A LAW & ECONOMICS APPROACH TO SPECTRUM PROPERTY RIGHTS: A RESPONSE TO WEISER AND HATFIELD

Thomas W. Hazlett[*]

INTRODUCTION

The provocative Article by Phil Weiser and Dale Hatfield[1] presents a challenging analysis of property rights to radio spectrum. Its main thesis is that a property system, by which they mean a private property regime, is difficult to construct because the rights are complicated to design.[2] Radio emissions lurch in many dimensions and are hard to predict; they are probabilistic rather than precise.[3] Weiser & Hatfield argue that this complexity has been ignored by advocates of private property, who reflexively cite property rights in land as the relevant analogy.[4] It is a poor analogy, Weiser & Hatfield offer. Defining land is simple, defining spectrum is not simple, and the metaphor leads to an incomplete and potentially dangerous argument for a premature shift to a rights structure that may harm the economy.[5] Before markets are unleashed, spectrum ownership rights must be made complete and defined with certainty else we risk making public policy even less supportive of productive activity than it is under the present system of administrative allocation.[6]

Here I present a law and economics analysis that is distinctively different. Happily, it largely dovetails with the Weiser & Hatfield public policy position. Both approaches aim to facilitate a rights regime that enables markets to allocate radio spectrum, abandoning the traditional regime in

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[*] Professor of Law & Economics, George Mason University. Contact thazlett@gmu.edu. The author wishes to thank Dean Brenner, Eric Claeys, Charles Jackson, and Wayne Leighton for helpful insights. Jason Arentz and Alyssa DaCunha supplied valuable research assistance. No liability escapes the author.

[1] Philip J. Weiser & Dale Hatfield, *Spectrum Policy Reform and the Next Frontier of Property Rights*, 15 GEO. MASON L. REV. 549 (2008).

[2] *Id.* at 588, 608.

[3] *See generally id.* at 575-80. They argue that transmission variability means signal strength can only be predicted statistically. *Id.* at 580.

[4] *Id.* at 550, 580, 598.

[5] *See id.* at 591, 608. Weiser and Hatfield conclude that "instituting property rights in spectrum is not as simple as transposing existing real property rules for trespass onto spectrum licenses." *Id.* at 608.

[6] *See id.* at 591, 598, 603.

place since 1927, wherein administrative allocation decides how to use the spectrum resource.[7]

Law and economics informs this policy exercise in fundamental ways. A wide array of models illuminates the key legal, political, and economic forces that interact to create property rights, and how those regimes evolve over time. These analyses hold important lessons for those dealing with the regulation of radio spectrum. In fact, the earliest property rights analogies drawn by regulators—to general common law rights of first appropriation[8] and specifically to those found in riparian claims[9]—were crucial in organizing economic activities in the dawn of the wireless era. In modern times, regulatory reforms establishing de jure or de facto private ownership of radio spectrum itself have yielded numerous insights as to the costs of efficiency-creating transactions under alternative rules. These examples constitute not metaphors, of course, but practical experience, ongoing tests of how liberal spectrum property regimes operate. They include the operation of cellular networks utilizing broadly defined, de facto spectrum ownership rights,[10] and the emergence of reforms in countries that have explicitly adopted a "property rights" model for radio spectrum.[11]

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7 *See* Weiser & Hatfield, *supra* note 1, at 608-09.

8 Dean Lueck, *The Rule of First Possession and the Design of the Law*, 38 J.L. & ECON. 393, 419-22 (1995).

9 68 CONG. REC. 215, 216-19 (1926) (including in the Record the full text of Oak Leaves v. WGN).

10 *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 J.L. & TECH. 335, 394-95 (2001); Thomas W. Hazlett & Matthew L. Spitzer, *Advanced Wireless Technologies and Public Policy*, 79 S. CAL. L. REV. 595, 655-56 (2006); Thomas W. Hazlett, *The Spectrum-Allocation Debate: An Analysis*, IEEE INTERNET COMPUTING, Sept.-Oct., 2006 at 68, 68-69; THOMAS W. HAZLETT, *An Economic Evaluation of Spectrum Allocation Policy*, *in* COMMUNICATIONS THE NEXT DECADE 249, 250 (Ed Richards, Robin Foster, & Tom Kiedrowski, eds., 2006); Thomas W. Hazlett, *Ronald Coase and the spectrum question*, *in* UTILITY REGULATION IN COMPETITIVE MARKETS 37, 50-52 (Colin Robinson ed., 2007); Thomas W. Hazlett, *Optimal Abolition of FCC Spectrum Allocation*, 22 J. ECON. PERSP. 103, 105 (2008).

11 *See, e.g.*, Milton Mueller, *New Zealand's Revolution in Spectrum Management*, 5 INFO. ECON. & POL'Y 159, 162-75 (1993); Ian Hayne, *Spectrum Property Rights and Practical Auction Design: The Australian Experience*, 1997 INDUS. ECON. COMM'N 179-91 (Australian Gov't Publ'g Serv.), *available at* http://www.pc.gov.au/__data/assets/pdf_file/0005/66884/iec1997.pdf; Robert W. Crandall, *New Zealand Spectrum Policy: A Model for the United States?* 41 J.L. & ECON. 821, 827-30 (1998); Pablo T. Spiller & Carlo Cardilli, *Towards a Property Rights Approach to Communications Spectrum*, 16 YALE J. ON REG. 53, 73-82 (1999); 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*, *supra* note 10, at 523-31; Giancarlo Ibarguen, *Liberating the Radio Spectrum in Guatemala*, 27 TELECOMM. POL'Y 543, 545-49 (2003); Thomas W. Hazlett, Giancarlo Ibarguen, & Wayne Leighton, *Property Rights to Radio Spectrum in Guatemala and El Salvador: An Experiment in Liberalization*, 3 REV. OF L. & ECON. 437, 438 (2007), http://www.bepress.com/rle/vol3/iss2/art10; Thomas W. Hazlett, *Property Rights and Wireless License Values*, 51 J. L. & ECON. (forthcoming Aug. 2008) (manuscript at 10-17), *available at* http://ssrn.com/abstract=519602.

A basic implication of the seminal work of R.H. Coase adds clarity. Coase saw that the costs and benefits generated by alternative property approaches were subject to a fundamental symmetry.[12] No method of defining rights is free if it excludes valuable alternatives. The Weiser & Hatfield analysis is highly asymmetric, however, categorically focusing on the difficulties claimed to be associated with defining private ownership interests. Whatever the magnitude of such costs, there is no free lunch. The central weakness of the present administrative allocation regime is that it regularly resolves potential conflicts among wireless users by suppressing vast amounts of productive activity. Importantly, a central point of agreement in this discussion is my concurrence with Weiser & Hatfield that the costs of "command and control," as they term it, are excessive. Yet, the analysis they present singularly focuses on the problems of defining private interests in frequencies, as though a cost-free alternative were available. This runs perilously close to what Harold Demsetz has dubbed "the Nirvana Fallacy."[13]

My Article is organized as follows. In Part I, I outline some basic aspects of property rights and their usefulness as devices for social coordination. This attempts to underscore trade-offs: more complete rights are better, but costly, and the optimal structure is necessarily incomplete. In Part II, the paper examines the evolution of spectrum policy. With broadcasting, traditional licenses were used, granting highly restrictive wireless use rights. In cellular, however, much broader discretion was delegated to licensees, permitting operators to exercise de facto spectrum ownership. Extensive market activity is observed in the trading and reconfiguration of such property rights, yielding essential insights as to efficient rights configuration. In Part III, the performance of the distinct rights regimes in the television and cellular bands is compared. Contrary to the Weiser & Hatfield claim that cellular operates as a special case, the efficiency-creating opportunities of the cellular property regime are shown to broadly apply. In Part IV, the paper considers pathways to property rights. The focus is on relevant policy alternatives that include the costs of delay—extending the rampant inefficiencies caused by the policy status quo—when appraising alternative choices. Part V then offers a conclusion.

I. DEFINING PROPERTY RIGHTS

Property rights help to coordinate productive use of economic resources. How such rights come into being, the rival regimes that exist in different spaces, and the evolution of those regimes helps to inform policy choices governing particular resources. When considering the efficient for-

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12 Ronald H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 2-8 (1960).

13 Harold Demsetz, *Information and Efficiency: Another Viewpoint*, 12 J. L. ECON. 1 (1969).

mulation of radio spectrum rights, a wide range of useful analogies exists in property and contract law. The analogies are not limited to private ownership of land; they include experience with other resources and with the development of wireless markets. In any event, the transactional symmetry noted in Coase's classic treatment underscores that where private property rights are costly to define, alternative rights are as well. The trick is to understand the full social costs and benefits of each. The technical issues asserted to complicate rights definitions in a private property regime are identically present in an administrative allocation regime. Marketplace evidence reveals that the cost of the private rights definitions are, all told, generally far less than those for rights managed as state property, which largely control "interference" by leaving vast productive opportunities untapped.

A. *The Land Analogy Is Sometimes Helpful in Spectrum, Sometimes Not*

Interestingly, the landmark argument for spectrum property rights offered by Ronald Coase[14] did, in part, rely on land as a model for framing spectrum rights; elsewhere he abandoned *in rem* land rights in favor of *in personam* rights—the "bundle of sticks" approach.[15] The departure from land was not, however, a helpful one. Coase sabotaged his own argument regarding the efficiencies of private property by inadvertently vesting the rights necessary for innovation (and measured trade-offs of radio interference across uses) with regulators rather than with the entrepreneurs who could efficiently exploit emerging opportunities. In this instance, the land analogy was extremely useful in defining spectrum property, but Coase cast it aside.

The land analogy appears in the Weiser & Hatfield argument itself—where it is largely inapt. Weiser & Hatfield suggest that due to the difficulties in defining spillovers across frequency spaces owned by rival parties, government regulators should determine regional spectrum uses much as a zoning commission coordinates land uses.[16] Zoning in land, however, arises from resource conflicts (spillovers) where transactions are difficult due to bargaining among a large number of parties.[17] Where landowners can effec-

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14 Ronald H. Coase, *The Federal Communications Commission*, 2 J.L. & ECON. 1, 14-21 (1959).

15 *In rem* rights relate to the ownership of things, generally implying a broad set of defined and undefined appropriation rights associated with possession of the resource. *In personam* rights, conversely, specify particular activities or uses that the owner may engage in. See the excellent analysis in Thomas W. Merrill & Henry E. Smith, *What Happened to Property in Law and Economics?* 111 YALE L. J. 357, 360-66 (2001).

16 *See* Weiser & Hatfield, *supra* note 1, at 593 (arguing that the spectrum should be zoned for different uses similar to how land authorities zone different neighborhoods).

17 The zoning institution in land, as Weiser and Hatfield recognize, often restricts output to protect incumbent owners of developed property, a result that reduces social efficiency. Weiser & Hatfield, *supra* note 1, at 595 (citing Nicole Stelle Garnett, *Ordering (and Order in) the City*, 57 STAN. L. REV. 1,

tively bargain with neighbors, mutually beneficial transactions to determine land use are generally preferable.[18] But, land ownership is often widely dispersed, owing to efficiencies of vertical integration into land by home owners, farmers, industrial firms, governments, and other parties. This ownership dispersion opens a case for land use regulation. To imply social efficiency, that case must incorporate not only the potential benefits, but also the potential costs, of such regulation. Importantly, such regulation affords incumbent property owners the opportunity to gain entry barriers that limit competition and harm consumers—an economic outcome that bears great resemblance to the current system for allocating radio spectrum.[19]

The conditions that justify land zoning do not generally exist in spectrum. Unlike land ownership, diverse ownership of tiny frequency spaces is inefficient. Spectrum in one geographic location is highly complementary with spectrum elsewhere, particularly spectrum in the same frequency. Scale economies in constructing wireless infrastructure—capital making spectrum access rights more valuable—lead markets to organize ownership patterns so as to capture such efficiencies.[20] The 25 MHz of cellular bandwidth used by Verizon Wireless to provide wireless phone service in Phoenix is the same 25 MHz the Verizon network uses in Portland, Oregon.[21] Both frequency spaces are far more valuable as 25 MHz bands controlled by one network than as small slices owned by thousands of different entities which would then have to engage in costly transactions to make use of their bandwidth. Such complementarities are strong and widely observed in wireless.[22]

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39 n.192 (2004) (collecting sources) and RUTHERFORD H. PLATT, LAND USE AND SOCIETY 296 (1996)). There also exist alternative mechanisms for coordinating and controlling neighborhood effects despite the presence of large numbers of individual land owners, including contracts widely used in markets where zoning has not been imposed, the most famous example being Houston, Texas. BERNARD H. SIEGAN, LAND USE WITHOUT ZONING 23-76 (Univ. of Chicago Press 1972).

18 This is, of course, the "Coase Theorem" result. Coase, *supra* note 12.

19 *See* Hazlett, *Property Rights and Wireless License Values*, *supra* note 11, at 2.

20 Of course, government regulation often blocks these efficient outcomes. The example chosen, involving bandwidth aggregation by cellular carriers in the U.S., occurs where rules are sufficiently permissive as to permit market outcomes. It should be noted that one of the scale efficiencies captured by regional or national networks using similar frequencies from market to market is the cost-reduction with regard to radio spillovers. Weiser & Hatfield argue that such spillovers are difficult to define and costly to contain, but overlook market mechanisms—such as aggregations that reduce borders—that mitigate such costs.

21 *See* FCC Universal Licensing System, Cellular License KNKA205, http://wireless2.fcc.gov/UlsApp/UlsSearch/license.jsp?licKey=12936 (last visited Apr. 25, 2008); FCC Universal Licensing System, Cellular License KNK212, http://wireless2.fcc.gov/UlsApp/UlsSearch/license.jsp?licKey=13094 (last visited Apr. 25, 2008).

22 They also hold in unlicensed bands, where the coordination across markets is provided by administrative allocation. Indeed, an important driver of the development of 802.11x devices, which access unlicensed frequencies, is that similar 900 MHz and 2.4 GHz have been dedicated globally for

Efficient ownership patterns can be inferred from both market development and how property regimes evolve. This frame of reference was brought into focus in Ronald Coase's pathbreaking work.[23] David D. Friedman lucidly explains the Coasian approach using the land analogy:

> A court settling disputes involving property, or a legislature writing a law code to be applied to such disputes, must decide which of the rights associated with land are included in the bundle we call "ownership." Does the owner have the right to prohibit airplanes from crossing his land a mile up? How about a hundred feet? How about people extracting oil a mile under the land? What rights does he have against neighbors whose use of their land interferes with his use of his?
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> The Coasian answer is that the law should define property in a way that minimizes the costs associated with the sorts of incompatible uses we have been discussing: airports and residential housing, steel mills and resorts. The first step is to try to define rights in such a way that, if right A is of the most value to some one who also holds right B, they come in the same bundle. The right to decide what happens two feet above a piece of land is of most value to the person who also holds the right to use the land itself, so it is sensible to include both of them in the bundle of rights we call "ownership of land." But the right to decide who flies a mile above a piece of land is of no special value to the owner of the land, hence there is no good reason to include it in that bundle.[24]

Because the configuration of property rights can incorporate these efficiency considerations, no "patent troll"—a property owner strategically asserting a claim in order to extract a share of productive gains created by others—holds up airline flights. While land owners have broad rights to exclude trespass, the contours are drawn rationally in ways that allow new technologies (e.g., air flight) to peacefully co-exist. The same analysis applies usefully to radio spectrum; here is a proper land analogy:

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the use of specified technologies. There are alternative ways to coordinate such outcomes, of course, including private ownership, as has been seen in the aggregation of U.S. wireless licenses to achieve national coverage through the purchase of (literally) thousands of licenses distributed to hundreds of different licensees. *See* Thomas W. Hazlett, *Is Federal Preemption Efficient in Cellular Phone Regulation?*, 56 FED. COMM. L. J. 155, 193-203 (2003).

[23] Ironically, Ronald Coase's work directly focused little attention on the question of how property rights are efficiently configured. Because his analysis illuminated the centrality of property rights in achieving efficient organizational outcomes, however, his work triggered further analysis of how property rights are created and evolve. *See* Harold Demsetz, *Toward a Theory of Property Rights II*: *The Competition Between Private and Collective Ownership*, 31 J. LEGAL STUD. 653, 665-71 (2002); Harold Demsetz, *Ownership and the Externality Problem*, *in* PROPERTY RIGHTS: COOPERATION, CONFLICT, AND LAW 286-89 (Terry Anderson & Fred S. McChesney eds., 2003). A comment on the matter is offered in Fred S. McChesney, *Coase, Demsetz, and the Unending Externality Debate*, 26 CATO JOURNAL 179, 182-85 (2006).

[24] DAVID D. FRIEDMAN, LAW'S ORDER 44 (Princeton Univ. Press 2000).

> If it is my land, does that mean I can forbid radio stations from broadcasting without permission, on the theory that if I can pick up the signal, the radio waves must be trespassing on my property?[25]

> The right to forbid radio waves from passing over my property . . . is of very little use to me. If every property owner had that right, setting up a radio station would require unanimous consent from ever owner within range of the broadcast, making a transfer of the right from the owner to the person to whom it is of most value a prohibitively difficult transaction. It makes more sense to have legal rules in which the right to broadcast on a particular frequency is entirely separate from the ownership of the land over which the broadcast passes.[26]

As the above discussion indicates, land may be a helpful analogy when thinking about spectrum property rights. Other property analogies can also inform the analysis and help determine how fully to define spectrum rights so as to provide an efficient transactional framework. They also reveal that spectrum's technical characteristics pose legal challenges posed in other contexts.

B. *Complete Definition of Spectrum Property Rights Unnecessary and Inefficient*

A healthy academic literature provides guidance as to how property rights regimes evolve across markets.[27] Definitional problems are routinely encountered in land, oil reserves (held by land owners, with oil deposits not clearly defined on the surface and subject to wide ranging external impacts[28]), and intellectual property (where the innovations to be discovered are impossible to identify ex ante and even difficult to specify ex post[29]). Patent rights, further, are not determined precisely but are probabilistic. Investments are made according to predictions about where future conflicts will arise.[30] Fisheries, water, and other common pools present their own challenges.[31] Across these resources, much has been learned about how

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25 *Id.* at 112.

26 *Id.* at 113.

27 Dean Lueck & Thomas J. Miceli, *Property Law*, *in* 1 HANDBOOK OF LAW AND ECONOMICS 209-13 (A. Mitchell Polinsky & Steven Shavell eds., North-Holland 2007).

28 GARY D. LIBECAP, CONTRACTING FOR PROPERTY RIGHTS 96-97 (Cambridge Univ. Press 1989). The "unitization" solution in defining ownership of oil deposits has clear parallels in defining radio spectrum to avoid rent-seeking dissipation.

29 Mark A. Lemley & Carl Shapiro, *Probabilistic Patents*, 19 J. ECON. PERSP. 75, 81-83 (2005).

30 *Id.* at 81-82 (arguing that "patent thickets" arise from building probabilistic patent portfolios).

31 *See, e.g.*, Ronald N. Johnson & Gary D. Libecap, *Contracting Problems and Regulation: The Case of the Fishery*, 72 AM. ECON. REV. 1005, 1006-10 (1982) (discussing formal and informal efforts to address inherent problems with fisheries, specifically in the shrimping industry); B. Delworth Gardner, *Legal Impediments to Transferring Agricultural Water to Other Uses*, *in* AGRICULTURAL POLICY AND THE ENVIRONMENT 67 (Roger E. Meiners & Bruce Yandle eds., Rowman & Littlefield 2003); ELINOR OSTROM, GOVERNING THE COMMONS 104-10 (Cambridge Univ. Press 1990); Terry L. Ander-

rules adapt to specific circumstances, permitting ownership rights to improve social coordination and steering rivalry away from wasteful rent-seeking to productive investments. Useful analogies are supplied across the realm of property law; for instance, much can be learned about intellectual property law from real property law, despite striking economic and physical distinctions between the two regimes.[32] No scale is available to calibrate an "easy to difficult" property rights continuum, but if one existed the requirements for radio spectrum would not likely be located at the polar extreme.

Yet the rank ordering is of no consequence. If spectrum's definitional requirements are uniquely high, then this fact burdens allocations through both regulatory commission and markets. The relative lack of transparency within regulatory "public interest" determinations masks, but does not diminish, the cost of rules imposed to reduce conflicts. Definitional problems plaguing administrative control may not be readily apparent, but the United States' TV Band offers a ripe illustration of the heavy social costs borne by defining spectrum use rights under the state property model.[33] TV transmitters emit narrowly specified broadcast services; stations are widely separated, with much (largely unused) "white space" between them; other (non-TV) services are excluded from accessing the band. The net result is that the TV Band supplies virtually no incremental value to society despite being capable of generating tens of billions of dollars annually in consumer surplus.[34] This loss is the cost of rights definition under administrative allocation. Different property regimes generate distinct efficiencies in organizing resource use—thus the case for private property. However, the *technical issues* are fixed.

Perhaps the most important property rights analogy in the spectrum policy discussion makes no appearance in Weiser & Hatfield's argument: contract law.[35] Here we observe private parties, who internalize costs, "contracting for property rights."[36] Parties routinely leave contracts incom-

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son & J. Bishop Grewell, *Property Rights Solutions for the Global Commons: Bottom-Up or Top-Down?*, 10 DUKE ENVTL. L. & POL'Y F. 73, 88-89 (1999) (discussing individual tradable quotas in New Zealand fisheries); Carol M. Rose, *Expanding the Choices for the Global Commons: Comparing Newfangled Tradable Allowance Schemes to Old-Fashioned Common Property Regimes*, 10 DUKE ENVTL. L. & POL'Y F. 45, 50-62 (1999) (discussing tradable environmental allowance systems to manage renewable environmental resources).

32 Richard A. Epstein, *The Structural Unity of Real and Intellectual Property*, PROGRESS ON POINT 13.24 (The Progress & Freedom Foundation, Wash. D.C.), Oct. 2006, at 3-9.

33 Allocational issues in the TV Band are discussed in more detail *infra* Part II.A.

34 *See* Thomas W. Hazlett & Roberto E. Muñoz, *What Really Matters in Spectrum Allocation Design* 32-33 (AEI-Brookings Joint Ctr. for Regulatory Studies, Working Paper No. 04-16, 2004), *available at* http://aei-brookings.org/admin/authorpdfs/redirect-safely.php?fname=../pdffiles/phpYq.pdf.

35 *See* Hazlett, *Optimal Abolition of FCC Spectrum Allocation*, *supra* note 10, at 117.

36 LIBECAP, *supra* note 28, at 4.

plete.[37] Economic actors who enter into them, and the judges who enforce them, see trade-offs: more specificity in a formal agreement yields the benefits of greater contractual certainty but are costly to craft.[38] Therefore, incomplete contracts are optimal and are interpreted by courts as basic documents subject to ex post expansion: held to define rights for contingencies that would have been efficient ex ante if the parties had been able to contract costlessly.[39]

Patent law yields similar spectrum insights, even as the analogy is inexact. Patent trolls, entities that strategically seek rents via activities that tax productive enterprise, result from situations where property contours are extremely costly to define—so costly, in fact, that the regime economizes on patent definitions until disputes arise.[40] Were more precise property definition to take place ex ante, fewer trolls might exist but greater resources would be expended on (mostly) worthless ownership interests.[41] Thus, it is presumably more efficient to support the less costly informational requirements of a patent registration system that creates imperfect rights, but more readily enables productive activities to commence. This process saves the search for precision until an invention has proven profitable enough to litigate and then, of course, only if conflicting claims are present.[42]

A similar analysis applies to spectrum where exhaustive rights would be useful if they could be defined for free. Alas, they cannot. Therefore, when the Federal Communications Commission's ("FCC" or "the Commis-

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37 FRIEDMAN, *supra* note 24, at 160-61.

38 *Id*.

39 "In the last ten to fifteen years, a new area has emerged in economic theory, which goes under the heading, 'incomplete contracting.' This approach has been useful for understanding topics such as the meaning of ownership . . . ." The basic idea motivating this literature is that a contract that specifies terms across all contingencies "would be prohibitively expensive." Oliver Hart & John Moore, *Foundations of Incomplete Contracts*, 66 REV. ECON. STUDIES 115, 115 (1999).

40 Mark A. Lemley argues that the Patent and Trade Office "is rationally ignorant of the objective validity of the patents it examines." Understanding this situation should "prompt us to strengthen the validity inquiry made by the trial courts." Mark A. Lemley, *Rational Ignorance at the Patent Office*, 95 NW. U. L. REV. 1495, 1531-32 (2001).

41 "[S]ociety ought to resign itself to the fact that bad patents will issue, and attempt to deal with the problem ex post, if the patent is asserted in litigation. This result is admittedly counterintuitive. It depends crucially on the fact that very few patents are ever the subject of litigation, or even licensing. Because of this, money spent improving the [Patent and Trade Office] examination procedures will largely be wasted on examining the ninety-five percent of patents that will either never be used, or will be used in circumstances that don't crucially rely on the determination of validity." *Id.* at 1531-32.

42 Pushing rights definition to an after-the-fact determination has important costs, including deterrence of investment due to the risk that a given claim will not be deemed enforceable, and the overinvestment in staking (and litigating) legal claims. These costs are, of course, part of the necessary balancing, and proposals to cost-effectively improve the performance of either ex ante (registration) or ex post (litigation) rights definition processes are important to consider. *See, e.g.*, Joseph Farrell & Robert P. Merges, *Incentives to Challenge and Defend Patents: Why Litigation Won't Reliably Fix Patent Office Errors and Why Administrative Patent Review Might Help*, 19 BERKELEY TECH. L. 943, 960-68 (2004).

sion") Spectrum Policy Task Force Report posits, "[t]he Commission should seek to . . . clearly and exhaustively define spectrum users' rights and responsibilities . . . [and] account for all potential dimensions of spectrum usage (frequency, power, space, and time),"[43] it errs. This categorical approach to definitional clarity provides no balance. Just as "minimizing interference" is inefficient,[44] attempting to *maximize clarity* in the definition of rights stalls efficiency in a legalistic morass. This assertion is more than theoretical conjecture; decades-long proceedings have laboriously analyzed and detailed use rights in valuable bands to, ostensibly, clarify the situation.[45] The practical result has been that productive spectrum has been wasted precisely because the reverse occurred: an unbalanced pursuit of defined use rights created ineffective ownership rights.

The efficient path balances the costs of specificity against its benefits, assigning property rights without wholly precise metrics for radio interference. Moreover, technical measurements are themselves—even if formally exact—economically imprecise. A small emissions spillover at one instant may inflict more damage than a much larger one at another. Hence, technical perfection in the measurement of border contours is itself highly imperfect, in addition to very expensive. Invoking the aphorism about the "ideal being the enemy of the good," would be appropriate if any real evidence that elongated definitional battles in radio spectrum led to *better*, let alone *ideal*, results. The procedure regulators use to estimate future interference patterns is notable mostly for the "attractive nuisance"[46] it affords rent-seekers.[47]

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43 FCC, SPECTRUM POLICY TASK FORCE REPORT 16, ET Docket No. 02-135 (2002).

44 As Coase noted in *The Federal Communications Commission*, *supra* note 14, at 27, and as Weiser and Hatfield stress. Weiser & Hatfield, *supra* note 1, at 567.

45 While a request to allocate spectrum for cellular telephony was made in 1947, it wasn't until 1982 that the FCC reallocated TV band frequencies for the service. GEORGE CALHOUN, DIGITAL CELLULAR RADIO 45-62 (Artech House 1988).

46 I am indebted to Kenneth Robinson, long-time telecommunications policy expert, for this apt application of the familiar legal paradigm.

47 While it is easy to ascribe this rent seeking motive to incumbent licensees, to which it often applies aptly, it should not go unnoticed that other parties, including the communications bar, telecommunications consultants (including economists and engineers), regulators and former regulators, prosper under this administrative structure. When the Rand Corporation declined to publish the spectrum property rights proposal that they had commissioned Ronald Coase, William Meckling, and Jora Minasian to write circa 1962, the review that informed Rand of the dire consequences of publication (and so scared them off) noted that "fire and counterfire" would be ignited by "CBS, FCC, Justice, and--most of all--Congress." Rand was warned to back away from the study or risk the wrath of the "Washington-Big Business maelstrom." Ronald H. Coase, *Comment on Thomas W. Hazlett: Assigning Property Rights to Radio Spectrum Users: Why Did FCC License Auctions Take 67 Years?*, 41 J.L. & ECON. 577, 579-80 (1998).

C. *The Practical Evolution of Spectrum Property Rights*

Early attempts to theoretically define spectrum spaces,[48] pathbreaking when market institutions were nascent, have been superseded by real-world applications where property rights visibly evolve. Regimes governing cellular spectrum, for instance, not only reveal how regulatory choices can define exclusive rights, as Weiser & Hatfield note,[49] but demonstrate how millions of transactions involving end users (subscribers), vertical networks (Blackberry, Palm), rival networks (mobile virtual network operators, or "MVNOs"), application vendors (supplying, for instance, location-based services), and content platforms (as with DoCoMo's iMode) reconfigure those exclusive spectrum rights to create value. These complex organizational mechanisms require high levels of sunk investment in infrastructure to connect users and suppliers through time and space.[50]

The theoretical constructs drawn to define spectrum in 1969 are less informative when such markets are already functioning, or when the law provides a precise definition. For instance, a 1996 Guatemalan statute literally defines *títulos de usufructo de frecuencias* ("*TUFs*").[51] These legal titles consist of one page listing just seven identifiers; Guatemala has used this "analogy" for spectrum property rights for over a decade.[52] Similar experiments now dot the globe, with incremental reforms liberalizing spectrum ownership rights in Australia, New Zealand, and El Salvador.[53] Ongoing liberalization efforts are underway in Norway and the United Kingdom.[54] None of these regimes is likely to be characterized as the ultimate solution; policy success is relative and iterative. But the expanding database of spectrum property institutions and the markets that form around them constitutes a rich source of knowledge as to how to reform the traditional system of administrative allocation.

The ownership patterns that emerge in spectrum markets have direct relevance to the interference problems encountered by regulators and which allegedly stymie development of private spectrum rights. In the paradig-

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48 *See* Arthur S. De Vany et al., *A Property System for Market Allocation of the Electromagnetic Spectrum: A Legal-Economic-Engineering Study*, 21 STAN. L. REV. 1499, 1510-18 (1969); Jora R. Minasian, *Property Rights in Radiation: An Alternative Approach to Radio Frequency Allocation*, 18 J.L. & ECON. 221, 227-35 (1975).

49 Weiser & Hatfield, *supra* note 1, at 588 (FCC defined property rights for cellular services).

50 *See* Hazlett & Spitzer, *supra* note 10, at 647-48.

51 Ibarguen, *Liberating the Radio Spectrum in Guatemala*, *supra* note 11, at 546; Hazlett, Ibarguen & Leighton, *supra* note 11, at 442-43.

52 Ibarguen, *Liberating the Radio Spectrum in Guatemala*, *supra* note 11, at 546.

53 For a review of these liberal spectrum regimes, see Hazlett, *Property Rights and Wireless License Values*, *supra* note 11, at 10-17.

54 *See* OFFICE OF COMMC'NS (U.K.), SPECTRUM FRAMEWORK REV. 4-5 (Nov. 23, 2004) [hereinafter OFCOM PLAN], *available at* http://www.ofcom.org.uk/consult/condocs/sfr/sfr2/sfr.pdf (explaining the United Kingdom's multi-year approach to releasing new spectrum and implementing spectrum trading).

matic case, Weiser & Hatfield consider a Denver TV station that tosses out radiation that has a predictable contour, most of the time.[55] Frequently, however, radiation skips over close-in areas only to swamp distant receivers—either on the same or adjacent channels.[56] Weiser & Hatfield assert that this stochastic element, where random events impact where signals conflict, is a sizeable hurdle for property rights definition.[57]

Within the FCC's allocation process, it surely is. But that hurdle is a product of mechanism design, not radio emissions. Given the incentives of the regulators who make "public interest" determinations, efficient solutions are rejected in favor of decision-making processes that reward the human capital of the processors. Conversely, were decision makers rewarded on the expeditious and profitable use of spectrum to create valuable services, they would quickly discover what market transactors long ago learned: that when the spectrum ownership rights are combined into a single package, the "technical" issues regarding interference contours dissolve.[58] Of course, potential radiation conflicts would remain unchanged—Denver TV station broadcasts would still pop in and out of distant receivers—but the costs and benefits from coordinating wireless applications would be rationally accounted for by a single owner. The conflict turns into a manageable optimization problem when ownership rights extend over the spillover border. This path is not free, as organizational costs associated with managing additional assets within a given enterprise may rise. A balancing test produces the optimum.[59]

Competitive markets discover such spectrum sharing optima. The policy goal is to initially define and package property rights so as to facilitate a pathway to efficient resource employments. This became a subject of considerable interest in law and economics, when analysis moved beyond the zero-transaction cost assumption embedded in the Coase Theorem.[60] An important discovery has been the finding that excessive dispersion in private rights assignments can result in "anti-commons" tragedies.[61]

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55 Weiser and Hatfield discuss the predicted contour versus the actual radiation of a Denver TV station. Weiser & Hatfield, *supra* note 1, at 584-86.

56 *See id.* at 569, 571 (discussing geographic and adjacent channel spillovers).

57 *Id.* at 588.

58 Demsetz, *Ownership and the Externality Problem*, *supra* note 23, at 282.

59 Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347, 357-59 (1967); Demsetz, *Toward a Theory of Property Rights II*, *supra* note 23, at 662-65.

60 *See* Harold Demsetz, *When Does the Rule of Liability Matter?*, 1 J. LEGAL STUD. 13, 25-28 (1972); Terry L. Anderson & P.J. Hill, *The Evolution of Property Rights: A Study of the American West*, 18 J.L. & ECON. 163, 164-68 (1975); Barry C. Field, *The Evolution of Property Rights*, 42 KYKLOS 319, 319-45 (1989).

61 Michael A. Heller, *Tragedy of the Anti-Commons*: *Property in the Transition from Marx to Markets*, 111 HARV. L. REV. 621, 637-40 (1998); Lee Anne Fennell, *Common Interest Tragedies*, 98 NW. U. L. REV. 907, 926-33 (2004).

Such tragedies are endemic in spectrum.[62] This is due to the extant state property regime[63] that sporadically assigns limited sets of spectrum ownership rights that cannot be easily reconfigured to accommodate productive deployments.[64] For example, the TV Band would never be utilized as it is today if rights to the allocated spectrum were vested in parties who could effectively transact to divert frequencies to their highest valued employments. The economic failure is not due to transaction costs inherent in private spectrum rights, but in the limited and highly dispersed rights created by administrative allocation.

Cellular networks provide a vivid contrast. While licenses have been highly fragmented in geographic scope, they have permitted broad spectrum ownership rights. Owners (licensees) have then transacted to efficiently aggregate complementary spectrum spaces. This has involved not only the consolidation of over 50,000 licenses to construct national networks,[65] but the investment of tens of billions of dollars to create wireless network infrastructure making these allotted frequency spaces more productive.[66] Carriers then sell access rights, with spectrum bundled with the use of network assets.[67]

Similar approaches would remedy the Denver TV station's interference boundary problem. Were the rights of the local and distant frequency spaces packaged as one bundle, owners would internalize spillovers.[68] Unless diseconomies of scale substantially increase costs, a more efficient

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62 Thomas W. Hazlett, *Spectrum Tragedies*, 22 YALE J. ON REG. 242, 242-59 (2005).

63 Radio spectrum is featured as a standard example of a state property regime, also known as a system of administrative allocation. *See* Lueck & Miceli, *supra* note 27, at 196-98. Regulators have the option of creating and distributing further spectrum rights under this regime, and do so under the "public interest" standard. This results in variation across wireless sub-markets, with cellular bands operating with de facto private property, while television broadcasting continues to operate with licenses granting owners specific wireless "use permits" yielding little discretion in the use of radio spectrum.

64 *Id*. at 198.

65 Hazlett, *Is Federal Pre-emption Efficient in Cellular Phone Regulation?*, *supra* note 22, at 194.

66 Hazlett & Spitzer, *supra* note 10, at 647.

67 Wireless networks do not typically sell "spectrum" in discrete transactions, but sell services that combine use of the wireless network with the spectrum assets which the carrier is authorized to use. This reflects customer demand and underlying efficiencies: the bundled product is far more valuable than its component parts. Carriers do frequently trade spectrum itself, as in the sale of licenses, but the transactions generally include complementary infrastructure (if it exists), as the combined assets are more valuable when they are controlled by a single economic organization that can optimize allocation choices.

68 Another way to say this is that the border interference issue can be resolved by eliminating the border. When a single enterprise owns both the property where economic activity originates and the property where the pollution spills as a byproduct of that activity, then the costs and the benefits of the activity and its polluting byproduct are considered by the owner who optimizes production fully incorporating these trade-offs. Notably, transaction cost savings stem from the fact that it is no longer necessary (as with disparate owners) to legally define the (now non-existent) borders. *See* Demsetz, *When Does the Rule of Liability Matter?*, *supra* note 60, at 19-22.

outcome is achieved.[69] Distributional concerns do not deter this arrangement; the ownership of the merged entity can be parceled, as in private spectrum markets. Equity share distribution, relatively easy to apportion, replaces spectrum splitting.

Regulators have tested this tragedy-mitigation approach and realized positive results. Consider the anti-commons problem infecting the 1850-1990 MHz band. It was designated by the FCC for emerging digital cellular ("PCS" or personal communications service) services, but for several years (from approximately 1989 to 1993) some 4500 incumbent point-to-point licensees (many of which provided communications for public utilities, offshore drilling rigs, and railroads) argued that they were using the band and could not tolerate either more traffic or relocation.[70] The "people will die" argument was featured prominently, despite the incumbents' own study that estimated that moving their operations would cost just $1 billion.[71] This was not a princely sum; it made at least 120 MHz of nationwide spectrum wholly available for licensed PCS. Cellular licenses, allocated just 50 MHz nationwide, were then valued nationally at about $100 billion[72]—implying that the 120 MHz made available for PCS would be worth at least two orders of magnitude more than its opportunity cost.

After a political stalemate, the FCC finally began assigning PCS licenses in 1995, via auction, with *overlays*.[73] These permitted the new licensee to operate in the PCS band, while respecting the continuing operations of incumbent licensees, who were grandfathered.[74] The FCC imposed binding arbitration on the incumbents to negotiate relocation, with the new PCS licensees liable for the incumbents' moving costs (i.e., new equipment of equal or higher functionality).[75] Time limits were also imposed on negotia-

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69 This means that an enlargement of the scope of the firm, now holding more property rights, may also entail costs, namely those stemming from the cost of organizing productive activity within the firm. *Id.*

70 *See* Anita Taff, *Microwave Users Bent on Keeping Their Spectrum*, NETWORK WORLD, June 15, 1992, at 31. This hold-up was a potent form of patent trolling, as the party asserting property rights (incumbents protesting interference from new applications) deterred all new deployments, not simply extracting rents from the creator of a valuable resource use after deployments were productively generated gains.

71 *See* Edward M. Greenberg & Catherine M. Lloyd, *POP Out: The Changing Dynamics of the Cellular Telephone Industry*, (Morgan Stanley—U.S. Investment Research, 1991).

72 *See* 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*, *supra* note 10, at 514 & n.562.

73 In comparison, European Union licenses for digital cellular (or 2G—"second generation"—to which PCS is comparable) were essentially assigned 1989-1992. *See* ORG. FOR ECON. COOPERATION & DEV., THE ECONOMICS OF RADIO FREQUENCY ALLOCATION 85-86 (1993).

74 Peter Cramton, Evan Kwerel & John Williams, *Efficient Relocation of Spectrum Incumbents*, 41 J.L. & ECON. 647, 662 (1998).

75 *Id.* at 666-67.

tions over compensation.[76] This set of rules empowered de facto spectrum owners, parties which internalized the gains from relocation, to overcome the anti-commons tragedy.[77] This is a sterling example of how markets improve social performance over administrative allocation and highlights the role that regulators can play in greasing the skids.

Permitting large licenses (in geography and spectrum space) and conducting simultaneous auctions, preferably with combinatorial bidding,[78] are reinforcing institutional mechanisms to facilitate efficient solutions to border problems. These allow markets to re-assemble the spectrum borders that U.S. regulators regularly over-supply and then wastefully regulate (through long, complex "harmful interference" rule makings) on the claim that "technical" issues are exceptionally difficult to resolve. At the most general level, ex post adjudication schemes are substitutes for ex ante rights definition. For example, while Guatemala required very little information in its *TUFs*, it adopted a binding arbitration mechanism for interference disputes that included tight time lines for complaints and resolution.[79] Such mechanisms substitute for the rigid zoning and "building code" regulation currently supplied by the FCC. Either approach faces challenges of rights definition, and must deal with precisely the same engineering issues. Only by comparing the total net benefits of either approach is a realistic policy comparison made.

II. LIBERAL LICENSING VERSUS TRADITIONAL LICENSING

Weiser & Hatfield argue that spectrum regulation has seen little reform since the 1934 Communications Act.[80] While the basic administrative allocation regime then enacted still survives, carrying profound consequences, some regulatory policies have changed quite remarkably. Most importantly, the emergence of a dominant non-broadcast industry—wireless telephony—has driven liberalization, including de facto spectrum owner-

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76 *Id.*

77 *See* 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*, *supra* note 10, at 514.

78 This general set of issues is best explained in Evan Kwerel & John Williams, *A Proposal for a Rapid Transition to Market Allocation of Spectrum*, FCC, Office of Policy & Plans Working Paper No. 38 (Nov. 2002).

79 Ibarguen, *Liberating the Radio Spectrum in Guatemala*, *supra* note 11, at 547; Hazlett, Ibarguen & Leighton, *supra* note 11, at 444.

80 Weiser & Hatfield, *supra* note 1, at 549-51 (saying "the FCC has largely maintained the legacy model of regulation" since the New Deal).

ship via cellular licenses.[81] These changes offer exceedingly important lessons for crafting additional and superior property rights in spectrum.

A. *Traditional Licensing*

The TV band uses traditional licensing,[82] meaning that narrowly-specified wireless use rights issue to licensees. This format bars effective spectrum ownership by private parties, as technologies, applications, or business models not specified in the license are not permitted for use. Regulators, not owners, decide how to share bandwidth by determining if new services can coexist with existing uses.

In previous work, I have evaluated the digital TV transition, [83] now officially twenty-one years in duration.[84] Today, the opportunity lies in reorganization of terrestrial video broadcasting by one of two methods: (1) contracting for universal coverage via cable, satellite, or Internet, or (2) broadcasting terrestrial TV signals using substantially less bandwidth.[85] Restructuring would cost society a tiny fraction of the hundreds of billions of dollars in new social value that would be unleashed by having an additional 294 MHz of highly productive VHF-UHF frequencies (the size of the digital TV band, post analog switch-off, encompassing channels 2-51) to use for emerging wireless services.[86] Yet, because no party—not TV station owners, not government agents, not high-technology companies lobbying for new unlicensed access to TV band "white space," not potential service

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81 The assignment of such licenses by competitive bidding in the U.S. and many other countries is also an important aspect of liberalization, but is not fundamental to this discussion over how spectrum itself should be allocated.

82 Traditional licensing authorizes a party to use particular wireless equipment in specific ways as determined by the regulator. Technologies, services, and business models are prescribed. Where a licensee seeks to provide a new service or upgrade technology, a new regulatory determination must be made—and the license terms altered—to determine whether the petition is "in the public interest." *See* 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*, *supra* note 10, at 391; Hazlett & Spitzer, *supra* note 10, at 623 (comparing "parsimonious allocation" of rights to the broader allocations made in more liberal licenses).

83 Thomas W. Hazlett, *The U.S. Digital TV Transition: Time to Toss the Negroponte Switch*, 1-2, 36-37 (AEI-Brookings Joint Center for Regulatory Studies, Working Paper No. 01-15, 2001).

84 The transition to "advanced television" was kicked off in a proceeding that opened in 1987. The proximate cause of the rulemaking was to stop the reallocation of TV band airwaves to cellular and public safety applications, a move opposed by incumbent television broadcasters. JOEL BRINKLEY, DEFINING VISION 8-30 (Harcourt Brace & Co. 1997).

85 Co-locating transmitters in each market (i.e., broadcasting from one spot) can mitigate significant interference issues, yielding more TV reception in far fewer MHz than in the existing configuration, where viewing areas must (under FCC allocation rules) accommodate transmissions from disparate locations. *See* Hazlett, *Optimal Abolition of FCC Spectrum Allocation*, *supra* note 10, at 111.

86 *Id.* at 109-11.

providers who could most efficiently supply innovative and socially valuable services with the available bandwidth—can exercise exclusive frequency rights, the transactions necessary to achieve the social optimum are pre-empted.

The roadblock, in Coasian terms, is the lack of private property rights. In spectrum policy terms, it is the administrative allocation of the TV band, with the great majority of use rights held by the regulatory agency. The very parsimonious rights issued by the FCC require licensees to continue broadcasting advertiser-supported over-the-air video signals.[87] Despite the fact that few households rely on these broadcasts and none need to,[88] incumbent broadcasters and regulators support the system because they benefit from the arrangement. For policy makers, traditional licensing serves as a backdoor entrance into content regulation, an activity that would otherwise (outside of the spectrum allocation context) be an unconstitutional First Amendment violation.[89] For incumbent broadcasters, the administrative system provides benefits in the form of zero-priced licenses and protects them from increased competition with regulatory entry barriers. In one key form of protection, the FCC awarded property rights to broadcast licensees for channel slots on cable TV, a system called "must carry." Under terms of the 1992 Cable Act, the signals of broadcast stations have priority placement on cable TV systems, free of charge.[90] Hence, we now use the most precious radio spectrum inputs, perhaps worth well over $1.5 trillion in present social value if used productively,[91] as a registration system to determine which companies receive carriage favors. This "free spectrum" is excruciatingly expensive.

In many FCC "interference" discussions, technology is characterized as a weapon that solves airwave conflicts; as science advances, these con-

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87 *See* Hazlett, *The U.S. Digital TV Transition: Time to Toss the Negroponte Switch*, *supra* note 83, at 12; Hazlett, *Optimal Abolition of FCC Spectrum Allocation*, *supra* note 10, at 111.

88 A relatively modest investment in subscription video services would bring broadcast TV service to all non-subscription households in America.

89 *See, e.g.*, ITHIEL DE SOLA POOL, TECHNOLOGIES OF FREEDOM 108-50 (Belknap Press 1983) (explaining how licensing of the press violates free speech, including licensing of the broadcast press); THOMAS G. KRATTENMAKER AND LUCAS A. POWE, JR., REGULATING BROADCAST PROGRAMMING 5-32 (The MIT Press 1994) (documenting the ongoing political interest in content regulation by policy makers overseeing radio and television licensing). Academic studies have explicitly tied this demand for content regulation to the structure of spectrum allocation. *See, e.g.*, Thomas W. Hazlett, *Physical Scarcity, Rent Seeking, and the First Amendment*, 97 COLUM. L. REV. 905 (1997); Thomas W. Hazlett, *Assigning Property Rights to Radio Spectrum Users: Why Did FCC License Auctions Take 67 Years?*, 41 J.L. & ECON. 529 (1998).

90 Thomas W. Hazlett, *Digitizing "Must Carry" under* Turner Broadcasting v. FCC *(1997)*, 8 SUP. CT. ECON. REV. 141, 145-46 (2000).

91 *See* Hazlett & Muñoz, *supra* note 34, at 42.

flicts fade.[92] One day, scarcity may disappear altogether. Weiser & Hatfield, to their analytical credit, are skeptical.[93] Indeed, the basic premise is dubious. Scant evidence supports the claim that advanced wireless technologies diminish the "interference" problem, and abundant evidence supports the opposite view.[94] Martin Cooper estimates a one million-fold increase in the intensity of spectrum use, 1900-1950, and another one million-fold increase from 1950-2000.[95] This has given rise to "Cooper's Law," the projection that wireless communications capacity doubles every 2.5 years.[96] But demand increases *pari passu* with capacity. Each bandwidth breakthrough stimulates additional wireless applications. Each generates its own conflicts, between users and between rival technologies. No engineering feat will "fix" this rivalry or eliminate these choices.

Administrative allocation of spectrum will, with new opportunities as with the old, resolve such trade-offs in a setting where decision agents fail to internalize economic costs and benefits. Again, consider the TV band, where there is vast under-utilization, a strong point made by Weiser & Hatfield.[97] They ascribe this result, however, to the FCC's "interference virus"[98] approach, by which they mean a poor regulatory focus wherein the agency over-emphasizes the cost of airwave conflicts and under-values the benefits of additional services.

The agency is surely overly conservative on average, an operational outcome I have previously analyzed in some detail.[99] But this does not flow from an unfortunate policy cut that randomly went astray. The structural dynamics of the agency itself create this regulatory bias against competitive entry. The "interference virus" is endogenous to FCC zoning, an agency-created epidemic. Administrative allocation is well-known to commit too many "Type II" errors in order to provide too few "Type I" errors—the

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92 *See* Yochai Benkler, *Some Economics of Wireless Communications*, 16 HARV. J. L. & TECH. 25, 28, 30 (2002) (arguing that technological developments have changed the spectrum policy debate because advanced technology removes the need for any spectrum management).

93 Weiser & Hatfield, *supra* note 1, at 599.

94 Peter W. Huber & Evan T. Leo, *Licensed Spectrum and the Unlicensed Commons* 22-41 (Dec. 2005) (unpublished manuscript, on file with the author).

95 See the website of Arraycomm, the firm Cooper founded: http://www.arraycomm.com/serve.php?page=Cooper. Cooper is commonly referenced as "the father of the cellphone," given his involvement (as a Motorola engineer, patent holder, and maker of the first cellphone call accessing the public switched telephone network) in the development of the technology.

96 *Id.*

97 Weiser & Hatfield, *supra* note 1, at 559-61 (recognizing that the FCC has left significant unused space between television channels to avoid any possible interference which unnecessarily restricts development of new services).

98 *Id.* (defining the "virus view" of interference as the FCC's choice to prevent *all* interference).

99 *See* 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*, *supra* note 10.

"minimize interference" approach.[100] Two examples demonstrate this behavior. For decades the Interstate Commerce Commission inefficiently blocked pro-consumer entry, protecting the interests of incumbent shipping companies; [101] while the Food and Drug Administration's testing and approval policies account for substantial net fatalities by imposing drug lags that do more harm than good.[102] These anti-social outcomes are a structural feature of the regulatory agency, not a bug picked up by chance.

Incumbent licensees reliably and vocally complain about potential radio interference from entrants, emitting ex ante claims that may have more to do with fear of competition than with a legitimate expectation of airwave damage.[103] However, such claims cannot be categorically dismissed, as some interference generates costs that outweigh benefits. The problem is that the parties who internalize the costs and benefits, including those flowing from delayed innovation or reorganized spectrum use, are not the ones balancing the trade-offs. Instead, public officials make "interference" determinations premised on engineering data which, as Weiser & Hatfield show, is stochastic and often difficult to chart.[104] The central problem is not technical, however, but economic: how valuable are the options gained (by entry), and how valuable are the options lost (via interference)? The "interference virus" is observed from a political process where the possibly destructive effects of entry are over-weighted, because of the visibility of damage to an existing service and the powerful political influences protecting incumbents' rents. A regulatory tragedy of the commons systematically occurs in administrative licensing decisions in trucking, airlines, cable TV franchising,[105] drug approvals,[106] and radio spectrum.

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100 Michael D. Intriligator, *Drug Evaluations: Type I vs. Type II Errors* 7-10 (UCLA Research Program in Pharm. Econ. & Policy, Paper No. 96.2, 1996), http://repositories.cdlib.org/pep/96-2 (last visited Mar. 27, 2008).

101 Speaking of the Interstate Commerce Commission's regulation of entry into trucking, economist Alfred Kahn writes: "[T]he Commission has pursued an extremely restrictive policy with regard to the issuance of new licenses. The possibility that the applicants would take business away from existing carriers has been an important consideration in inducing it to refuse them." ALFRED E. KAHN, 2 THE ECONOMICS OF REGULATION 15 (The MIT Press 1988).

102 Intriligator, *supra* note 100, at 11-12.

103 In a study of potential opportunities for low-power FM radio entry, it was found that at least 100,000 new stations could be licensed assuming separation rules (interference contours) historically used by the FCC. Yet, the Commission, reacting to incumbent (full power) radio station's claims about potential interference made available only about 1,000 licenses. Thomas W. Hazlett & Bruno E. Viani, *Legislators v. Regulators: The Case of Low Power FM Radio*, 7 BUS. & POLS. 1, 1-2 (2005), http://www.bepress.com/bap/vol7/iss1/art1/.

104 *See* Weiser & Hatfield, *supra* note 1, at 559, 569, 571.

105 Thomas W. Hazlett, *Duopolistic Competition in Cable Television: Implications for Public Policy*, 7 YALE J. ON REG. 65, 65 (1990).

106 "Drug testing in the United States is currently biased toward the minimization of 'Type I' error, that is, toward minimizing the chance of approving drugs that are unsafe or ineffective. This regulatory focus of the Food and Drug Administration (FDA) ignores the potential for committing the alternative

B. *The Cost of Spectrum Rights Definition*

As noted by Weiser & Hatfield, cellular licenses cede broad property rights that yield control over airwaves.[107] With such property rights, cellular networks achieve efficiencies that are not possible elsewhere. Mobile networks, for instance, seamlessly and persistently upgrade technologies, not just from analog to digital,[108] but from IS-95 to 1xRTT to EV-DO to EV-DO Rev. A.[109] Each iteration of the code division multiple access ("CDMA") standard costs carriers billions of dollars but also yields millions of users new capacity and functionality.[110] Rival GSM (global system for mobile) networks have their own, parallel migration paths, which deploy increasingly advanced systems in order to compete.[111]

'Type II' error, that is, the error of not approving drugs that are, in fact, safe and effective. Such Type II errors can result in the loss of significant benefits to society when the sale of drugs that are safe and effective is prohibited. The present drug approval system puts enormous stress on Type I errors and largely ignores Type II errors, thereby raising the cost of drug testing and delaying the availability of safe and effective drugs. A more balanced set of FDA drug approval standards, accounting for the consequences of both Type I and Type II errors, could result in better outcomes, as compared to the present system." Intriligator, *supra* note 100, at 1.

107 *See* Weiser & Hatfield, *supra* note 1, at 588.

108 Tens of millions of analog handsets were in use in the mid-1990s, but given the right to offer digital services (via deregulation of the original cellular licenses, which mandated analog technology) carriers carefully migrated users to new units while investing billions of dollars in network upgrades. This delicate balancing occurred without the carriers being awarded new bandwidth; they simply allocated shared rights in the bandwidth they controlled.

109 Evolution Data-Optimized, Wikipedia, http://en.wikipedia.org/wiki/Evolution-Data_Optimized (last visited Mar. 27, 2008).

110 CDMA networks are operated in the U.S. by Verizon, Sprint, and Alltel. ConsumerReports.org, http://www.consumerreports.org/cro/electronics-computers/phones-mobile-devices/phones/cell-phones/cell-phones-sub/how-to-choose/cellphones_how_to_choose.htm (last visited Mar. 21, 2008).

111 AT&T (formerly Cingular) and T-Mobile operate GSM systems in the U.S. *Id.* It bears noting that regulatory lags limiting the bandwidth available for U.S. cellular carriers were major drivers of two important wireless mergers in 2004-05. The acquisition of AT&T Wireless by Cingular gave the latter network additional spectrum space, and this triggered a major upgrade of their network to supply 3G (third generation) broadband. *See* Sue Marek, *Cingular Wireless: Supercarrier Impresses with Merger Gains*, WIRELESS WEEK, Mar. 15, 2005, http://www.wirelessweek.com/article.aspx?id=72082. Meanwhile, Sprint bought Nextel, and quickly embarked on its broadband upgrade. Verizon had already found sufficient bandwidth to build out its EV-DO (broadband) facilities, but the fourth surviving U.S. carrier, T-Mobile, was left without sufficient bandwidth (or a merger partner) and had to delay its adoption of more advanced technology. Brian Dolan, *T-Mobile USA's 3G: Better Late Than Never*, Jan. 11, 2008, http://www.fiercewireless.com/story/t-mobile-usas-3g-better-late-never/2008-01-11 (last visited Mar. 21, 2008). In the September 2006 auction of AWS licenses (allocated 90 MHz in the 1.7 GHz and 2.1 GHz bands), T-Mobile emerged the highest bidder, paying $4.2 billion for licenses. It immediately announced the investment of another $2.7 billion to upgrade its system for broadband capability. Lags in U.S. spectrum allocation remain extremely costly as they deter highly productive investments. It is important to note that these burdens yet occur in the "deregulated" cellular space—where former FCC Chairman Reed Hundt once proclaimed, "We . . . totally deregulated the wireless industry." REED E. HUNDT, YOU SAY YOU WANT A REVOLUTION 98 (Yale Univ. Press 2000). The statement contains an

In each mobile network upgrades, coordination problems are endemic. Existing wireless users create "harmful interference" to users adopting newer technologies. Network capacity must be apportioned between rival data and voice applications as well as among numerous network applications (e.g., MVNOs). Cellular carriers have proven relatively adept at organizing such complexity. The technological dynamism, the flowering of diverse applications, and the ongoing reallocation of radio spectrum seen in the cellular bands compare favorably to the common interest tragedy observed in the TV Band.[112] These positive outcomes are tied to the transactions made possible, or impossible, by the property rights afforded licensees.

Weiser & Hatfield bemoan the failure of the FCC to enact an "interference temperature," ostensibly clarifying spectrum rights held by licensees.[113] The Commission sought to define a "noise floor" that could accommodate unlicensed low-power devices in the same bands where licensees, such as cellular operators, provided service without creating "harmful interference" to the licensed services.[114] The essential argument was that, by explicitly defining a "safe harbor," a band within which low-powered devices could operate, licensees would gain security in their property rights (via enhanced definitional clarity) and users of unlicensed radios could gain extra bandwidth. Social gains all around.

The proceeding lasted four years, and in May 2007 the FCC closed the matter, stating:

> Commenting parties generally argued that the interference temperature approach is not a workable concept and would result in increased interference in the frequency bands where it would be used. While there was some support in the record for adopting an interference temperature approach, no parties provided information on specific technical rules that we could adopt to implement it.[115]

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element of truth, but the deregulation provided no mechanism for accessing new spectrum. Remedying such anti-consumer "warehousing" by the government remains a key objective of liberalization. *See* Hazlett, *Optimal Abolition of FCC Spectrum Allocation*, *supra* note 10, at 115-16.

112 The liberalization of cellular is gradually migrating to the TV band, where digital licensees are given more discretion over available bandwidth use. This has resulted in, for example, public TV stations using part of their broadcast signals for data-casting applications without any loss in video reception. *See, e.g.*, National Datacast, http://www.nationaldatacast.com/home.html (last visited Mar. 21, 2008); *see also* Howard A. Shelanski & Peter W. Huber, *Administrative Creation of Property Rights to Radio Spectrum*, 41 J. L. & ECON. 581, 581 (1998) (discussing the liberalization of radio spectrum policy).

113 Weiser & Hatfield, *supra* note 1, at 565 (describing how the only recent FCC initiative to create property rights, the "interference temperature" system, failed).

114 For an extensive analysis of the Commission's proposal, see Hazlett & Spitzer, *supra* note 10, at 605-21.

115 Order, Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile, and Satellite Frequency

This policy retreat was dramatic. In November 2003, the FCC's inquiry was launched with gusto, announcing that a new "interference temperature . . . could represent a fundamental paradigm shift" in spectrum allocation.[116] Yet the FCC's process in pursuing spectrum property rights was fatally flawed. First, it ignored the existing pattern of de facto property rights that gave cellular licensees control over low-power emissions within their bands. This liberal regime had already extended powerful spectrum-sharing incentives to market competitors who were making highly effective use of them. CDMA networks, for instance, have embedded mobile handsets with chips for years that adjust 800 times per second to find the lowest power levels needed to sustain links to the network.[117] The desire of carriers to economize on "harmful interference" drives this sophisticated technology, as each carrier controls and potentially sells the spectrum space it conserves.

Second, the FCC assumed that *regulators* had to carve out and assign new access rights to users, ignoring the opportunity for owners of liberal licenses to themselves assign spectrum sharing rights. This turned positive-sum transactions into battles over wealth transfers, and created myriad new borders to administratively define. The FCC then found that this path proved too costly to pursue.[118]

Third, the Commission framed the issue as an engineering problem—setting a bright-line test for permissible encroachments would be as easy as taking one's "temperature." The engineering premise was wrong—the FCC could find no thermometer to sense and measure encroachment. But, more deeply, even if the FCC had discovered a simple metric, it would not have revealed the level of *harmful* interference. Damage from conflicting uses is an economic outcome that includes the costs of valuable activities not undertaken because the transactions necessary to achieve them are inefficient. The FCC had no way to properly evaluate these economic trade-offs, which is one reason it focused on the wrong metrics.

In sum, the failure of the "interference temperature" proceeding demonstrates both the inefficiency of explicit, exhaustive property rights definitions when less specific, ownership templates are available, and the degree to which the state property spectrum allocation regime continues to confuse economic choices with engineering rules. This was the precise bureaucratic approach shown to be inimical to consumer welfare maximization in Coase.

Bands, ET Docket No. 03-237 (May 4, 2007), *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-07-78A1.pdf.

116 Notice of Inquiry and Proposed Rulemaking, Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile and Satellite Frequency Bands, 18 F.C.C.R. 25,309 ¶ 1 (Nov. 28, 2003).

117 *Spread Betting*, THE ECONOMIST, June 19, 2003, at 24.

118 *See supra* note 115 and accompanying text.

C. *Patent Trolls*

Weiser & Hatfield raise the specter of "patent trolls," arguing that a premature switch to private property in spectrum will produce rent-seeking inefficiencies.[119] As presented, however, the argument suggests little for spectrum policy: intellectual property is not abandoned because patent trolls impose costs. The benefits of the property regime are seen to offer offsetting advantages. The rational course in IP is to retain private property rights while searching for reforms that mitigate the patent troll problem.

In spectrum, moreover, the patent troll problem is markedly distinct. The current regime faces widespread "patent troll" hold-ups in virtually every place where it has not carved out liberal, exclusive rights. Again, take the example of the TV Band. Incumbent licensees, enjoying highly restrictive use rights (to transmit from particular locations, offering specified video services delivered via mandated standards, using an ad-supported business model), have, since the 1940s, resisted efforts to reallocate unoccupied channels on the grounds that the new services would compromise their provision of their "public interest" broadcast outputs.[120] A standard tactic is to allege that radio interference will result. Highly ambitious claims of this sort have thwarted productive enterprise. Assertions that cable TV systems would "siphon" broadcast TV viewers[121] lead the FCC to impose anti-cable rules in the 1960s, a particularly egregious example of regulatory protectionism.

Meanwhile, vast bandwidth has been protected (i.e., new technologies have been blocked from accessing it) in order to introduce "advanced television."[122] In recent years, hundreds of TV stations have been far more valuable for their regulatory hold-up options, not to mention the "must carry" rights to claim bandwidth on cable and satellite TV systems, than for their ability to deliver programming via over-the-air broadcasts. Incumbents strategically block productive airwave use in large measure because they do *not*

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119 *See* Weiser & Hatfield, *supra* note 1, at 553, 582-83 (stating that licensees with spectrum property rights "might bring trespass claims as a means of extracting payments from unlucky transmitters").

120 CALHOUN, *supra* note 45, at 45-46; Hazlett, *The U.S. Digital TV Transition: Time to Toss the Negroponte Switch*, *supra* note 83, at 22-23.

121 This is the claim of economic competition as "interference" with an existing business model. It is noteworthy that "competition is not a tort" under common law, FRIEDMAN, *supra* note 21, at 190, but the FCC did, in fact, block cable TV systems from competing with broadcasting from the early 1960s until the late 1970s, when the Commission deregulated cable TV and permitted "siphoning." Thomas W. Hazlett, *Cable Television*, *in* 2 HANDBOOK OF TELECOMMUNICATIONS ECONOMICS 192, 194-95 (Sumit K. Majumdar et al. eds., 2006).

122 The digital TV transition, officially launched as a move to "advanced television" in 1987, was triggered when land mobile services were seeking TV band spectrum for competitive cellular networks. The broadcasting industry urged the FCC to rebuff the request, made in the mid-1980s, on the premise that vacant channels were being saved for the new video technology. BRINKLEY, *supra* note 84, at 26-27.

own spectrum and therefore do not financially suffer from the opportunities lost. I have previously called this a "hostage crisis," wherein TV licensees refuse to let valuable airwave space be reallocated so as to extract large payments and/or regulatory favors.[123] If economically efficient spectrum parcels had been distributed to responsible owners, economic incentives and competitive constraints would combine to eliminate such hold-ups.

A crucial switch occurs with private rights: the incumbent's option to politically veto the reallocation of bandwidth vanishes. We have already seen that a well-designed transition to private rights, as in the overlay approach in the PCS band, would allow owners to negotiate efficient transitions.[124] The benefit to incumbents from holding up entrants evaporates when regulators are no longer blocking reallocation, explicitly or implicitly. Instead, the action shifts to market negotiations, bounded by the value of the incumbent's spectrum on the high side and the cost of the incumbent's move to vacate on the low side. Property owners, both the overlay entrant and the grandfathered incumbent, will negotiate within this range to execute mutually beneficial trades thereby promoting social welfare. Administrators have no reliable information revealing these values and weak incentives to discover them. Therefore, the current regime fails to capture available gains.

Other hold-up opportunities may remain, but are dealt with by standard institutions, including binding arbitration and takings. For instance, the parties used binding arbitration to discover and enforce efficient terms for the reallocation of PCS incumbents.[125] General courts, administrative judges, or special courts[126] could use FCC "harmful interference" precedents, or property law in other contexts, in resolving border issues. In a depoliticized environment stripped of the arbitrary "public interest, convenience, or necessity" standard,[127] these property decisions would develop a body of law, as we see in other resource rights. Deploying additional devices to lower transaction costs, as when spectrum is shared by a division of

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123 Thomas W. Hazlett, *Hostage Standoff*, BARRON'S, Mar. 19, 2001, at 46, *available at* http://mason.gmu.edu/~thazlett/Op-eds/The%20Political%20Spectrum%20-%20Hostage%20Standoff.pdf.

124 *See supra* notes 70-77 and accompanying text.

125 Cramton et al., *supra* note 74, at 19-21.

126 I have previously recommended a "Spectrum Court" with expertise developed in the field. *See* Hazlett, *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*, *supra* note 10, at 551-55.

127 The 1927 Radio Act established that spectrum allocation decisions be made by the Federal Radio Commission "as public convenience, interest or necessity requires." Radio Act of 1927, ch. 169, 44 Stat. 1162, 47 U.S.C. §§ 81-83 (repealed 1934). This language was adopted verbatim in the 1934 Communications Act which transferred this regulatory authority to a newly created agency, the Federal Communications Commission. *See* Communications Act of 1934, 42 U.S.C. §§ 301 *et seq*. (1982). The standard is exceedingly vague, vesting wide discretion in the agency. William T. Mayton, *The Illegitimacy of the Public Interest Standard at the FCC*, 38 EMORY L. J. 715 (1989).

equity[128] in lieu of defining separate spectrum contours, can smooth the transition to private ownership. In extreme situations, spectrum properties can be condemned under eminent domain rules.[129] None of these invites a special problem with opportunistic rent-seeking. As evidenced in already functioning private spectrum spaces this private rights system does not succumb to disruption via trolls. Qualcomm's MedioFLO experience is a prime example where incumbent hold-ups disappeared once private property rights gave parties the opportunity to bargain.

D. *MediaFLO: Liberal Regime Success . . . in Broadcasting*

Qualcomm's MediaFLO is put forth by Weiser & Hatfield as an example of the problem with regulatory lags in adjudication of "harmful interference."[130] As presented, the example is weak, for the FCC accommodated Qualcomm's request in less than two years, a fairly timely response. But the MediaFLO example is, in other ways, powerful. Namely, it illustrates the potential for hold-up problems in administrative allocation by case-by-case rulemakings; it also reveals that the efficiency-creating transactions engaged by cellular networks extend to distinct technologies operating under a similar property rights regime.

Under the standard "public interest" procedure for evaluating new entry, applicants request permission to access radio spectrum. The 700 MHz frequencies, now used in part by MediaFLO, were the subject of reallocation requests (i.e., requests to permit services distinct from broadcast television, for which the band had been dedicated in regulatory actions stretching from 1939 to 1953[131]) as early as 1985.[132] The Chairman of the FCC had announced that the Commission would reallocate these airwaves as early as 1996.[133] Not until June 2003 did the FCC auction licenses for the use of the 6 MHz allocated to UHF Channel 55, when Qualcomm purchased licenses

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128 *E.g.*, Sprint Corp., Quarterly Report (Form 10-Q) (May 9, 2005), *available at* http://sec.edgar-online.com/2005/05/09/0000101830-05-000157/Section8.asp (discussing Sprint and Virgin's exchange of equity and discounted network services).

129 *See generally* RICHARD EPSTEIN, TAKINGS (1985). Restrictions on takings, limiting them to a narrow class of actions, appear in law precisely because it is generally inefficient for governments to force transactions not willingly made. It is also why "just compensation" is an important feature of such interventions.

130 *See* Weiser & Hatfield, *supra* note 1, at 566-67 (saying the regulatory strategy, as evidenced in the MedioFLO situation, moves too slowly).

131 *See* Hazlett, *The U.S. Digital TV Transition: Time to Toss the Negroponte Switch*, *supra* note 83, at 2-3.

132 *See* BRINKLEY, *supra* note 84, at 8.

133 *See* Hazlett, *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*, *supra* note 10, at 557-58.

conveying rights to deliver services without the regulations and restrictions levied on broadcast television. [134] In January 2005, Qualcomm petitioned the Commission to establish a rule indicating how much "interference" Qualcomm could legally create for TV stations using channels 54, 55, or 56. The Commission answered this query with a specific determination of "harmful interference"—rejecting a request to standardize the analysis[135]—in October 2006. Weiser & Hatfield associate this twenty-month lag with the cost of property rights definitions.[136]

In fact, the regulatory lags are far longer elsewhere; as noted above, prying the channel away from the TV band took two decades. There is no disagreement that the current regulatory process, which sets arbitrary terms for license contours under a "public interest" determination that is non-standard, imposes net social costs. The essential allocation problem is not that contours are technically challenging, however. Rather, the institutions created to determine spectrum use rely on decision-makers who maximize something other than social welfare.

The MediaFLO case emerges as an example of how private spectrum rights facilitate optimization. The mobile TV service is a product of wireless technology company Qualcomm, the innovative developer of CDMA.[137] As noted, Qualcomm bought nationwide coverage via TV Channel 55, yielding it liberal use of 6 MHz.[138] Qualcomm is able to use the bandwidth allocated to the license—6 MHz—to deliver MediaFLO to customers.[139] The key policy innovations here are the broad spectrum rights

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134 Press Release, Qualcomm, Qualcomm Subsidiary to Support Nationwide Delivery of Mobile Multimedia in 700 MHz Spectrum (Nov. 1, 2004), *available at* http://www.qualcomm.com/press/releases/2004/041101_mediaflo_700mhz.html [hereinafter 2004 Qualcomm Press Release] ("Qualcomm acquired the majority of this [UHF Channel 55] spectrum in the June 2003 Federal Communications Commission (FCC) Auction No. 49 . . . .").

135 "In its decision, the FCC considered embracing a more systematic (and less ad hoc) standard for interference management on similar issues as well as instituting a streamlined procedure for determining issues like that raised by Qualcomm. Ultimately, however, the FCC declined to do either, instead adhering to its usual public interest case-by-case determination system that invites rent-seeking (i.e., delay-inducing) behavior by competitors." Weiser & Hatfield, *supra* note 1, at 566 (footnotes omitted). The policy outcome flows from the regulatory structure. General rules, while socially efficient, were not as highly valued by the Commission. The opportunity to retain regulatory discretion was.

136 *See id.*

137 DAVE MOCK, THE QUALCOMM EQUATION (2005).

138 The fact that the Channel 55 licenses were offered at one time allowed efficient aggregation. This mitigated border interference issues on Channel 55, given the band is controlled by the same company everywhere. *See* Order, In the Matter of Qualcomm Incorporated Petition for Declaratory Ruling, WT Docket No. 05-7, ¶¶ 2-3 (Oct. 13, 2006) [hereinafter "FCC MediaFLO"].

139 Qualcomm does not market the service to end users, but contracts with mobile phone operators such as Verizon and AT&T to include a MediaFlo option on subscribers' handsets. *See* 2004 Qualcomm Press Release, *supra* note 134. This is a nice example, among multitudes, of the efficient aggregation of spectrum (or wireless services) via contract, creating efficiencies in the deployment of services. It is also notable that the market solution to "interference" in this instance is for the TV product to be delivered to

granted by licensees, and auctions that allow one bidder to efficiently aggregate complementary assets so as to quickly form a nationwide network.[140]

Under this regime, Qualcomm's economic interest is to maximize the value of that band. But Qualcomm faced a problem: many TV stations had the right to broadcast analog signals on Channel 55 until Feb. 17, 2009, the scheduled date of the digital "switch-over."[141] Moreover, TV stations assigned Channels 54 and 56 (adjacent frequencies) could be subject to radio interference from MediaFLO, damaging their viewers.[142]

Qualcomm did, in fact, ask the FCC in January 2005 to specify its Channel 55 contour, or "property rights."[143] The FCC struggled with this determination, producing a decision in October 2006. As it often does, the FCC settled on a rule of thumb, this one being based on the percentage of local TV viewers potentially affected by MediaFLO's signal interference.[144] These rules of thumb reveal the FCC's capitulation to practicality, underscoring the inevitable imprecision of rights definitions.[145] The lesson Weiser & Hatfield appear to take away is that the episode shows the complicated nature of these property contour decisions.[146]

Verizon or AT&T customers via frequencies separate from those carrying phone network traffic. This economizes on "technical" spillovers and contractual squabbling over how to divide system capacity and design architectures.

140 Actually, a combinatorial bid option would have rationalized the auction aggregation process, and is an improvement that the FCC has discussed for a decade but has yet to generally implement. *See generally* PETER CRAMTON, YOAV SHOHAM, & RICHARD STEINBERG, COMBINATORIAL AUCTIONS (2006).

141 Press Release, Qualcomm, QUALCOMM Applauds Passage of Definitive End-Date for Digital Television Transition by U.S. Congress (Feb. 1, 2006), *available at* http://www.mediaflousa.com/content/newsroom/article7.shtml (last visited Mar. 27, 2008).

142 FCC MediaFLO, *supra* note 138, ¶ 3.

143 *Id.*

144 "[F]or the first full year after the release of this *Order*, we will consider interference from Qualcomm stations affecting a protected TV/DTV station of up to 0.5 percent of the population within the Grade B contour of a protected TV station or DTV noise-limited service contour, without discounting for cable and satellite penetration, to be *de minimis* and therefore acceptable. For the second year, the *de minimis* exception will be increased to 1.0 percent, and it will be further increased to 1.5 percent for the remainder of the DTV transition." *Id.* ¶ 30.

145 No matter the Commission's rhetoric regarding the need to "minimize interference," it routinely permits *de minimis* interference, otherwise virtually no wireless activity would occur. Aloha (another 700 MHz license owner which supported Qualcomm's MediaFLO petition) states, "Aloha contends that similar *de minimis* standards have been applied broadly and are more the norm than the exception." *Id.* ¶ 24. Yet, here the question of whether *de minimis* interference would be permitted generated a policy analysis that took months to resolve, as incumbent broadcast TV stations vigorously opposed the idea. *Id.* ¶ 25.

146 *See* Weiser & Hatfield, *supra* note 1, at 567. If, alternatively, Weiser & Hatfield are only suggesting that the current regulatory regime is producing the delays and costs attendant to spectrum contour definitions, then we have no disagreement whatever. It is my contention, in truncated format, that

I see the example as a demonstration of the reverse. First, a 20-month proceeding is overly lengthy and consumes too many resources (e.g., interested parties created filings and lobbied, FCC staff worked on this proceeding instead of other projects, etc.). But this standard outcome of administrative allocation flows from the incentives of the regulators, policy makers, and private interest groups (including the communications bar) that shape administrative procedures. If technical spectrum issues fundamentally caused the problem, the FCC would rationally standardize its border rules to economize on resources. Some parties asked the FCC to do just this in the MediaFLO matter, but the request was rejected. [147] The FCC preferred to maintain ad hoc rules over a general approach that would reduce administrative costs. This bureaucratic choice is consistent with the view that regulators seek to maintain valuable discretion, but is inconsistent with the view that technical difficulties are driving the cost of these determinations. Standardizing either contours or procedures and employing FCC precedents as default rules would help remedy rulemaking costs and delays. Binding arbitration with strict time limits is another solution.[148] Strict time limits on the FCC alone is yet another.[149]

Qualcomm did not need an FCC "interference" rulemaking to negotiate property rights with incumbent TV stations. It began buying TV station broadcasting rights, paying to interfere with grandfathered stations using Channel 54, 55 and 56, *before* the FCC issued its October 2006 rulemaking.[150] In these agreements, TV stations agreed to accept interference from MediaFLO, in some cases moving to a new TV channel or going dark; Qualcomm paid compensation to stations.[151] Today, MediaFLO is broadcasting with national (if less than ubiquitous) coverage, having "reallocated" spectrum. This is Coasian bargaining in a positive transaction cost environment.

However, FCC approval of these bargains was *required*. To determine the "public interest," the Commission conducted a 20-month proceeding. Notably, incumbent broadcasters, as an industry, vigorously opposed Me-

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spectrum rights definition is remarkably difficult only if you're doing it wrong. The FCC's case-by-case method does it wrong.

147 *See* Weiser & Hatfield, *supra* note 1, at 566; *supra* note 140.

148 Such mechanisms are used in the Guatemalan spectrum reforms. *See* Ibarguen, *Liberating the Radio Spectrum in Guatemala*, *supra* note 11, at 547; Hazlett, Ibarguen & Leighton, *supra* note 11, at 444.

150 *See* Hazlett, Ibarguen & Leighton, *supra* note 11, at 444 (stating that in Guatemala claims must be adjudicated within ten days of filing).

150 *See infra* Appendix, Table 1.

151 *See, e.g.*, BroadcastEngineering.com, Commission approves QUALCOMM's MediaFLO transmission for Washington, D.C. area Sept. 10, 2007, http://broadcastengineering.com/RF/commission-qualcomm-mediaflo-dc-0910/index.html ("QUALCOMM has made deals with WNUV-TV, Channel 54 in Baltimore, and WHAG-DT, channel 56 in Hagerstown, MD. Both have agreed to accept any potential interference that the transmissions might cause.").

diaFLO's entry as contrary to the "public interest" in over-the-air broadcasting, a plea to deter entry based on the asserted interference created by its mobile TV product for broadcast TV viewers. To wit:

> There is a fundamental policy question at stake. Will the commission permit an involuntary loss of universal, free over-the-air viewing in order to facilitate the development of a subscription based-based video clipping service you can see over your cell phone? The TV viewers receiving interference will be disenfranchised, losing access to news, public affairs and important emergency information.[152]

Individual TV station owners have, in market after market, elected to abandon the "public interest" in broadcasting by selling out to a competing product.[153] Their policy position changed radically when they bore the opportunity cost, turning from opponents of innovation to enablers.[154] This demonstrates how the cartelistic agenda enforced by a regulatory agency breaks when private property rights unleash competitive bargaining. In this case, the "overlay" sold to Qualcomm for Channel 55 made the firm the residual claimant for values created. Transactions then proceeded. If more effort went into crafting the precise interference contours, the net effect would retard market reallocation.

Even with the impediments levied by administrative allocation rules for interference, Qualcomm has reallocated a substantial portion of the TV Band. As a resource owner, it has sought to realize deals producing benefits exceeding "interference payments." This is the socially efficient rule. The transactions have allowed Qualcomm to deliver new services with a reallocation of Channel 55 spectrum.[155] In traditional FCC years, this change took about fifteen minutes.

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152 BroadcastEngineering.com, MediaFLO poses interference, public policy threat, says MSTV president, (Feb. 22, 2006), http://broadcastengineering.com/hdtv/Mediaflo-mstv-president20060222/index.html.

153 *See infra* Appendix, Table 1.

154 The actual damage to the "public interest" is essentially non-existent. The FCC rules permit MediaFLO to cause interference to TV signals received in as many as 2% of households in the market, but with over 90% of television viewing taking place in homes that receive signals through cable or satellite, that is a trivial proportion of TV viewing. Under conservative assumptions, just [.1]*[.02] = 0.2% of total households in the market. Of course, the damage inflicted would only be sporadic, much like the effects of rain or snow on satellite TV signals. But, with the latter—which nearly 30 million households subscribe to despite the occasional reception outage—the MediaFLO spillovers only possess a chance of altering over-the-air reception of Channels 54, 55 or 56, and only through Feb. 2009, when the all-digital system will utilize Channels 2 through 51. In a given market, only one station would occupy this trio of channels, and (being a high-numbered UHF) it would not likely account for more than 1% of total TV viewing in non-subscription households. This reduces the universe of potentially impacted TV viewing to 0.002%, much less than the damage affecting satellite TV reception.

155 A list of markets in which MediaFLO is currently offered is available at http://www.flotv.com/getflo.shtml (last visited Mar. 27, 2008).

Zoning for compatible uses might well block this reallocation because MediaFLO constitutes a *new use* of TV Band spectrum. This "entrant to the neighborhood" has been unwelcome under decades of actual FCC zoning decisions, where anti-competitive outcomes are routinely couched as "technical reasons." So too here, as seen with the "public interest" argument to exclude MediaFLO's use of Channel 55 due to "harmful interference," in the view of the TV broadcasters' trade association. Zoning, to the extent that it homogenizes applications in frequency space, would inefficiently block just the sort of pro-consumer spectrum reallocation that Qualcomm produced. Indeed, FCC zoning of the TV Band *has blocked* this and countless other innovations from gaining access to this valuable spectrum for decades.

On the other hand, zoning was unneeded to help define interference contours. Paying TV stations to move, go dark, or accept "interference" was the efficient solution, and it occurred without the costs and risks of FCC zoning.[156] The efficiencies that result from Qualcomm's overlay rights are impressive precisely because market allocation substituted for administrative allocation, generating social gains even in the face of poorly designed spectrum contours. Qualcomm's spectrum reallocation, overcoming the "patent trolls" of broadcasting, illustrates some of the key efficiencies of private property rights. The jarring comparison between the efficiencies of private rights in the cellular bands and the waste from state management in the TV band further demonstrates this point.

III. PROPERTY RIGHTS IN CELLULAR AND THE TV BAND

The striking asymmetries in performance between the most important wireless sectors—broadcast TV and mobile telephony—vividly demonstrate both the advantages of exclusive spectrum rights and the large economic gains available from policy reform. Cellular's productive activities, efficiently organized via market transactions that dynamically reconfigure spectrum rights to seize evolving opportunities, contrasts with broadcasting's common interest tragedies. The difference does not derive from technology or physics, as the MediaFLO example should make clear. When liberal licenses supply the spectrum rights necessary for productive market transactions, economic incentives generate rational trade-offs.

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156 FCC spectrum allocation has often been likened to a zoning board, although the agency also imposes substantial rules and restrictions regarding technologies used and content transmitted—making it like a zoning board with additional authority for building codes. *See* Peter W. Huber, Boban Matthew & John Thorne, *Estimating the Costs of Telecommunications Regulation*, *in* WHITE PAPERS: THE UNPREDICTABLE CERTAINTY 292 (Nat'l Academy of Sciences ed., 1998).

A. *Efficiencies in Cellular Bands*

The organization of cellular markets offers crucial data about the crafting of efficient property rights in radio spectrum. CMRS licenses,[157] permitting licensees broad discretion in their choice of technologies, services, and business models, brings allocated spectrum under de facto private ownership. It should be noted that the rights conveyed are not perfectly expansive, as some restrictions on spectrum use remain (e.g., licensees are prohibited from offering ad-supported video directly competing with TV broadcasters), and licensees do not enjoy de jure ownership of airwaves (all licensees have had to agree to forego any claim to "vested rights" in frequencies since December 1926, even before passage of the Radio Act[158]).[159] But the rights bundles delegate broad discretion to licensees, qualitatively distinct from the specific use permits traditionally issued.

With broad, exclusive spectrum rights, de facto owners invest aggressively in wireless infrastructure complementary to their airwaves and then promote intense utilization of the opportunities thereby afforded.[160] The reference to this regulatory model as "exclusive use"[161] reveals a high level of confusion by policymakers: cellular bands are the most intensely shared frequencies (measured in net economic value generated[162]). Firms do not bid billions of dollars for licenses to obtain "exclusive use," but to exercise "exclusive rights" so as to enable diverse *non-exclusive* spectrum access for subscribers, application providers, technology suppliers, and rival networks. For example, innovators like Research in Motion ("RIM") or Apple contract for access to wireless networks. Products such as Blackberries and iPhones then deliver wireless functionality to millions of customers despite being developed by firms lacking licenses or other spectrum assets.[163]

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157 Commercial Mobile Radio Services ("CMRS") are supplied by "land mobile" licenses, in FCC jargon, and are now commonly called "cellular," "mobile," or "wireless" phone services. CMRS includes cellular licenses (distributed mostly by lottery in the 1980s), PCS licenses (distributed by auction starting in 1995), and Specialized Mobile Radio ("SMR") licenses issued for dispatch services but then liberalized (in 1990) to allow digitization and to supply calls connecting to the public switched network. *See* Hazlett, *supra* note 22, at 161-66. SMR licenses were used by a former FCC lawyer to start Nextel, acquired by Sprint in 2005. *See* Cyren Call.com, Leadership, Morgan O'Brien, http://www.cyrencall.com/index.php?Option=com_content&task=view&id=16&Itemid=57#brien (last visited Apr. 2, 2008); Sprint.com, Company Info, http://www.sprint.com/companyinfo/history/ (last visited Apr. 2, 2008).

158 Hazlett, *Physical Scarcity, Rent Seeking, and the First Amendment*, *supra* note 89, at 925.

159 Hazlett, *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*, *supra* note 10, at 373-74 & n.133.

160 Hazlett & Spitzer, *supra* note 10, at 617-18.

161 OFFICE OF COMMC'NS (U.K.), SPECTRUM POLICY TASK FORCE REPORT 5 (2002).

162 *See, e.g.*, Hazlett & Spitzer, *supra* note 10, at 596-97.

163 *See* Thomas W. Hazlett, *How the 'Walled Garden' Promotes Innovation*, FINANCIAL TIMES, Sept. 25, 2007, at 9.

The wholesale approaches are diverse. RIM effectively buys tiny frequency slices, bundled with wireless network connectivity, in bulk from mobile carriers; RIM's Blackberry customers are then able consume billions of minutes of network access.[164] RIM produces and sells radio devices (Blackberries) and maintains computer networks that route content (in particular, email messages) to and from mobile carriers, which then relay this valuable content to Blackberry users. Subscription revenue is then split between RIM and the carrier.[165]

Apple's iPhone, on the other hand, is a hardware device optimized to obtain voice and data network access via a particular network.[166] In the U.S., the iPhone is available only on AT&T's GSM system.[167] Apple sells the handset and bundles it with Apple's pre-selected carrier phone subscription. Apple is reported to keep revenues from the phone and to receive $18 per month from AT&T for the iPhone subscription.[168] Apple does not provide network services such as are supplied by RIM's email servers, but is considering a change in strategy that would bring it into closer rivalry with Blackberry.[169]

These two products illustrate the straightforward manner in which cellular markets now accommodate a rich array of retail and wholesale transactions. Innovators are able to buy wireless network access, in small or

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164 Press Release, Research in Motion, Research in Motion Reports Fourth Quarter and Year-End Results for Fiscal 2008 (Apr. 2, 2008), http://www.rim.com/news/press/2008/pr-02_04_2008-01.shtml (last visited Apr. 8, 2008). The RIM business model is described in Priya Ganapati**,** *Telecom Price War Could Lift BlackBerry Sales*, THESTREET.COM (Feb. 29, 2008), http://www.thestreet.com/_yahoo/news analysis/techtelecom/10405677.html?cm_ven=YAHOO&cm_cat=FREE&cm_ite=NA.

165 Heather Green, *Inside the Blackberry Workaround*, BUSINESS WEEK, Feb. 10, 2006, http://www.businessweek.com/technology/content/feb2006/tc20060210_490726.htm?chan=search (last visited Apr. 8, 2008). Research in Motion, Fiscal Year 2007 Annual Information, SEC Filing, *available at* http://www.rim.com/investors/pdf/RIM_Form-40-F.pdf.

166 The iPhone business model is described in Saul Hansell, *The $831 iPhone*, N.Y. TIMES (Oct. 25, 2007), http://bits.blogs.nytimes.com/2007/10/25/the-831-iphone/.

167 Cheryl A. Tritt, Telecommunications Future, 920 PLI/Pat 133, 159 (Dec. 2007); Apple.com, iPhone Overview: Why AT&T, http://www.wireless.att.com/cell-phone-service/specials/iPhoneCenter.html (last visited Apr. 8, 2008). Apple.com, Rate Plans for the iPhone, http://www.apple.com/iphone/easysetup/rateplans.html (last visited Mar. 23, 2008). Apple currently uses an exclusive model, selecting one carrier per market to transact with. Blackberry, in contrast, offers its "network" on multiple competing systems. For a discussion of various models, see Thomas W. Hazlett, *Market Allocation of Radio Spectrum*, 6-7 (Int'l Telecomm. Union Workshop on Market Mechanisms for Spectrum Management, Document MMSM/02), *available at* http://www.itu.int/osg/spu/stn/spectrum/workshop_proceedings/Background_Papers_Final/Coleman%20Bazelon%20-%20Thomas%20Hazlett.pdf.

168 Johnny Evans, AT&T Paying Apple $18 per iPhone per month?, NETWORK WORLD, Oct. 25, 2007, http://www.networkworld.com/news/2007/102507-att-paying-apple-18-per.html (last visited Apr. 8, 2008); Saul Hansell, *supra* note 166 (assuming that payments to carriers will drop from $18 to $9 per month).

169 Duncan Stewart, *Either fruit a good choice*, FINANCIAL POST, Mar. 14, 2008 (last visited Apr. 8, 2008) ("Apple just announced a new software release it said would make the iPhone a more powerful work e-mail tool -- an arrow aimed at RIM's core market.").

large increments, and deploy them to offer valuable services to the public. Hence, the use and reconfiguration of spectrum rights develops under the template offered in the cellular license. It is also informative to inspect the emerging markets to see how interference issues are dealt with. The network resources "consumed" by Blackberries or iPhones potentially conflict with wireless access afforded a carrier's numerous other customers.[170]

In either case, the "interference" problem is handled in straightforward fashion. Not by divvying up frequency spaces and meticulously defining "harmful interference" boundaries. Instead, carriers aggregate spectrum ownership rights for the efficient creation of networks, and then disaggregate access rights by selling services. Blocked and dropped calls resulting from interference becomes a quality of service ("QoS") issue. Carriers price accordingly—subscriber churn punishes carriers that price QoS too highly. Of course, poor network performance lowers demand for access, both by wholesale buyers (like RIM) and retail customers. Hence, rival networks compete, investing in additional base stations and technology upgrades (including those embedded in customer handsets which they often subsidize) to coordinate shared use of the spectrum they control.[171] Their objective is to optimize use, squeezing the greatest net benefits out of the spectrum space they control. This optimization incorporates the cost of investments, alternative technologies, system architectures, and transaction costs.[172] In the iPhone case, the reported terms make the analysis exceedingly simple: AT&T decides whether the net iPhone subscription revenue 'bump' is positive after accounting for all incremental costs. By transacting, AT&T reveals that the payments made to Apple and the business lost due to the service degradation suffered by its other customers is exceeded by the value generated by hosting the iPhone.[173] This is the socially efficient outcome.

The optimization extends to defining property rights to radio spectrum. The carriers and the application vendors do not transact by divvying up small slices of raw spectrum, but by packaging large bundles. This approach reduces border disputes, which would dissipate resource value, harming resource owners. That game is lucrative when incumbents can

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170 *See* Hazlett, *supra* note 167, at 11-14, 18.

171 *See* Robert W. Hahn, Robert E. Litan, & Hal J. Singer, *The Economics of "Wireless Net Neutrality*, 3 J. COMPETITION L. & ECON. 399, 400-04, 422 (2007) (including an appendix of wireless innovations).

172 *See* Christopher S. Yoo, *Network Neutrality and the Economics of Congestion*, 94 GEO. L.J. 1847, 1852-53 (2006) (showing that when transaction costs render metering network-usage uneconomical, imposing restrictions on bandwidth-intensive activities may well enhance economic welfare by preventing high-volume users from imposing uncompensated costs on low-volume users).

173 It will also include revenues lost by competition from the iPhone—'cannibalization'—but these are not social costs. The weight afforded such profit offsets may approximate zero, however, if AT&T projects that the iPhone will be offered by another network were it to decline to host it.

convince regulators to thwart entry,[174] and losses are socialized. Ownership changes the game.

Cross-border conflicts are, interestingly, also remedied at relatively low cost, as Weiser & Hatfield have observed.[175] With symmetric interests in productively utilizing spectrum, cellular operators characteristically delegate border interference issues to company engineers who expeditiously hammer out inexpensive, mutually agreeable solutions.[176] Notably, they avoid the FCC, electing Coasian bargains over obstructionism. Hence, private property rights facilitate spectrum sharing within assigned contours and across them.

B. *The Cellular-Is-A-Special-Case Argument*

Weiser & Hatfield nicely articulate some of these efficient outcomes in cellular.[177] Yet, they characterize the efficient transactions as resulting from the technical characteristics of cellular rather than the influence of private spectrum ownership.[178] They go further and reject the cellular market as a test case—"the optimism that Kwerel and Williams take from the cellular context is potentially misplaced."[179] To be clear, Weiser & Hatfield write:

> First, the technical characteristics of cellular services make them less prone to interference . . . . [N]ot only do the large geographic areas associated with cellular bands make geographic spillover problematic only in a relatively small percentage of the total area, but the fact that such systems are "cellularized" (i.e., the transmission systems operate in distinct areas) creates a greater opportunity to carefully tailor coverage to limit interference among a limited number of firms. Second, providers of cellular services are stable and "repeat players" creating considerable incentives for cooperative behavior and against engaging in strategic behavior along the lines of patent trolls.[180]

The first claim contains two references to special "technical" circumstances. One is that cellular networks are large in geographic scale, and this

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174 Incumbents can benefit not only by resisting competitive entry, but any entry. If the incumbent exercises sufficient influence to stop something valuable from being produced, then they gain an implicit equity interest in that they are now empowered to cut a deal within the regulatory system to allow the entry. These transactions are conducted as implicit quid pro quos, as explicit payments for political support on regulatory matters raises questions about the propriety of the administrative process.

175 Weiser & Hatfield, *supra* note 1, at 588 (in cellular, geographic spillover disputes are "routinely resolved without the involvement of the FCC").

176 *See id.* at 588-89.

177 *See id.* at 588 ("[V]aluable transactions involving the transfer of those rights take place on a routine basis . . . .").

178 *See id.* at 588-89.

179 *Id.* at 589. Weiser and Hatfield disagree with Kwerel & Williams, *supra* note 78, at 16 (proposing to build on the success of the transition to market allocation of spectrum as done in cellular).

180 *Id.* at 588-89 (footnotes omitted).

reduces border interference issues.[181] This is exactly correct, but is a feature of the property rights structure, not of the technical characteristics of cellular. Market transactions—both those that aggregate licenses and those that do not splinter them—produce this outcome. As owners of frequency rights, licensees seek efficient configurations that take into account the costs and benefits of scale. The emergence of four national U.S. wireless networks, consolidating *over 50,000 local CMRS licenses* via secondary market trades,[182] powerfully testifies to this rationalization process, a feature of liberal ownership rights.

The second technical distinction asserted is that the low-power systems used in cellular, which essentially reuse the same frequency bands from cell to cell, are uniquely interference-friendly.[183] This is not true. The adjustable power levels in cellular systems are handy features, in that they permit more intense use (or "sharing") of radio spectrum by millions of potentially interfering users. But the accommodation of additional usage creates extra potential for conflicts. Again, advanced technology, in creating valuable wireless opportunities, causes new rivalries between competing spectrum users.[184] It is possible that offsetting gains in defining frequency spaces (i.e., the benefits from low-power cellularization that Weiser & Hatfield assert[185]) more than offset these new conflicting demands. But the argument is two-sided. And when the empirical realities are investigated, there is no cause to suppose that the shift in cellular points in the direction of eliminating scarcity.

The Weiser & Hatfield analysis also incorrectly assumes that transaction costs are exogenous to the property rights regime.[186] To the degree that cellular operations efficiently limit spillovers, they incorporate real cost savings. Indeed, the central thesis underlying Weiser & Hatfield's conclusions is that radio interference is extremely costly to define and, hence, remedy.[187] With private property rights, the market rewards efficient "technical" solutions. Nationwide cellular networks may utilize many fewer than 40,000 base stations by adjusting power to higher levels and switching to more of a "broadcast" technology.[188] Instead, they efficiently "cellularize"

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181 *See* Weiser & Hatfield, *supra* note 1, at 588.

182 Hazlett, *Is Federal Pre-emption Efficient in Cellular Phone Regulation?*, *supra* note 22, at 194.

183 *See* Weiser & Hatfield, *supra* note 1, at 589.

184 Huber & Leo, *supra* note 94, at 15; Weiser & Hatfield, *supra* note 1, at 589.

185 Weiser & Hatfield, *supra* note 1, at 589.

186 Weiser & Hatfield are in good company, as they follow a path tread by Coase. See Merrill and Smith (2001) and Demsetz (2003) for analysis of why Coase's assumption about the easy separability of property rights and transaction costs leads to analytical error. Coase, *supra* note 12; Merrill & Smith, *supra* note 15; Demsetz, *Ownership and the Externality Problem*, *supra* note 23.

187 *See* Weiser & Hatfield, *supra* note 1, at 588.

188 Data from the Cellular Telecommunications & Internet Association (trade group for U.S. mobile carriers) ("CTIA") indicate that, as of June 2007, there were 210,360 cellular base stations in the U.S. These are spread across a large number of operators, but just four have achieved national scale

to create additional capacity while investing more in base stations and network equipment.[189]

In fact, every cellular network chooses a different mix of "broadcasting" and "cellularization," implicit in the degree to which it splits cells[190] or uses its options to increase the capacity of a given number of cells.[191] Recall that in supplying MediaFLO, a mobile video service, Qualcomm elected not to cellularize despite that opportunity (given liberal terms of 700 MHz licenses). It delivers a one-way service where large traffic (video) flows to customers. Broadcast here proves the more efficient format according to Qualcomm, which has profit incentives to make the economically correct choice given its exclusive control of allocated radio spectrum.

Efficiencies from spectrum ownership are on display in another respect. Two mobile broadcast video services rivaling MediaFLO have already tested their services and, finding their economic opportunities modest, reallocated their bandwidth to more promising ventures. Aloha sold its licenses to AT&T, perhaps to be used for broadband data.[192] Crown Castle has leased its frequency space (with an option to buy) to private equity firms associated with a satellite radio operator reportedly interested in using it to enhance signal reception.[193] These relatively rapid market reorganizations stand in vivid contrast to the decades-long administrative allocation cycles required to "re-farm" radio spectrum.[194] They exemplify how private ownership encourages technologies—cellular or broadcast—to stop "interfering" so that prospectively more productive wireless applications can proceed.

(AT&T, Verizon, Sprint, and T-Mobile). Hence, it is safe to assume that national networks now feature between 40,000 and 50,000 cells per network. CTIA-The Wireless Asc., *Semi-Annual Wireless Industry Survey*, http://files.ctia.org/pdf/CTIA_Survey_Mid_Year_2007.pdf (last visited Mar. 23, 2008).

189 *See* CALHOUN, *supra* note 45, at 398.

190 In these choices, operators are keen to adjust for the costs and benefits yielded by different frequency bands. One reason 700 MHz licenses are highly prized (and more valuable in auction bids) is that the coverage benefits for a given cellular pattern are generally (depending on technology) much higher. *See* Letter from Charles C. Townsend, Managing Gen. Partner, Aloha Partners, L.P., to the Honorable Joe Barton, Chairman, U.S.H.R. Comm. on Energy and Commerce, (Apr. 27, 2005), *available at* http://www.dtvcoalition.com/News/Read.

191 Using an array of antennas on base stations, cellular systems increase the capacity of cells by effectively re-using space within each cell. *See* Martin Cooper, *Antennas Get Smart*, SCIENTIFIC AMERICAN, July 2003, at 49, 55.

192 Grant Gross, *AT&T buys high-speed wireless spectrum for $2.5 billion, AT&T buys all of Aloha Partners' spectrum in the highly coveted 700MHz band ideal for long-range broadband services*, INFOWORLD, Oct. 9, 2007, *available at* http://www.infoworld.com/article/07/10/09/ATT-buys-high-speed-wireless-spectrum_1.html.

193 Joseph Palenchar, *Two XM Investors Lease Nationwide Spectrum*, TWICE: THIS WEEK IN CONSUMER ELECTRONICS, July 25, 2007, *available at* http://www.twice.com/article/CA6463086.html.

194 See discussion about the reallocation of TV band spectrum to cellular telephony, *supra* notes 122-24.

The second argument in the Weiser & Hatfield passage is that large, stable neighbors induce easy resolution of border disputes.[195] This is correct, although the small number of neighbors (the reciprocal of large neighbors) is the key.[196] Globally, regulators have tended to allocate relatively large swaths of spectrum to cellular licenses because it is so clearly efficient. By contrast, widely dispersed rights delay service roll-outs. U.S. regulators have actually been lagging in this respect, issuing far more geographically fragmented licenses than European Union countries, for example. This fragmentation has been associated with substantial social costs precisely because transactions are neither free nor instantaneous.[197] Over time, however, U.S. cellular operators have consolidated licenses. The market gravitates to this solution because the transactional inefficiencies of too-widely dispersed ownership are largely internalized.

Transactional efficiencies in cellular owe to distinctions associated with property rights rather than technology, suggesting that a liberal regime can be applied to spectrum allocation generally. In striking contrast to the broad spectrum grants issued in cellular licenses are the very limited and specific rights granted TV broadcasters. Analysis of the TV band reveals the undesirable effects of the existing regime and how it might fruitfully be changed.

C. *Tragedies in the TV Band*

The FCC traditionally issues limited use rights to access the TV band. A TV station cannot go dark one day and open up the next as a high-speed wireless broadband provider.[198] This contrasts with cellular bands, where

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195 *See* Weiser & Hatfield, *supra* note 1, at 589.

196 Cellular licenses have actually changed hands fairly often. Thousands of license sales in the 1980s and early 1990s aggregated networks, paving the way for the bargaining efficiencies seen today, as noted. *See* Hazlett, *Is Federal Pre-emption Efficient in Cellular Phone Regulation?*, *supra* note 22, at 193-94. In recent years, hundreds of licenses changed hands in the sale of AT&T Wireless to Cingular in 2004, and thousands changed hands in the sale of Nextel to Sprint in 2005. *Id.*

197 Olivier Blanchard, Martin Baily, Hans Gersbach, Monika Schnitzer & Jean Tirole, *Reaching Higher Productivity Growth in France and Germany, Sector Case: Telecommunications Services*, McKinsey Global Institute Research (Oct. 2002), at 21-22, *available at* http://www.mckinsey.com/mgi/reports/pdfs/europe/sector_telecom.pdf.

198 The alert reader will note that, in fact, stations can do these things—subject to a "public interest" determination by the FCC. The barriers for obtaining such waivers have historically been high. The FCC's decision to permit stations transmitting on Channels 54, 55, and 56 to be compensated by Qualcomm to accept interference from MediaFLO's Channel 55 operations was a measured FCC relaxation of traditional policies. *See supra* note 145. Much of the rigidity in use rights is embedded not just in the requirement to request regulatory permission for changes in spectrum use, which are subject to rent-seeking opposition by rivals, but in the manner in which the FCC awards rights in politically-configured bundles. For instance, a TV station may desire to go dark to make the 6 MHz allocated to its license available for more valuable services, but fail to petition for such rights on the (reasonable) expectation

the FCC grants much broader spectrum rights.[199] This distinction in property rights drives dramatically different outcomes.

Consider the TV Band's current configuration. Some 67 channels are set aside for over-the-air broadcasting, of which 49 will survive the digital TV switchover scheduled for February 2009. Even with the reallocation of some 18 channels (or 108 MHz)—a reallocation taking over twenty years to achieve[200]—only a handful of these set-aside channels will actually be assigned for broadcast use.[201] An average of just 8 per market (210 markets with about 1700 stations) are assigned to full-power broadcast stations, meaning that 83.5 percent of the total TV channels allotted will be effectively *unoccupied* in the digital broadcasting era.[202]

A coalition of technology companies including Microsoft and Google petitioned the FCC to establish rules permitting low-power unlicensed devices to access the "white space" frequencies not hosting a TV broadcaster.[203] Incumbent broadcast TV licensees oppose this plan, and a dispute has erupted.[204] The debate is contentious, a classic rent-seeking struggle. Instead of auctioning assets to parties that value them most highly and delegating spectrum sharing rules to those enterprises, resources are allocated via administrative fiat. Fashioning this situation as an engineering inquiry, the Commission is examining devices submitted by computer companies to see if they "work"—that is, whether they provide services using TV Band airwaves and cause only "de minimus interference" to TV broadcasts.

As of this writing, the FCC has rejected one prototype unlicensed device submitted by Microsoft, a radio that purports to identify and avoid

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that its "must carry" rights (giving the station some level of control over cable and satellite TV spectrum) would not convey. The privilege to demand free carriage on rival video delivery platforms is politically associated with the mission created for TV broadcasting under historical "public interest" determinations.

199 Hazlett, *Optimal Abolition of FCC Spectrum Allocation*, *supra* note 10, at 115; *see* Weiser & Hatfield, *supra* note 1, at 588.

200 *See supra* note 84.

201 This depends on what the meaning of "used" is, a discussion that gets us to the heart of the Coasian critique. TV station trade groups argue that all TV channels are fully utilized because, even if a channel in a particular market does not host a TV broadcaster, it buffers the reception for signals being locally broadcast.

202 This assumes 1700 full power TV stations, 49 channels, and 210 TV markets.

203 Cade Metz, *TV giants lock horns with Microsoft and Google over white space wireless play, 'God made those airwaves for us'*, THE REGISTER, Oct. 13, 2007, http://www.theregister.co.uk/2007/10/13/big_four_tv_networks_attack_google_microsoft_wireless_proposal (last visited Mar. 27, 2008).

204 *Id.*

emitting on channels where TV is being broadcast.[205] A second device has been submitted and is being tested.[206]

The central inefficiencies in FCC spectrum allocation are well-framed here. The FCC is developing spectrum sharing rules *technically*, when the relevant trade-offs—say, between the advantages of enhanced digital TV reception as against an increase in the sales price of unlicensed devices—are *economic*. Moreover, the agency making the resource choices fails to internalize the costs or benefits of its actions. A lengthy regulatory process (the "white space" proceeding opened in December 2002[207]) does not lower the wealth of FCC staff or Commissioners. Indeed, delays can be profitable, either politically or professionally (in terms of, say, post-agency employment). The results generated by this process do not incorporate the range of wireless choices actually available. While tech firms lobby the FCC to approve particular devices and the TV broadcasting industry lobbies against them.[208] TV stations are voluntarily accommodating Qualcomm's new MediaFLO in negotiated deals. The efficiency properties of rival rights regimes explain this difference.[209]

Because regulators hold the ownership rights to "white space," almost no social progress is possible along the chosen policy path. Even if the extant proceeding permits some unlicensed devices to eventually access some TV band frequencies, net social benefits are unlikely to follow. Either the sharing rules will not be conducive to wireless applications (e.g., as in the unlicensed PCS "listen before talk" devices[210] or in the non-exclusive access rights granted in the 3650-3700 MHz band[211]) or the incremental use of

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205 Lorraine Lawson, *White Space Internet Devices Get Second Chance*, IT BUSINESS EDGE, Jan. 22, 2008, *available at* http://www.itbusinessedge.com/blogs/emt/?p=269; tvnewsday.com, *More Reps Protest 'White Spaces' Devices*, TV NEWSDAY, Oct. 23, 2007, *available at* http://www.tvnewsday.com/articles/2007/10/23/daily.8.

206 Lawson, *supra* note 205.

207 Notice of Inquiry, In the Matter of Additional Spectrum for Unlicensed Devices below 900 MHz and in the 3 GHz Band, ET Docket No. 02-380, (Dec. 20, 2002).

208 *See, e.g.*, Comments of MSTV and NAB to the OET Report on the Performance of Prototype TV-Band White Space Devices, ET Docket No. 04-186, (Aug. 15, 2007), *available at* http://www.mstv.org/docs/MSTV-NAB%20COMMENTS%20AUG%2015%202007%20(2).pdf.

209 The implication is not that the unlicensed device use of TV Band "white space" would be socially productive if only the regulatory approvals could be sped up. Optimal use of the "white spaces" depends on the value of opportunities besides the unlicensed devices submitted for FCC approval. As shown below, it is highly likely that more efficient alternatives are available.

210 Carol Ting et al., *Modeling the Efficiency Properties of Spectrum Management Regimes* 3 (Dep't of Telecomm., Mich. State Univ., Revised Working Paper 2004), *available at* http://quello.msu.edu/wp/wp-04-03.pdf.

211 Jerry Brito, *The Spectrum Commons in Theory and Practice*, 2007 STAN. TECH. L. REV. 1, http://stlr.stanford.edu/pdf/brito-commons.pdf.

additional unlicensed bandwidth will not be as valuable as the wireless opportunities foreclosed.[212]

The proceeding is now headed for a consumer welfare debacle. Whatever happens with the crafting of specific sharing rules for unlicensed radios, TV broadcasts will be left in place. Because regulators will continue to protect (or over-protect) DTV signals on existing channel assignments, vast socially productive opportunities will go unrealized. Continuing to dedicate 294 MHz of prime VHF/UHF bands for over-the-air broadcasting, when cable and satellite delivers over 90 percent of TV reception—and could provide 100 percent at modest incremental cost[213]—blocks efficiencies. A rationalization of the TV band (either by bunching transmissions in one location in each TV market[214] or by shifting video delivery to cable and satellite) would make 200-294 MHz of "cleared spectrum" available, unleashing literally hundreds of billions of dollars in new consumer value.[215]

The FCC's traditional TV Band allocation, being extended from analog to digital, guarantees a tragedy of the anti-commons that will block available social gains. A policy decision to set-aside "white spaces" for access by unlicensed users will disperse rights further, distributing tiny "property" fragments that can be re-organized only via government regulation. Given the slowness and rigidities of that process, TV Band upgrades to accommodate new uses will be doomed for years or even decades.[216] This pushes broadcast television—the exciting, cutting-edge application of

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212 Regarding policy debates over whether the FCC should allocate more bandwidth for unlicensed devices, THE ECONOMIST writes: "A few pioneers profess indifference to the debate. Dewayne Hendricks, boss of Dandin Group, a wireless internet-access provider, does not care whether governments open up more spectrum because, 'all the spectrum we need is already in play.'" *On the Same Wavelength*, THE ECONOMIST (Aug. 12, 2004); OFCOM PLAN, *supra* note 54, at 34; Hazlett & Spitzer, *supra* note 10, at 642-45.

213 Adding broadcast TV retransmission to 15 million U.S. households not subscribing to television service could be done at a cost of under $4.5 billion, orders of magnitude less than the opportunity cost of 294 MHz of radio spectrum cleared entirely of the TV encumbrances. *See* Hazlett, *Optimal Abolition of FCC Spectrum Allocation*, *supra* note 10, at 113; Hazlett, *The U.S. Digital TV Transition: Time to Toss the Negroponte Switch*, *supra* note 83, at 16.

214 Co-locating transmitters is one way to reduce adjacent channel interference. Moreover, with digital broadcasting, a single broadcast transmitter sending out the signals of multiple TV stations could efficiently use a small fraction (say, 50 MHz) of the 294 MHz to broadcast interference-free signals to households and *increase* the number of actual programs received in the typical U.S. market.

215 Conservatively estimating only the value of 200 MHz of additional spectrum in U.S. cellular markets, and incorporating only voice services, yields over $1.5 trillion in present value. Hazlett & Muñoz, *supra* note 34, at 42.

216 That popular usage develops does not mean that spectrum is being economically utilized. TV sets generate $20 billion in annual sales, but this popularity does not refute the view (which I share with Weiser & Hatfield) that the TV band is inefficiently over-allocated to broadcasting. The question is whether the opportunities sacrificed are less than the benefits provided. Because TV programs can be more efficiently transmitted using (far) less than 402 MHz (or 294 MHz) of VHF/UHF frequencies, the fact that many households depend on off-air antennas becomes a transactional problem.

World War II—into dominance of the band for generations to come. Ironically, Congress has allocated some $1.5 billion in public funds to pay for household adoption of over-the-air digital TV receivers[217]—prolonging the anti-commons tragedy with public subsidies.

D. *Application of Cellular Model Would Solve TV Band Problems*

The TV band reallocation plan is deeply flawed for reasons noted by Coase: decision-makers "minimize" spillovers without the information or incentives to get the economic trade-offs correct. Resource ownership was Coase's theoretical solution. We have since tested his policy conjecture, and found the theory compelling.

Overlays have efficiently distributed property rights in PCS, AWS, and 700 MHz licenses.[218] In these cases, incumbent licensees dotted the allocated bands and entrants were assigned overlays by auction.[219] These rights granted winning bidders the opportunity to bargain with incumbents, moving the existing systems to alternative bands or technologies (such as fiber links) or buying them out altogether. This process resolved interference conflicts, allowing valuable new services to be launched. It also highlighted how various arbitration rules could help transitions. The overlay approach to TV Band reallocation was proposed in 1996 by United States Senator Larry Pressler (R-SD) who advocated selling 6 MHz overlays to TV "white space."[220] My 2001 proposal argued for five national licenses allocated 80 MHz each, an approach designed to reduce border issues.[221] A similar overlay rights auction for the 294 MHz digital TV band, perhaps offering seven national licenses allocated 42 MHz each, could be instituted today.

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217 David Katzmaier, *Bush signs DTV bill; analog cutoff February 17, 2009*, CNET NEWS.COM, Feb. 9, 2006, *available at* http://reviews.cnet.com/4531-10921_7-6436458.html (last visited Mar. 27, 2008). Sanford C. Bernstein & Co. forecasts that about $1.3 billion of this subsidy fund will be spent by consumers, including it in their estimate that $3.1 billion will be spent by households to purchase new digital TV receivers for the 2009 transition. *See* Associated Press, *Cable Companies Stand to Gain from Digital TV Confusion*, Feb. 18, 2008, http://www.foxnews.com/story/0,2933,331040,00.html?sPage=fnc/scitech/personaltechnology (last visited Apr. 8, 2008).

218 Licenses for Advanced Wireless Services, allocated 90 MHz, were sold at auction for about $14 billion in 2006. Rules are liberal, permitting mobile voice and data networks with few operating, business, or technology restrictions. MediaFLO, discussed above, uses 700 MHz licenses.

219 *See supra* Part III.C.

220 Hazlett, *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*, *supra* note 10, at 548-49.

221 *Id.* at 549; Hazlett, *The U.S. Digital TV Transition: Time to Toss the Negroponte Switch*, *supra* note 83, at 13.

IV. COMPARING APPROACHES

Setting analytical differences to the side, the policy convergence between Weiser & Hatfield and the law and economics approach is real. The normative prescription in both analyses is a liberal regime where competitive spectrum owners organize wireless activity. This calls for regulatory reforms that enable decentralized parties to exercise effective control and to provide an efficient process for determining who owns what.

Many pathways are possible, including those constructed by incremental policy changes that extend models instituted by United States regulators and have been tested in the marketplace. Liberal licenses now form the basis for extensive network investments, technologically-advanced deployments, and the most economically significant mass market wireless applications. Alternatively, more radical policy regime switches could occur. Statutory reforms to introduce private property rights in spectrum were instituted by New Zealand (1989), Australia (1992, 1997), Guatemala (1996) and El Salvador (1997).[222] Experiences there, including market developments and legal/regulatory performance in the definition and enforcement of rights, can inform regime evolution elsewhere. Alternatively, regulatory agencies may choose to ambitiously liberalize, allocating substantially more spectrum to flexible-use licenses. The U.K. regulator, Office of Communications ("Ofcom"), is pursuing such a path. Ofcom announced, in 2004, its intention to allocate about 70% of the bandwidth below 3 GHz to liberal licenses by the year 2010.[223]

A. *Weiser & Hatfield's Permissive Zoning*

Here I underscore the happy ending: As I read their essay, Weiser & Hatfield do not actually create a "zoning" solution to the property rights definition problem. Instead, they create a format for defining property borders that are subject to reconfiguration by spectrum owners. Such a policy approach could effectively *de-zone* rigid allocations, using existing (implicit or explicit) spectrum contours defined in licenses as a basis for permitting wireless activities not explicitly authorized by regulatory authorities. This is the essential ingredient for market allocation of radio spec-

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222 *See* Hazlett, Ibarguen & Leighton, *supra* note 11, at 438.

223 OFCOM PLAN, *supra* note 54, at 32.

trum.[224] Such systems are now in place in various markets around the world.[225]

But reforms need not impose the "mixed" solution that Weiser & Hatfield advance.[226] While recommending that the FCC award most spectrum rights to private competitors, they argue that unlicensed bands, such as those hosting cordless phones and Wi-Fi (802.11x) devices, are socially efficient.[227] They then purport to derive the implication that such bands should be allocated administratively:

> In short, the commons model has much to commend it and we believe it should be implemented in conjunction with a property rights approach. In many respects, the two models complement each other and may be more effective in tandem than in isolation. As Pierre de Vries put it, the two models may well operate "in the same way that a public park enhances the market value of surrounding properties, and the use by surrounding residents increases the utility of the park."[228]

Citing the allocation of real estate to public parks as the justification for allocating spectrum to unlicensed bands is another land analogy that offers great clarity. Three fundamental insights are gleaned from a law and economics analysis.

First, the "commons" cited is not a commons. Unlicensed bands are regulatory set-asides with government imposed access rules.[229] This situation is distinct from one where self-interested economic agents collectively own the underlying asset and determine resource appropriation rules. Common property institutions that survive the market test, such as grazing lands shared by local farmers in the Swiss Alps[230] or common shareholders

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224 It's an approach I advocated as one possible reform path. Thomas W. Hazlett, *Liberalizing US Spectrum Allocation*, 27 TELECOMMS. POL'Y 485, 487-89 (2003); Hazlett, *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*, *supra* note 10, at 548.

225 This is the basic structure of the spectrum reform statutorily enacted in El Salvador in 1997. Hazlett, Ibarguen & Leighton, *supra* note 11, at 442. It also forms the de facto result when, as in the United States, a licensee is given permission to provide previously unauthorized services. *See* Shelanski & Huber, *supra* note 112, at 595-97.

226 Weiser & Hatfield, *supra* note 1, at 598-600.

227 *See id.* at 598-99.

228 *Id.* at 600 (quoting 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* 18 (New. Am. Found., Working Paper No. 14, 2006), *available at* http://www.newamerica.net/files/WorkingPaper14.DTVWhiteSpace.deVries.pdf.

229 For example, the so-called unlicensed Part 15 devices (e.g., Wi-Fi transmitters, cordless telephones, wireless microphones, and garage door openers) are governed by FCC regulations documented starting at 47 C.F.R § 15.1 (2006).

230 *See* OSTROM, *supra* note 31, at 61-65. The farmers have well-defined common property rights matched to particular land uses resulting in optimal production; yet they protect those resources from a tragedy of the commons through tight community controls. *Id.*

in a corporation,[231] are generally characterized as wealth-maximizing outcomes. In contrast, the state allocates and controls unlicensed bands, and regulators prescribe governance rules to limit potential conflicts.[232] Distinct outcomes arise because decision makers fail to internalize wealth gains or losses.

The point is not simply taxonomical. Administrative allocation of unlicensed bands relies on regulation where decision-makers are subject to the standard constraints of what Weiser & Hatfield call "command and control."[233] Once regulators set aside an allocation for unlicensed use, no residual claimant—a Qualcomm MediaFLO, say, or a Nextel—will reassemble rights in a more productive manner. This creates an anti-commons that may be reorganized in subsequent periods only by another iteration of "command and control."

Most fundamentally, the "mixed" system proposed by Weiser & Hatfield is *un*mixed at the FCC spectrum allocation level. That is because, to determine the "mix," the system must make a case-by-case determination as to how each band is used and regulated. This discretionary political process imposes a regulatory bottleneck, taxing all wireless innovations and producing suboptimal results.[234]

Second, the land analogy offered by Pierre de Vries illustrates that a "mixed" outcome is efficiently achieved via a private property regime. That system, of course, is what governs land ownership. No Federal Land Commission ("FLC")[235] parcels out use rights or determines where private developments can be located versus public parks. Rather, owners of private property rights seek to maximize the value of their assets in a competitive framework. This regime does not limit diverse use models for land, but reliably discovers the efficient combinations. The observation that bands may benefit from being located near (in frequency space) other bands is a correct one, but positing it as a benefit of administration allocation simply assumes away the economic process wherein complementary adjacencies

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231 Andrei Shleifer & Robert W. Vishny, *A Survey of Corporate Governance*, 52 J. FIN. 737, 738 (1997) (corporate governance mechanisms help ensure shareholders receive a return on their capital investment).

232 *See* Hazlett, *An Economic Evaluation of Spectrum Allocation Policy*, *supra* note 10, at 50-52; *supra* note 229.

233 *See* Weiser & Hatfield, *supra* note 1, at 558 (listing all of the government activity in managing spectrum).

234 As a practical matter, a policy commitment to "contain" unlicensed allocations, devoting regulatory energies to allocating new exclusive property rights in efficient packages, tends to remedy this problem. This is the approach taken by Ofcom regulators, who have elected to freeze existing unlicensed allocations while pushing forward with a broad expansion of de facto private property rights. *See* OFCOM PLAN, *supra* note 54, at 6.

235 The juxtaposition of an FLC to the spectrum allocation function of the FCC was put forth by R. H. Coase, *Evaluation of Public Policy Relating to Radio and Television Broadcasting: Social and Economic Issues*, 41 LAND ECONS. 161, 163 (1965).

are implemented and antagonistic borders avoided. Land markets, the analogy chosen here, rely on ownership incentives to make these choices. Curiously, however, unlicensed bands are routinely characterized as the wireless analog to a "public park."[236] The analogy appropriately leads spectrum policy to private property, not state property.[237]

Third, society benefits when a private property regime in land rationalizes the supply of "commons." Competitive asset markets reveal opportunity costs, enabling provision of diverse resource employments deemed to add net social benefits—an efficiently mixed system. Land is owned, of course, by non-profit organizations, including public entities. The underlying private property regime in land facilitates productive use of these parcels, bringing transparency to the investments made.

Were an FLC to convene a "public interest" allocation policy, detrimental hold-ups would occur. No one could use land until that Commission made a public determination that a given land use was in the "public interest." Incumbents could claim that "interference," in the form of pollution, traffic, or economic competition, would harm the "public interest." The net social losses of this regime, as compared with a more fluid system of private land ownership, would likely be large. So with spectrum. Coase proffered a socially superior means of producing an efficient output mix, one which constitutes the consensus economic view today[238]—namely, a policy shift to a general system of private property rights in radio spectrum. This regime does not preclude "public spectrum parks," but in fact *reduces* their cost by, first, eliminating regulatory bottlenecks associated with case-by-case rulemakings and, second, by making opportunity costs transparent. In this environment, for-profit firms,[239] non-profit enterprises, industrial consortia, or public agencies[240] can efficiently supply unlicensed bands.

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236 SPECTRUM POLICY TASK FORCE REPORT, *supra* note 43, at 38.

237 Note that land zoning does not create public parks, or "commons" that offer the analogy for unlicensed bands. Parks result from ownership rights being acquired by entities (for-profit, non-profit, or public) that elect a particular access regime for the use of their resource.

238 *See* Promoting Efficient Use of Spectrum Through Elimination of Barriers to Dev. of Secondary Markets, Comments of 37 Concerned Economists, WT Docket No. 00-230, (FCC Feb. 7, 2001), *available at* http://aei-brookings.org/admin/authorpdfs/redirect-safely.php?fname=../pdffiles/phpkx.pdf.

239 The case for this is given in Kwerel & Williams, *supra* note 74, at 30-31 ("Future expansion of dedicated spectrum for unlicensed use could be obtained through negotiation between the manufacturers of such devices and spectrum licensees.").

240 Eliminating unlicensed bands currently employed would be impractical. One of the problems with distributing tiny slivers of use rights under the state property regime is that contractually reassembling the rights to construct positive sum exchanges is, typically, prohibitively costly. *Id.* at 12. Eliminating an unlicensed band would then appropriate some users who have made specific investments, discouraging other investments going forward.

B. *Liberal Spectrum Rights and the Costs of Delay*

The Weiser & Hatfield plea to slow liberalization due to the complexities of private rights definition carries its own Coasian answer: delaying productive wireless activity is not cost-free. The evidence strongly indicates that delay costs are quite substantial. Given that real-world experiments in de facto spectrum ownership have produced large social benefits, the evidence strongly suggests that the greatest risks lie in stasis. Properly designed programs invest only as much in ex ante rights definitions as necessary to avoid a net dissipation of benefits.[241]

The path of least resistance likely lies in broadening existing rights bundles by allocating additional bandwidth to liberal licenses, facilitating efficient aggregations via auctions, overlays or other mechanisms, and providing ex post dispute resolution mechanisms that improve upon existing institutions (courts, regulatory agencies). The following measures offer a possible policy agenda:[242]

(1) Use Existing Templates for Spectrum Ownership. Liberal licenses, such as those developed for the United States' CMRS or "spectrum licenses" designed by regulatory agencies elsewhere, offer basic definitions of frequency spaces. These definitions have widely proven sufficient to begin the contracting process, as seen in voluminous spectrum rights reconfiguration in the marketplace.[243]

(2) Use Overlay Rights, not Administrative Allocation, to "Re-farm" Spectrum. By assigning residual band rights to new owners, responsible economic agents are empowered. These parties internalize net benefits from reorganizing bands. This approach has proven highly effective in PCS, AWS, and in Qualcomm's Channel 55 licenses.[244] Overlays bring "white space" into productive use by enabling small numbers bargaining, remedying anti-commons tragedy.

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241 *See supra* Part I.B. The predictive models that Weiser and Hatfield endorse, replacing field tests to detect radio emissions, Weiser & Hatfield, *supra* note 1, at 591-92, do not clearly improve the current situation. Predictive models are subject to bias and developed with conflicting assumptions. Regulatory battles may be easily provoked, and stretched, by honest disagreements or strategic efforts to deter new entry as arguments over a given interference model are adjudicated. Searching for natural experiments in which predictive models have proven their worth in the market and can be cost-effectively applied by regulators would resolve this question.

242 This agenda draws on several sources cited previously. Hazlett, *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*, *supra* note 10, at 544-55; Hazlett, *Liberalizing US Spectrum Allocation*, *supra* note 224, at 487-88; Kwerel & Williams, *supra* note 78, at iv (proposing a massive reallocation of restricted spectrum to flexible use and auctions of both assigned and unassigned spectrum to assign spectrum to its highest valued use).

243 *See supra* Part III.A for a discussion of the success of liberal licenses in cellular bands.

244 *See supra* text accompanying notes 70-79.

(3) Tweak the Templates. Existing rights bundles can, in some instances, be broadened. Whatever the zoning or building code restrictions embedded in the license, licensee rights can be expanded to permit any activity conducted within the contours of the license. Some have decried this deregulatory approach as a grant of "windfalls" to incumbents, but pro-competitive effects (liberalizing rights among multiple competitors can increase output, lowering retail prices) make the direction of license windfalls ambiguous.[245] Enabling more productive use of airwaves, however, is unambiguously pro-consumer.

(4) Facilitate Efficient Aggregation. Combinatorial, simultaneous, two-sided auctions reduce bargaining costs.[246] Where competitive or distributional issues arise, regulators should use equity distributions to broaden share ownership and avoid the creation of new, costly airwave borders.

(5) Dispute Resolution Mechanisms. I have previously recommended a Spectrum Court to adjudicate border disputes based on license parameters and existing FCC precedents,[247] an institutional approach not entirely dissimilar from that enforced by administrative law judges at the FCC. A property regime would move from arbitrary "public interest" determinations to systematic property rules. Such proceedings could sort out the advantages of predictive models versus field tests and would iteratively determine when liability rules were efficient substitutes for property rules.[248]

CONCLUSION

> In the scholarly arena, the lack of debate reflects . . . a consensus that developing and enforcing property rights [in spectrum] should be a reasonably simple task . . . . After all, many commentators argue, the legal system can enforce property rights in land . . . and should thus be capable of enforcing property rights in spectrum . . . . This conventional wisdom, as we explain, glosses over the challenges of creating use rights for spectrum.[249]

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245 In a cross-country study of 27 markets, countries granting more liberal licenses to cellular operators were found to have substantially *lower* cellular license values, results consistent with a strongly pro-competitive effect. *See* Hazlett, *Property Rights and Wireless License Values*, *supra* note 11, at 3.

246 Kwerel & Williams, *supra* note 78, at 16-19.

247 *See* Hazlett, *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*, *supra* note 10, at 551-55.

248 The general approach in property law is that property rules are appropriate when small numbers bargaining obtains, given that the owner and the trespasser can reach terms by negotiating. *See* Richard A. Epstein, *A Clear View of The Cathedral: The Dominance of Property Rules*, 106 YALE L.J. 2091, 2097 (1997). When transaction costs preclude this solution, courts then adopt liability rules, assessing trespassers for the cost of their incursions while stopping short of issuing injunctions. *See id.* at 2094, 2100-01.

249 Weiser & Hatfield, *supra* note 1, at 552 (footnotes omitted).

This Article has attempted to delineate some differences that shape this debate over how to efficiently craft property rights in radio spectrum. The law and economics approach incorporates theoretical and empirical research across a large variety of institutions and markets, usefully informing choices in spectrum policy. Where administrative allocation continues to squander socially valuable opportunities, productive efficiencies are available under alternative rules. These valuable options owe much to what has been learned from property regimes in land, water, fisheries, wildlife, oil, intellectual property, and radio spectrum itself. Indeed, the first calls for spectrum property rights were not based on a "withering critique" of FCC regulation[250] but on a general case for competitive markets in the allocation of resources. Empirical verification of that conjecture had to wait for spectrum market tests to develop. Now we know. Coase's theoretical conjecture, that private property rights in spectrum would beat administrative allocation, has amassed overwhelming empirical support.

Moving spectrum from administrative allocation to a liberal property regime facilitates an optimal diversity in applications, ownership, and modes of organization. Moreover, it eliminates regulatory bottlenecks that plague the current regulatory system. Analogies to many aspects of contract and property law support that conclusion, but it appears clearest in the experience already gleaned revealing how wireless markets efficiently create, enforce, share, and utilize property rights to radio spectrum.

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250 Weiser and Hatfield characterize the 1959 Coase article as such, *id.* at 563, but I read it quite differently. The limited critique of the FCC that appears is confined to First Amendment problems with broadcast licensing. Coase, *supra* note 14, at 8-12. Coase's spectrum policy argument was based on his assertion that spectrum was not a special case and, therefore, did not merit central planning. *Id.* at 14. He appealed to general economic theory in advancing this view, not on errors committed by regulators. *Id.*

APPENDIX

TABLE 1. STATIONS AGREEING TO PERMIT INTERFERENCE FROM MEDIAFLO[251]

Date requested	*Station*	*Market*	*Owner*	*Channel*
Mar. 14, 2007	KDOC	Los Angeles, CA	Ellis Communications Group KDOC, LLC	56
Apr. 13, 2006	KLDT	Lake Dallas, TX	Johnson Broadcasting, Inc.	54
Oct. 17, 2007	WBNX	Akron, Ohio	Winston Broadcasting Network	55
Mar. 15, 2007	WEDU	Tampa, FL	Florida West Coast Public Broadcasting, Inc.	56
Oct. 16, 2006	WFFT	Ft. Wayne, IN	NEXSTAR	55
Sept. 25, 2007	WGGB	Springfield, MA	WGGB Licensee	55
Oct. 16, 2006	WHAG	Hagerstown, MD	NEXSTAR	55
July 26, 2007	WKAR	East Lansing, MI	WKAR Public Broadcasting	55
Aug. 24, 2007	WMAE	Booneville, MS	Mississippi Authority for Educational TV	55
June 28, 2007	WNUV	Baltimore, MD	Baltimore Licensee	54
Sept. 25, 2007	WNVC	Fairfax, VA	Commonwealth Public Broadcasting	56
Nov. 22, 2006	WOPX	Melbourne, FL	ION Media Networks	56
Nov. 30, 2005	WPXE	Kenosha, WI	ION Media Networks	55
Nov. 13, 2007	WPXK	Jellico, TN	ION Media Networks	55
Mar. 29, 2007	WREX	Rockford, IL	WREX Television, LLC	56
Aug. 21, 2006	WRSP	Springfield, IL	GOCOM	55
Nov. 30, 2005	WYIN	Gary, IN	Northwest Indiana Broadcasting, Inc.	56
Dec. 4, 2007	WZDX	Huntsville, AL	Huntsville Television Acquisition Licensing, LLC	54
May 30, 2007*	WTBY	Poughkeepsie, NY	Trinity Broadcasting of New York, Inc.	54
May 30, 2007*	WYPX	Amsterdam, NY	Paxson Albany License, Inc.	55
July 20, 2005*	WLNY	Riverhead, NY	WLNY-TV, Inc.	55
June 7, 2005*	WACX	Leesburg, FL	Associated Christian Television System, Inc.	55
June 7, 2005*	KWDK	Tacoma, WA	Puget Sound Educational TV, Inc.	56

* Granted by FCC

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[251] Barbara A. Kreisman & Roger S. Noel, FCC, Official Release DA-07-820A1 (Feb. 23, 2007), *available at* http://www.scribd.com/doc/316126/US-Federal-Communications-Commission-FCC-Official-Release-DA07820A1?query2=lower+700MHz+band+and+mediaflo.