spectrum Rights report describes three general spectrum usage models, each of which "represents an ideal."[6] These models fairly represent the predominant strands of mainstream debate about possible approaches to spectrum management that have emerged throughout the history of radio regulation. They do not cover all of the nuances of the existing system nor potential wrinkles in alternative schemes, and this is not their purpose. The models represent an attempt to reduce the different systems to their analytical essence. At the risk of oversimplifying some incredibly complex policy questions, they allow the policy maker to take a step back and see the forest for the trees. Because an understanding of the three models is necessary to orient any discussion of the SPTF's conclusions, I begin by providing a

6. SPTF REPORT, *supra* note 5, at 2.

brief overview of the three models discussed by the SPTF. My account substantively coheres with the SPTF's own summary of these models, although I provide some additional historical background and draw upon the academic literature to put the different models in broader context.

A. THE COMMAND-AND-CONTROL MODEL

The SPTF calls the prevailing model of radio regulation the "command and control" model. Although this name (which seems to be popular with the current FCC Chairman) seems more than just a bit value-laden, I will adopt the SPTF's terminology in order to avoid any confusion. As some commentators have emphasized, it is impossible to understand the theoretical basis of the prevailing regulatory regime without having at least a sense of the technological and industrial factors that influenced its development during the formative years of radio. This history makes clear that the command-and-control model reflects an uneasy compromise between the need to allocate spectrum amidst conditions of scarcity and a certain conception of the spectrum as a public resource that should provide public benefits.

The basic structure of the command-and-control emerged as a response to the radio boom of the 1920s.[7] Following World War I, during which the Navy exercised supreme control over the airwaves, the biggest development in radio was the rise of broadcasting. The commercialization of the vacuum tube during the war enabled high power amplification of continuous waves for the first time.[8] With the formation of RCA, the industry effectively consolidated key patent rights in a single entity, thereby eliminating holdup problems that had dogged technical progress.[9] Additionally, the government's training of thousands of radio operators to contribute to the war effort replenished the ranks of the amateurs, who, after the war, led the way in pushing the limits of the new technology. They began to use the new equipment for more than point-to-point communications, transmitting news, music, sporting events, and other programming to anyone who

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7. For useful historical accounts of the early history of radio regulation see generally Susan J. Douglas, Inventing American Broadcasting, 1899-1922 (1987); Philip T. Rosen, The Modern Stentors: Radio Broadcasters and the Federal Government, 1920-1934 (1980); HUGH R. SLOTTEN, RADIO AND TELEVISION REGULATION: BROADCAST TECHNOLOGY IN THE UNITED STATES, 1920-1960 (2000); Hugh G. J. Aitken, *Allocating the Spectrum: The Origins of Radio Regulation*, 35 Tech. & Culture 686 (1994).

8. Aitken, *supra* note 7, at 692.

9. *See* HUGH G. J. AITKEN, THE CONTINUOUS WAVE: TECHNOLOGY AND AMERICAN RADIO, 1900-1932 (1985), ch. 7 and ch. 8.

cared to tune in.[10] Not surprisingly, once these broadcasts started to grow in popularity, it was not long before commercial broadcasters got into the act. The Commerce Department issued the first broadcast license in March 1921. In the beginning of 1922, radio became a major subject of media coverage.[11] Magazines proclaimed the wonders of a technology that gave the masses "the best seat in the auditorium."[12] In December 1922, there were 576 licensed stations.[13] By 1924, sales of radio sets and parts totaled $358 million.[14]

The spread of broadcasting led to a growing congestion of the airwaves. The new stations were high powered services that radiated across large metropolitan areas; and, throughout the early 1920s, their power levels were increasing.[15] Whereas numerous low-powered stations could once transmit without interference on the same frequencies in different locations, the new broadcasters began to bump up against one another. Moreover, the emergence of advertising as a viable business model, as well as the increasing scale and capital requirements of broadcasting, had led to industry stratification.[16] In order to expand their audiences, large, "toll" radio stations increased their signal strength at the expense of non-commercial low power stations. Interconnection raised the stakes even further by making national radio networks feasible for the first time.[17] Competition for licenses intensified. These problems were compounded by inconsistent quality of transmitters and receivers.

These new pressures tested the government's existing regulatory powers under the Radio Act of 1912. An important first challenge came in 1921. To the dismay of its neighbors, the Navy and the *New York Times*, the Intercity Radio Company decided that lower Manhattan would be the best place to locate a high power radiotelegraph transmitting to cities in Europe and the western United States. Herbert Hoover, the Secretary of Commerce, attempted to revoke Intercity's license, prompting Intercity to sue for injunctive relief. The Circuit Court of Appeals sided with Intercity, ruling that under the 1912 Act, Hoover did not have the power to refuse to grant a license.[18] Hoover recognized the need for a new regulatory solution to

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10. *See* DOUGLAS, *supra* note 7, at 298-303.
11. *Id.* at 303.
12. *Id*. at 308.
13. Aitken, *supra* note 7, at 693, n. 22.
14. DOUGLAS, *supra* note 7, at 303.
15. Aitken, *supra* note 7, at 695.
16. *Id*. at 696.
17. SLOTTEN, *supra* note 7, at 24.
18. Hoover v. Intercity Radio Co., 286 F. 1003 (D.C. Cir. 1923), dismissed, 266 U.S. 636 (1924). At Hoover's request, the Justice Department had appealed to the Supreme Court. In the meantime Intercity went bust, so the case

the problem of spectrum management. Between February 1922 and November 1925, he convened four radio conferences, inviting technologists, industry leaders, and government officials to discuss the emerging radio crisis.[19] At the fourth conference, Hoover urged participants to "face the actualities frankly." Invoking a metaphor whose currency in spectrum debates continues to this day (although, as we shall see, for different ends), he continued:

> We can no longer deal on the basis that there is room for everybody on the radio highways. There are more vehicles on the roads than can get by, and if they continue to jam in all will be stopped. … Higher power has greatly strengthened the service to listeners, but it has aggravated the problem of providing lanes through the traffic.[20]

Hoover found a willing audience in the equipment manufacturers and leading broadcasters, who naturally sought to secure the use of the spectrum in order to minimize business risk and deter entry by competitors. In the meantime, although he could not refuse licenses, Hoover continued to assign station frequencies and hours of operation as a way of forestalling spectrum congestion. However, in 1926, another appeals court stripped him of these powers in *United States v. Zenith Radio Corporation*.[21]

Faced with growing interference and diminishing governmental authority to deal with it, Congress passed the landmark Radio Act of 1927,[22] which established the modern framework of spectrum regulation. The Act created the Federal Radio Commission and gave it extensive authority to regulate radio transmission. Congress empowered the FRC to limit interference (by assigning frequencies, power levels, and times of operation) and to classify stations. The FRC would, using fair procedures, distribute three-year station licenses in all parts of the country and renew them if the licensees demonstrated continued service in the public interest. The Commission could revoke licenses of stations that violated the act (the power that was lacking in the *Intercity* case).[23] Generally, the 1927 Act reversed the default rules that applied to station operators. As one historian explains, "Unlike

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became moot and was dismissed. Despite the mootness, the case seriously called into question the Commerce Department's authority.

19. *See* SLOTTEN, *supra* note 7, at 15-30

20. Quoted in SLOTTEN, *supra* note 7, at 32.

21. U.S. v. Zenith Radio Corporation, 12 F.2d. 614 (N.D. Ill 1926). It is interesting to note that this case was a test case brought by the president of the fledgling National Association of Broadcasters.

22. Radio Act of 1927, Pub. L. No. 69-632, 44 Stat. 1162.

23. SLOTTEN, *supra* note 7, at 40-41.

the 1912 act, which assumed that all citizens had a right to a license, the 1927 act emphasized that broadcasting was a privilege given to individuals based on their commitment to 'public interest, convenience, and necessity.'"[24] The basic administrative model created by the 1927 Act was carried over into the Communications Act of 1934, which replaced the FRC with the Federal Communications Commission, and persists to this day.

As the SPTF describes it, the current, command-and-control model of spectrum management essentially consists of four basic regulatory steps: allocation, adoption of service rules, assignment, and enforcement.[25] First, through its allocation powers, the FCC decides what kinds of uses it will permit in particular spectrum bands. Second, the Commission describes service rules that specify power limits, build-out requirements, and other rules for the service allocated to a particular band. Third, through assignment, the Commission parcels out licenses for use of the spectrum in specific bands through mechanisms such as first-come-first-served licensing, lotteries, hearings, or auctions. Finally, the Commission acts as a police officer, ensuring that license holders comply with the terms of their licenses and do not interfere with other licensed uses of the spectrum.

Carrying out these four functions subjects the FCC to enormous pressures. The FCC faces an enormous information-processing challenge. Evaluating potential competing uses for any given swath of spectrum, crafting technical rules, identifying the optimal licensee, and tracking compliance is a daunting set of tasks for any centralized agency to undertake. Constant technological change makes the project even more complicated. The Commission must constantly update rules as technological advances change the basic factual assumptions on which these rules are based. Moreover, the FCC faces intense political pressures.[26] The Commission's decisions affect a diverse array of powerful interest groups, who constantly lobby for their positions at all stages of the game. The epistemic difficulties and threat of industry capture lead many critics to support rival approaches that decentralize spectrum management decisions in the hands of private actors.

On the other hand, the command-and-control approach creates an administrative forum for the promotion of desirable public policies that a privately-ordered system might fail to generate. These objectives

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24. *Id.* at 40.

25. SPTF REPORT, *supra* note 5, at 3, citing Lawrence J White, 9 FALL MEDIA LAW & POLICY 19, 23-24 (2000).

26. *See, e.g.*, REED E. HUNDT, YOU SAY YOU WANT A REVOLUTION: A STORY OF INFORMATION AGE POLITICS (2000).

include strictly economic goals such as the minimization of harmful externalities and the prevention of market failure. They also include the support of broader social values, such as free expression, individuality, and democratic participation, which might not enter into an economic calculus. There has always been a distinct sense in which the airwaves are "special" and more demanding of special treatment to prevent not only monopoly, but monotony as well. Unlike agriculture, the financial markets, the environment, or any of the countless other areas of government regulation, the FCC's domain includes the primary channels of communication through which Americans inform themselves in order to make sound political and economic decisions. FCC regulations therefore affect the ways in which a democratic society can converse about legal and political change. At its best, the command-and-control system should help to preserve the preconditions for what some might call the American "way of life."

In short, the current system reflects an uneasy tension between often-conflicting goals such as the efficient allocation of scarce resources and the preservation of the "public interest." This conflict is rooted in early history of radio regulation and the fundamental technological and industrial assumptions of that age. Yet it would not be long before commentators would come to question these assumptions and look for alternatives to the command-and-control system.

B. THE EXCLUSIVE RIGHTS MODEL

In fact, competing visions of radio regulation are just about as old as the system itself. In 1926, just a few months before the passage of the 1927 Act, an alternative picture of the future of radio regulation was drawn in an Illinois state court. *Tribune Company v. Oak Leaves Broadcasting Station*[27] involved a dispute between two Chicago radio stations. WGN, operated by the Tribune Company, transmitted at 990 kHz and, since it went live in 1924, had developed a loyal audience of more than 500,000 listeners. WGES, operated by Oak Leaves and two other parties, had been broadcasting at 1200 kHz, but on September 7, 1926 moved to 950 kHz (possibly because it wanted to reach some of the WGES audience). The change in frequency caused interference between the two stations, and Tribune promptly filed suit in state court, requesting a restraining order to prevent WGES from transmitting at a frequency so close to WGS. WGES, for its part, responded that there were no other frequencies it could use that would

27. *Tribune Company v. Oak Leaves Broadcasting Station*, Circuit Court of Cook County Ill., Decision reprinted in CONG. REC. Dec. 10, 1926, at 215-219.

not interfere with other stations. Moreover, it asserted that the 40 kHz band separating the two stations should be enough to prevent interference if the stations and their listeners used properly tuned equipment. In a remarkable decision, Judge Francis S. Wilson ruled in favor of the plaintiffs. Analogizing from the common law of trademarks and the Western tradition of granting use rights in running water, Judge Wilson held that WGS' investment in and prior use of the band in question gave it a property interest in the band. Moreover, according to the Judge, "priority of time creates a superiority of right."[28] He ordered Oak Leaves to cease transmitting at the contested frequency and to refrain from transmitting within 50 kHz of the WGS signal within a 100 mile radius. Within a matter of months, however, the 1927 Act would supersede Judge Wilson's decision.

Although it represented a road not taken in radio policy, the *Oak Leaves* decision anticipated what would come to be a common assertion of many economists, namely, that a system of private property rights would provide the most efficient way to allocate scarce spectrum resources. This argument has come to be associated with a famous article by Ronald Coase[29] and the foremost modern advocate of the position is Thomas Hazlett of the conservative American Enterprise Institute.[30]

The SPTF formulates the property approach as an "exclusive use" model, "in which a licensee has rights that are exclusive, flexible, transferable…an interest in a frequency band that is similar to a fee simple interest in the spectrum, with the right granted being exclusive and perpetual, or nearly so."[31] In contrast to the command-and-control model, the exclusive rights approach places no use restrictions on license holders, as long as they adhere to basic technical rules regarding power and in-band emissions (in order to prevent "trespassing" on the spectrum of other licensees). The exclusive rights model envisions free transferability of licenses, thus enabling the creation of a secondary market in spectrum rights. Spectrum rights may be freely subdivided or recombined (within limits set by the antitrust laws, presumably) in ways that provide the most benefit to rights-holders and their constituencies.

Proponents of the exclusive rights approach generally make two related kinds of arguments in its favor. First, they argue that under

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28. *Id.* at 219.

29. Ronald H. Coase, *The Federal Communications Commission*, 2 J. L. & ECON. 1 (1959).

30. *See, e.g.,* 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 (2001).

31. SPTF REPORT, *supra* note 5, at 6.

conditions of spectrum scarcity, a secondary market is much more efficient than administrative procedures for allocating spectrum rights toward their highest valued use. This is a standard neoclassical economic argument for resource allocation in general. Markets allow for decentralized information processing among many participants who signal their individual valuations through the price mechanism. Over the long run, parcels of spectrum should end up in the hands of those who are best positioned to use them for maximum social benefit, since those are the people who are willing to pay the market price. The second argument is that property rights create incentives for capital investment in wireless systems. Secure in the knowledge that they retain a perpetual right to use their spectrum and that, if necessary, they can augment their holdings with other spectrum (at the right price), rights holders are likely to invest more in equipment and services to support new uses. This second point, of course, is a corollary of the first. Over time, licensees who under-invest in their spectrum will likely sell their rights to other parties who see the spectrum as a positive net present value opportunity, according to the exclusive rights view.

Opponents of the exclusive rights approach raise several objections. First, they argue that the property approach maximizes economic efficiency at the expense of non-economic values such as freedom of expression, public access to information, diversity of opinion, localism, etc. This overarching concern, of course, is one of the main reasons the framers of the 1927 Act did not opt for a property approach (incumbent broadcasters' desire to exclude new entrants was perhaps another important, but unstated, reason). Second, critics point out that markets often fail and warn that a property approach might lead market participants to hoard spectrum or otherwise game the system to their personal advantage.[32] Finally, closely related is the prospect of the "tragedy of the anticommons" recently hypothesized by Michael Heller[33] and most clearly articulated in the spectrum context by proponents of the spectrum commons model such as Yochai Benkler.[34] As we will see momentarily, these people claim that the most efficient new wireless technologies are dynamic and utilize very small frequency bands for very short periods of time. The necessary transaction costs to trade these time-slices would be so high

32. SPTF REPORT, *supra* note 5, at 7.

33. Michael A. Heller, *The Tragedy of the Anticommons*, 111 HARV. L. REV. 622 (1998).

34. See, e.g., Yochai Benkler, *Overcoming Agoraphobia: Building the Commons of the Digitally Networked Environment*, 11 HARV. J. L. & TECH. 287 (1998); Benkler, *Some Economics of Wireless Communications*, 16 HARV. J. L. & Tech. 25 (2002).

relative to the value of the individual time-slices as to make a market impossible.[35]

Although the exclusive rights approach has long been the main theoretical rival to the prevailing administrative system, for most of this time its popularity has been largely academic. However, the spectrum auctions of the early 1990s signaled a renewed interest in marshalling private market forces to facilitate the initial allocation of spectrum. Chairman Powell has shown a clear interest in extending the market approach to encompass a secondary market in spectrum rights. Moreover, a growing perception that the command-and-control system has been slow to adapt to new technologies has also fueled interest in the exclusive rights model, which is seen as more dynamic and responsive to technological change.

C. THE SPECTRUM COMMONS MODEL

Even as the exclusive rights movement gathered steam, a new rival approach emerged on the scene, driven by the same technological advances that tantalize exclusive rights proponents. Looking forward, many commentators believe new technologies will change the ground rules of wireless communications, and, in the process, increase both efficiency and individual liberty. An emerging group of technologists, academics, and social visionaries propose to solve the spectrum scarcity problem through a radical program of *de*regulation involving the removal of both public and private claims to the spectrum. The SPTF refers to this approach as the "spectrum commons" model, but the model is also commonly referred to as "open spectrum."

While the spectrum commons approach is novel, its roots run deep. In 1938, the FCC added Part 15 to its rules, which permitted operation of devices employing relatively low level RF signals without the need for individual licensing as long as they did not cause harmful interference to licensed services and did not generate emissions or field strength levels greater than a specified level.[36] At the time, the new rules were intended to encompass wireless record players, carrier current communication systems, and remote control devices.[37] Many

35. Eli Noam has proposed a microtransactions system that would alleviate this problem, but this idea is purely theoretical at this point. Eli Noam, *Spectrum Auctions: Yesterday's Heresy, Today's Orthodoxy, Tomorrow's Anachronism*, 41 J.L. & ECON. 765 (1998).

36. In Re: Revision of Part 15 of the Rules regarding the operation of radio frequency devices without an individual license. F.C.C. 89-103 (Apr. 18, 1989) (hereinafter PART 15 REVISION).

37. *Id.*

new devices that emerged over the years took advantage of the Part 15 license exemption, such as cordless telephones, garage door openers, and retail inventory control systems.[38] Simultaneously, the development of new spectrum-sharing technologies, such as spread spectrum, enabled part 15 radios to be "reasonably good neighbors with one another."[39] In 1989, the FCC revised Part 15 to allow the operation of unlicensed devices for any application within specified emissions limits.[40] The advent of standardized networking protocols, such as Ethernet, and advances in computing created a ferment of activity in the development of wireless digital networking protocols. All of these developments set the stage for the explosion in internet access using the IEEE 802.11b wireless local area network ("Wi-Fi") standard beginning in 1999. Industry analysts estimated that by the end of 2003 there were 4.2 million frequent Wi-Fi users in North America, and that the number would increase to 31 million by 2007.[41]

Open spectrum advocates believe that the growth of Wi-Fi presages a future of spectrum management that in some ways more closely resembles the early, pre-regulated days of radio than it does the world we live in now. They claim that spectrum scarcity, the central assumption of both the current system and the property approaches, is an obsolete concept—a by-product of the high-power, narrowband services used for traditional analog broadcasting.[42] They argue that inexpensive digital signal processing technology is ushering in an era in which low-powered, wide-band devices will greatly expand the overall amount of data that can be transmitted wirelessly to the point where spectrum scarcity is no longer a pressing concern. Equipment manufacturers, working through standards organizations such as the IEEE, can now develop highly efficient "agile" digital protocols (the most prominent but still relatively primitive example being the 802.11 family of standards) that dynamically adjust transmission frequencies and power levels to accommodate simultaneous spectrum users in any given area. In many instances, the amount of bandwidth that new technologies can deliver is proportional to the range of frequencies available for transmission: the wider the range of available frequencies, the greater the capacity of the system. At the limit, "ultrawideband" technology promises to deliver significant bandwidth in transmission

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38. *Id.*

39. Charles Jackson, Dynamic Sharing of Radio Spectrum: A Brief History (2002) (unpublished manuscript on file with author).

40. *See* PART 15 REVISION *supra* note 36.

41. Press Release, Gartner Group, Gartner Says Frequent Users of Wireless LANs Will Total 4.2 Million in 2003, *available at* http://www4.gartner.com/5_about/press_releases/pr26mar2003a.jsp.

42. *See, e.g.*, Benkler, Some Economics of Wireless Communications, *supra* note 34; LAWRENCE LESSIG, THE FUTURE OF IDEAS: THE FATE OF THE COMMONS IN A CONNECTED WORLD (2001), ch.5, ch. 12, and ch. 14.

bursts so small as to resemble low level noise emitted by conventional radio transmitters. Additionally, a new technology called mesh networks promises link low power spectrum users together in a kind of peer-to-peer radio network. In theory, the amount of data that can be transmitted through a mesh network increases with the number of participating users, a principle that technology pundit David Reed calls "cooperation gain." The notion that the scarcity of a wireless system might actually decrease as transmission increases of course turns an assumption underpinning decades of spectrum policy on its head.

Spectrum commons supporters claim that in order for these new technologies to achieve their promise, the axioms of spectrum regulation need to change. Part 15 notwithstanding, the command-and-control approach, with its emphasis on assigning specific technical requirements and mandated uses to narrow portions of the spectrum, is too inflexible to permit an expansive open spectrum regime. The exclusive rights approach provides more flexibility, but the transaction costs associated with negotiating spectrum access with existing license holders—even for unused frequencies—would be prohibitively high in relation to the small time-frequency slices of spectrum used by open spectrum technologies. In the course of a single transmission, a device might use many different frequencies for very short intervals, so that it would be impossible for any given user to negotiate with all of the spectrum owners. Spectrum commons advocates therefore believe that the goal of public policy should be, as much as possible, to reduce or even eliminate licensing restrictions on the airwaves, making such transactions unnecessary.

To the extent that government imposes rules on the spectrum, say the open spectrum supporters, they should be minimal regulations, similar to the Part 15 power limits, which apply across the entire spectrum (or at least a large portion of it) and only define the outermost bounds of acceptable use. Private actors, operating through standards bodies and other industry associations, can fine-tune these minimal, baseline rules with shared technical protocols that regulate traffic and minimize congestion. Like Herbert Hoover in the 1920s, spectrum proponents frequently invoke a vehicular traffic analogy, but for directly opposite purposes. Over time, they note, private toll roads have given way to public highways. Drivers on highways are generally free to travel wherever they want, using whatever kind of vehicle they want, carrying whatever cargo they want, so long as they follow minimal "rules of the road." Similarly, radio users in a spectrum commons regime would be free to transmit whatever they want, whenever they want, to whomever they want, so long as their devices conform to certain standards and protocols (the analogy is imperfect, because the open spectrum advocates would have standards bodies, instead of the government, fill in the content of the rules).

In general, supporters of a spectrum commons see at least three main types of benefits to opening up the airwaves, all of which relate to the claim of reduced scarcity. First, free access to the radio spectrum, coordinated by established technical "etiquettes," can vastly expand the capacity of wireless transmission to the point where allocation by administrative fiat or market is not even necessary. A spectrum commons thus creates net economic benefits by making a controlled resource freely available. Second, much as the "end to end" design of the Internet has paved the way for innovation by making access a matter of adherence to simple protocols,[43] an open spectrum arrangement would usher in an era of new products and services as for-profit and non-profit organizations freely implement new wireless ideas, unconstrained by the need to procure spectrum licenses or gain approval from the FCC. Third, increased access to the spectrum would lead to more freedom and unconstrained individuality, as end users and equipment makers experiment with new ideas and applications of wireless communications.[44] A spectrum commons would facilitate much greater use of the spectrum for uses that are currently not sanctioned by the FCC, and, in some cases, by groups that cannot obtain licenses for existing uses.

The chief theoretical criticism of the spectrum commons approach stems from skepticism about the central claim that technology can eliminate spectrum scarcity. This critique breaks down into supply-side and demand-side arguments. On the supply-side, the open spectrum argument requires a leap of faith that runs counter to 75 years of radio regulation. The current system of spectrum allocation, after all, developed as a response to increased spectrum use and interference following the introduction of broadcasting technologies in the 1920s. While laboratory experiments may suggest that new technologies can radically increase spectrum capacity, the proof will be in the pudding. For instance, Wi-Fi has been an unqualified success in private locations, but early deployments of public "hotspots" have in some instances led to interference between competing providers.[45] On the other hand, even if such interference proves to be systematic, proponents of open spectrum would argue that Wi-Fi cannot deliver maximum efficiency because it operates in limited bands and does not take advantage of all the latest digital signal processing techniques.

Second, there are demand-side objections. A large academic literature has grown up around the idea of the "tragedy of the commons," where unfettered access to a common resource results in

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43. *See, e.g.,* LESSIG, *supra* note 34, at 36-38.

44. *Id.* at ch. 5.

45. Nancy Gohring, *Wi-Fi Spreading Internet Access to the Masses*, SEATTLE TIMES, Dec. 10, 2002.

overuse to the detriment of society.[46] New technologies often beget unanticipated new uses. While an open spectrum approach might create an abundance of spectrum in the short run, increased access and new technologies could very well lead to a shortage down the road.[47] All one has to do is imagine a nation of teenagers downloading high-bandwidth video games or a gang of wireless spammers sending billions of unwanted video messages through the air to recognize that current uses of wireless systems may pale in comparison to what the future could bring. Once again, the open spectrum argument requires a leap of faith.

Nevertheless, despite these fundamental questions, the spectrum commons approach has emerged as a credible model within the SPTF. This surprising fact perhaps reflects not only the forcefulness of the open spectrum advocates, but also Chairman Powell's persistent pursuit of alternatives to the command-and-control paradigm, as well as his faith in the power of technology to solve pressing regulatory problems.

D. CONCEPTUAL INTERFERENCE

The SPTF models reflect dramatically different assumptions about the nature of the wireless world. This radical dissonance manifests itself clearly in the kinds of metaphors debate partisans use to illustrate their point of view. Exclusive rights advocates, not surprisingly, tend to think of spectrum as a physical thing that can be subject to fee simple ownership. More subtle arguments extend the real property metaphor to include talk of zoning rules, easements, etc., as a way of bringing in additional flexibility to the exclusive rights model. Pure commons theorists, on the other hand, tend to compare the spectrum to public resources such as highways, the atmosphere, or even free trade zones, which defy (simple) attempts at enclosure. Command-and-control supporters (to the extent they have a voice in the SPTF proceedings) sometimes frame the debate in terms of containing problems such as pollution.[48] Of course, some dissonance is to be expected, since the rulemaking process employed by the SPTF is designed to solicit comments from different interest groups. What is

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46. Garett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968).

47. David J. Farber and Gerald R. Faulhaber, *Spectrum Management: Property Rights, Markets, and the Commons*, ET Docket No. 02-135, July 18, 2002, at 19 (comment before F.C.C.).

48. Ass'n for Maximum Service Television, Inc. & Nat'l Ass'n of Broadcasters, ET Docket No. 02-135, Jan. 27, 2003, at 17 (joint comments before F.C.C.).

striking, however, is the degree to which the discussants' basic worldviews are, in a profound way, radically inconsistent.

III. ENVISIONING THE FUTURE

Having described the basic menu of options, the SPTF bravely attempts to figure out which model should guide U.S. spectrum policy in the future. The SPTF adopts a "one size does not fit all" strategy, recommending that the "Commission base its spectrum policy on a balance of the three basic spectrum rights models."[49] The central question for the SPTF therefore becomes how to determine when to apply each of the three models. The SPTF proposes a conceptual framework for making these decisions. This framework is well-conceived, but ultimately the SPTF fails to apply it in a completely honest fashion. Moreover, limitations in the application of the framework suggest that something is missing from the SPTF's menu of models. Consideration of this missing ingredient suggests that a theoretical resolution of the problem is likely to over-simplify the range of options available to policymakers.

A. A HEDGING STRATEGY

Confronted with the broad conceptual gulf separating the various models, the SPTF has two basic options. First, it could try to pick a winner. Relying on the testimony of outside experts and its own engineers, the SPTF could try to predict the evolution of wireless technology and the corresponding economic conditions that would develop. It could for instance, agree with the open spectrum camp that new technologies will lead to a Panglossian future of unlimited bandwidth and zero spectrum scarcity. It might, on the contrary, decide that spectrum scarcity is here to stay and adopt one of the more traditional models. Either way, the SPTF would be putting a stake in the ground about the future development of the spectrum. The second option, option, of course, is to hedge, and this is the approach the SPTF takes.

The hedging strategy is probably a wise choice. The siren song of technological progress has beckoned policy makers before. At several critical junctures in the radio history, technologists have argued that technical progress would inevitably lead to one or another policy outcome. Before the 1912 Act, for instance, equipment makers

49. SPTF REPORT, *supra* note 5, at 16

anticipated the modern open spectrum position, arguing that transmission bands would become so narrow that there would be room for everyone to communicate freely, thus obviating the need for regulation.[50] In the 1920's, David Sarnoff contended that super-high-powered transcontinental radio was the logical direction for radio, given the direction of broadcast technology.[51] The first prediction turned out not to be true using analog equipment available at the time. While the second prediction was technically feasible, the subsequent history of radio shows that the regulatory scheme, as much as the technical capabilities, had an effect on shaping consumers' preferences regarding the proper geographical scope of broadcasting services.

The SPTF is wise to take a position that accounts for uncertainty regarding the evolution of the underlying conditions of wireless communication. The path of progress is often beset with twists and turns, and the ultimate destination may change over time. The point is not that technologists are to be distrusted, but rather that policy-makers do well to take grandiose claims with a grain of salt. Keeping options open has its virtue when technology is moving at a rapid clip.

B. THE SPTF FRAMEWORK

Having decided to hedge, the SPTF tries to construct a framework that will help it to determine, given certain basic facts, the applicability of the various models. The SPTF approach to reconciling the three models follows a proposal by Farber and Faulhaber. [52] It hinges on two key factors: spectrum scarcity and transaction costs. As the SPTF explains,

> By "spectrum scarcity," we mean the degree to which competing demands to use particular spectrum exceed the supply of spectrum available. By "transaction costs," we mean the expenditure of time and resources required for a potential spectrum user to obtain the spectrum access rights necessary to its proposed spectrum use.[53]

The SPTF would consider both of these factors in determining which model is most appropriate in any given spectrum band. Because the SPTF only considers two basic relative states, "low" and "high,"

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50. DOUGLAS, *supra* note 7, at 217.
51. SLOTTEN, *supra* note 7, at 27.
52. Farber and Faulhaber, *supra* note 47, at 13.
53. SPTF REPORT, *supra* note 5, at 17.

for each factor, the SPTF framework essentially consists of a 2-by-2 matrix. (See Figure 1)

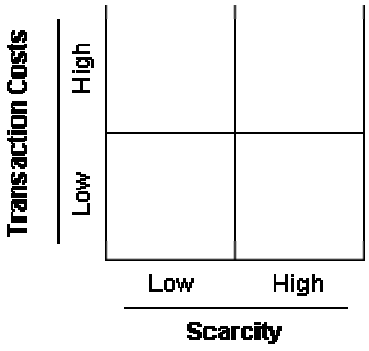

Figure 1: SPTF Matrix

According to the SPTF, there are two easy cases when application of the framework is straightforward. First, when scarcity is high and transaction costs are low for a particular band, the exclusive rights model is clearly most appropriate. The reason, according to the SPTF, is that scarcity necessitates rationing. In the absence of transaction costs, which could lead to market failure, the exclusive rights approach should lead to an efficient allocation of the band (or subdivisions of the band) to its highest valued use.[54] Second, in the SPTF's view, low scarcity and high transaction costs tend to favor application of the commons model.[55] High transaction costs would impede the efficient operation of a spectrum market. Yet low scarcity makes this fact practically irrelevant. An abundance of spectrum eliminates the need for rationing in the first place. There is enough spectrum for everyone to share in common.

The two remaining boxes in the matrix are more uncertain for the SPTF. The first uncertainty occurs when scarcity is low and transaction costs are also low. In this case, the SPTF notes that "the commons model again may be most appropriate, though this situation is less clear."[56] Low scarcity would suggest that a commons approach should not lead to overuse. On the other hand, low transaction costs would not impede the functioning of markets and low scarcity would tend to push the price toward zero: "With low transaction costs as well as low price, interested users should have unrestricted access to the

54. *Id.* at 17-18.
55. *Id.* at 19.
56. *Id.* at 19.

spectrum they need."[57] As Farber and Faulhaber point out, this ambiguity between the two models is in fact a potential benefit from the regulator's standpoint. Assuming transaction costs are low, the FCC can set up an exclusive rights regime in any given band. If scarcity turns out to be high, this decision will turn out to be justified on efficiency grounds. On the other hand, "[if] a property rights regime is imposed where scarcity is not present, the price of the resource at the margin falls to zero."[58] Thus, the exclusive rights approach automatically reverts to a spectrum commons, without any further regulatory intervention.

Uncertainty also plagues the SPTF in the situation when both transaction costs and scarcity are high. The commons model is clearly inappropriate in this case, because high scarcity could lead to overuse and contention for spectrum. The SPTF believes that in this case the exclusive rights model should continue to be the rule, but admits that "this situation is less clear."[59] The reason it is unclear is that high transaction costs suggest that the market may fail, thus raising the possibility of an inefficient allocation of spectrum resources. Nonetheless, the SPTF notes that that "the greater the scarcity, the greater will be the incentive for parties to find ways to overcome these high transaction costs."[60] Although the SPTF's framework would seem to call for another approach in this instance, the SPTF chooses to apply the exclusive rights model. I will return to this inconsistency in a moment.

These four scenarios exhaust the basic possibilities set up by the SPTF framework. Figure 2 provides a visual overview of the SPTF's position for each scenario.

57. *Id.* at 19.
58. Farber and Faulhaber, *supra* note 47, at 13.
59. SPTF REPORT, *supra* note 5, at 18.
60. *Id.*at 18.

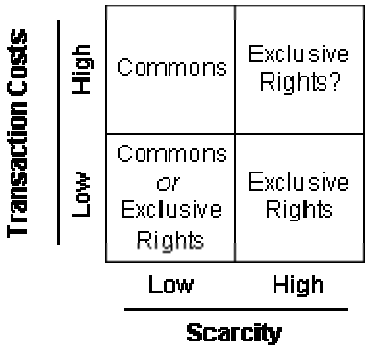

Figure 2: Application of Matrix

C. LIMITATIONS OF THE FRAMEWORK

As the foregoing discussion suggests, the SPTF's framework is conceptually interesting, if thoroughly ambiguous at points. In particular, three limitations of the framework stand out.

The first problem with the framework as described above is that it is contains an inherent bias against the open spectrum model. The SPTF's band-by-band approach would have the FCC apply different governing regimes to different slices of spectrum. This approach is perfectly acceptable from the perspective of the exclusive rights and command-and-control models, which are essentially predicated on this kind of division of the spectrum. Proponents of the commons model, however, emphasize that because of the nature of the new wideband communications technologies, the commons should be implemented across wide swaths of spectrum in order to provide maximum benefits. The SPTF is aware of this asymmetry and, following Farber and Faulhaber, embraces the concept of "spectrum easements." Just as easements in the physical world allow third parties to make limited use of someone else's property, spectrum easements would take advantage of "listen-before-transmitting" technology to allow third parties to use privately held spectrum on a non-interfering basis with the actual licensee.[61] As the SPTF acknowledges, this is a second-best solution, because "the easement model inherently limits the flexibility afforded to the licensee to some degree, and relies on government to define the scope of the easement."[62] As a result, the SPTF recommends easements only be allowed for "underlay technologies that operate at very low power…provided that the technical boundaries of the easement are well-defined."[63] The need to import a concept external to

61. *Id.*at 32.
62. *Id.* at 32.
63. *Id.* at 33.

the basic framework in order to preserve balance suggests that the framework itself may need some reworking.

Second, even as it apparently seeks to remove the government from the nitty-gritty management of wireless industries, the SPTF framework places a significant burden on the government. Specifically, it requires the government to monitor and measure scarcity and transaction costs in order to determine how to apply the framework to any given spectrum band. This information-processing task would be challenging enough to perform if the government was given an abundance of empirical data, but the debate concerns the future conditions of the spectrum and anticipates the effects of technological developments that have not yet reached commercial maturity.

Thus, we find ourselves in a regulatory catch-22. The optimal balance among the three models may depend on the degree to which spectrum turns out to be scarce or transaction costs turn out to be low. Yet those critical facts may very well follow from the regulatory approach that is implemented. For example, Farber and Faulhaber's price-mechanism argument notwithstanding, we may not know whether a wide-ranging spectrum commons can succeed if the spectrum is chopped up into little pieces in the first place. If new technologies require a spectrum commons in order to deliver unlimited capacity, one can hardly expect the price to drop to zero in an exclusive rights regime. Whether or not it is actually feasible to go straight to a sweeping open spectrum policy, the framework provided by the SPTF does not do much to resolve the problem of *ex ante* decision-making by the FCC under severe information constraints.

A third criticism involves an unexpected application of the framework. This problem takes its cue from the ambiguity surrounding the high scarcity/high transaction cost quadrant discussed in the previous section. This quadrant raises the specter of an inefficient allocation of spectrum due to market failure, since high scarcity requires some kind of resource allocation, but high transaction costs (relative to the value of the spectrum) could prevent a market in spectrum rights from clearing properly. Because market failure often provides a rationale for government regulation of private markets,[64] one might expect the SPTF to recommend the command-and-control model in this instance. Indeed, the SPTF recognizes this principle when it notes that "limited use of command-and-control" may be justified for "spectrum uses that require regulatory prescription to avoid market failure (e.g., satellite allocations to ensure global

64. Joseph E. Stiglitz, ECONOMICS OF THE PUBLIC SECTOR (2000), ch. 4.

harmonization of satellite frequency bands)."[65] Nevertheless, the SPTF argues for the exclusive rights approach in this quadrant of the framework, on the assumption that the market will somehow figure out a way to structure transactions so as to mitigate the transaction costs and avoid market failure. The decision to shun the command-and-control approach even when exclusive rights appear problematic seems at best odd and at worst disingenuous.

These defects in the SPTF framework suggest that the framework could use some analytic retooling if it is to be of any practical use. It may simply be impossible to reduce the complex problem of which governing approach to apply to the spectrum to just two dimensions, particularly ones as difficult to measure *ex ante* as scarcity and transaction costs. This is not to say the project is essentially flawed. Properly conceived, a workable framework could provide a useful conceptual guide for policymakers as they wander through the forest of regulatory decision-making in years to come.

D. OTHER MODELS?

The SPTF's reluctance to apply the command-and-control model may suggest the need to consider additional models of spectrum regulation other than the three depicted in the working group report. Indeed, conspicuously missing from the SPTF report (and from the spectrum debate generally) is discussion of a liability rule system as a fourth model of spectrum management. This is surprising, because liability rules occupy a central place in the toolbox of legal theorists seeking to analyze the allocation of social costs.[66] Liability regimes typically do not place absolute restrictions on the kinds of behavior that may be performed by actors within the system. Rather, they assign prices (determined by the government) to those actions, typically in the form of fines (where the proceeds go to the state) or damage awards (where the proceeds go to some injured party).[67] For example, some forms of pollution regulation use liability rules, which allow companies to pollute so long as they are willing to pay a fine. In theory, if the "price" is set at the right level, the liability approach allows the regulator to deter conduct with high external social costs without prohibiting such conduct when the benefits outweigh the costs.

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65. SPTF REPORT, *supra* note 5, at 21.

66. *See, e.g.*, Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972).

67. Louis Kaplow & Steven Shavell, *Property Rules Versus Liability Rules: An Economic Analysis*, 109 HARV. L. REV. 713 (1996)

As a model of spectrum regulation, liability rules might be the solution the SPTF is looking for in the "fourth quadrant" case where scarcity and transaction costs are both high. Unlike spectrum commons, liability rules utilize a pricing mechanism to deter overuse of a scarce resource. Unlike property rules, state-determined pricing circumvents market failure and the "tragedy of the anticommons" resulting from high transaction costs. And in contrast to the command-and-control model, a liability regime would not require *ex ante* government authorization to utilize spectrum for any given purpose, which would probably make it more palatable to the SPTF. In short, the liability approach combines the flexibility of open spectrum with a hedge against overuse by high powered broadcasters, without prohibiting such uses altogether when the benefits outweigh the costs. In this sense, the pollution analogy is quite apt. A properly structured liability regime might permit ongoing low-level spectrum "pollution" by Part 15-like devices while forcing large-scale "polluters" to internalize the costs of their behavior.

My point is not that liability rules are the end-all solution to the spectrum debate but rather the more modest suggestion that the SPTF's theoretical effort could benefit from consideration of additional models. The liability approach may or may not provide significant advantages upon further analysis. However, as recent scholarship has made clear, allocative rules come in a variety of shapes and sizes, which often resemble hybrids between the simple liability and property models.[68] The adaptability of the rules may ultimately prove essential if the FCC is to move beyond the command-and-control paradigm. Therefore, the SPTF's project would benefit from consideration of a range of models beyond the three described in its report.

IV. CONCLUSION

In the very early days of radio, before World War I, neither government nor private interests exerted any significant control over the radio spectrum. Americans viewed the airwaves as a vast and unconstrained frontier, a domain of unfettered freedom and individualistic expression. A devoted wave of amateur radio operators swarmed the new medium, transmitting and receiving with abandon. The airwaves were an open arena in which they were free to act as they pleased:

68. Abraham Bell & Gideon Parchomovsky, *Pliability Rules*, 101 MICH. L. REV. 1 (2002)

> To the amateurs, the ether was neither the rightful province of the military nor a resource a private firm could appropriate and monopolize. The ether was, instead, an exciting new frontier in which men and boys could congregate, compete, test their mettle, and be privy to a range of new information. Social order and social control were defied. In this realm the individual voice did not have to defer to the authority of business or the state. This realm, argued the amateurs, did not belong to hierarchical bureaucracies: it belonged to "the people."[69]

This "golden age" of wireless ended in 1912 with the sinking of the Titanic. When a breakdown in radio communications prevented other nearby ships from hearing the Titanic's distress calls, popular opinion and political forces turned against unfettered access to the airwaves. Congress passed the Radio Act of 1912, which effectively relegated amateur radio operators to the spectrum hinterlands. The 1912 Act represented "a watershed in wireless history, the point after which individual exploration of vast tracts of the ether would diminish and corporate management and exploitation, in close collaboration with the state, would increase."[70] The Radio Act of 1927 sealed the fate of the spectrum once and for all by establishing basic regulatory framework that governs wireless communications to this day.

The great spectrum debate, in the end, is an argument about whether it may be possible to raise the aspirations of the golden age from the deep seas of time, or whether this goal is just a utopian dream. At the very least, Chairman Powell and the SPTF deserve credit for attempting to resolve the matter in a comprehensive way, even if the effort is, at times, conceptually deficient. The SPTF's pursuit of this lofty goal may ultimately appear irrelevant, as the future of spectrum policy unfolds in the course of day-to-day compromises between special interests rather than through implementation of a majestic plan. Nonetheless, you can't blame them for trying.

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69. DOUGLAS, *supra* note 7, at 214.
70. DOUGLAS, *supra* note 7, at 236.