Spectrum Miscreants, Vigilantes, and Kangaroo Courts: The Return of the Wireless Wars

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The requirement that radio users obtain the government's permission in advance before transmitting has been a foundational feature of communications regulation for about eighty years. However, the recent regulatory expansion of "open" regimes for managing the electromagnetic spectrum, such as the increase in license-exempt and "light" licensed frequencies in several countries, may change all of that, and this prospect has created excitement among observers of wireless telecommunications and communication law. Garage door openers, cordless phones, and baby monitors, it is hoped, were just the first kinds of "radio stations" one could have without a license. Under open regimes, more people will have more wireless devices in their hands than ever before, and they will be able to use them in new ways. Proponents hope that more use, more efficient use, and more application innovation will result. However, the fate of services in these bands—and of the open spectrum model itself—now rests with user behavior. As of this writing, no one is sure of the answers to basic questions such as when (or if) these open bands of the electromagnetic spectrum will become congested with too many users, if they will fail due to congestion, or, more generally, what it is exactly that people will do with these new wireless freedoms. While allusions to "tragedies of the commons"[1] and their inevitability or avoidability have been widespread in writing about license-exempt spectrum, little is empirically known.

In effect, license-exempt bands are a partial return to communication policy's "state of nature"—what will people do without government? (Or, more properly, what will people do when the role of government is changed and the requirement for prior permission to transmit is removed?) Using two case studies drawn from a larger project across six countries, this Article considers the case of Wireless Internet Service Providers trying to use "open" spectrum, and chronicles their successes and failures. It shows, perhaps unsurprisingly, that when legal constraints are removed, users make their own order and are bound by their own local and differing standards of fairness and propriety. The topic of this Article could be identified by the keyword "*shared* spectrum," used in the literature—but in

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    1. Garrett Hardin, *The Tragedy of the Commons*, 162 SCI. 1243 (1968).

what follows it is clear that sharing sits alongside selfishness, coexistence with extortion, and formal law with kinship and neighborhood customs.

First, this Article will outline the theoretical approach embodied by these observations, an approach grounded in the anthropology of law and derived from Moore's process theory of law:[2] here, glibly labeled "telecommunications policy from below." Second, it will introduce Wireless Internet Service Providers (WISPs) and this project's methods in studying them. Next, it will present two detailed case studies from 2003 to 2005. The first case study describes an entrepreneurial project in a small city that never quite got off the ground because the spectrum never looked empty enough, while the second focuses on a "war" between two competing WISPs that evokes the world before the enforcement of radio regulations—the "Wild West" of radio, as some have called it. Finally, this Article will end by drawing conclusions about the future of open spectrum regimes and the utility of studying the administrative law processes of telecommunications with a process theory of law, or "telecommunications policy from below."

I.   TELECOMMUNICATIONS POLICY FROM BELOW: THE THEORY OF LAW AS PROCESS

If one is interested in the study of telecommunications policy, one almost always assumes that the action can be found in bodies one would identify as "policymaking" (legislatures and regulators), and that the appropriate object of study is a law or ruling—or, more expansively, an elite debate about one. Certainly the world outside these fora is crucial to research on telecommunications policy, but the outside world makes its entry via logical arguments in legal analysis, in descriptions of technological changes, in ideal hypothetical cases, in secondary reporting of market research, and in economic simulations of reason. Research on telecommunications policy is in this way dominated by a philosophically conservative approach to law—an approach encouraged structurally by the political economy of the policymaking process.[3]

If inherent in all of these diverse approaches is an overarching philosophy of law, the closest may be legal formalism. A policy researcher never need mention that "the law" of interest is the law as it exists written on a page or that the appropriate focus of a research project should be a patriciate debate over a present or future policy. The analyst's goal is usually to determine how a current or proposed law (on a page) is right or wrong. Research in this tradition has produced useful and even brilliant

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2. SALLY FALK MOORE, LAW AS PROCESS: AN ANTHROPOLOGICAL APPROACH (1978).

3. *See, e.g.*, THOMAS STREETER, SELLING THE AIR: A CRITIQUE OF THE POLICY OF COMMERCIAL BROADCASTING IN THE UNITED STATES 113–162 (1996).

work. However, although the experts toiling with such research are more savvy than any layman about the intrigues and interpretations that surround every line of formal law, these intrigues rarely appear in mainstream analyses of telecommunications policy, and they are almost never the focus of it.

In contrast, this Article takes a methodological approach derived from the anthropology of law, specifically Moore's theory of law as process.[4] This approach can be contrasted with other research on telecommunications policy by two central differences: First, it considers the law as it appears in the lives of people who are not policymakers. These lives occasionally appear in formalist telecommunication "user studies,"[5] but it is significant that what is *analyzed* in other studies is the communication technology (as in "telephone users" or "Internet users") and not the law. Telephone users are studied so that the right law can be written. The right law will then define the system that these telephone users use. "Yet although everyone acknowledges that the enforceable rules stated and restated in legal institutions, in legislatures, courts and administrative agencies, also have a place in ordinary social life, that normal locus is where they are least studied."[6] That is, telephone and other kinds of users are also users of the law. To care about this is not just to go looking for the same law in a different place, but instead it is looking for a different law. That is, not the telecommunications policy that is written, but the policy that you can get away with. It is well known that only a rare few will ever encounter formal legal proceedings, and even these laws oftentimes become operative only when a certain kind of person claims to know about it and presses for its enforcement.[7] And so, telecommunications policy then is not just responsible for systems and markets, it is also something that users (or rather, people) directly think about, interpret, manipulate, and even create in the course of their experiences with communication systems. This framework's second departure from other approaches to telecommunications policy then is that it takes as its object the intrigues and interpretations that surround law. Indeed, without formalist law as an object, this approach asserts that the surrounding impermanent perceptions are in fact the substance of the law. The rules are whatever we believe the

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4. MOORE, *supra* note 2.

5. *See, e.g.*, Christian Sandvig, *Public Internet Access for Young Children in the Inner City: Evidence to Inform Access Subsidy and Content Regulation*, 19 INFO. SOC'Y 171 (2003) (discussing previous user studies by this Author); Milton L. Mueller & Jorge Reina Schement, *Universal Service from the Bottom Up: A Study of Telephone Penetration in Camden, New Jersey*, 12 INFO. SOC'Y 273 (1996).

6. MOORE, s*upra* note 2, at 55 (citing Paul Bohannan, *The Differing Realms of the Law*, 67 AM. ANTHROPOLOGIST 33 (1965)) (internal citation omitted).

7. *See* MOORE, s*upra* note 2, at 79.

rules are, no matter what the law books say. Statutes are one way of talking about rules and order, among many other ways.

Many precedents for this approach exist. Although Moore's theory of law as process has not been employed in telecommunications, excellent previous scholarship in communications policy has focused critically on the political culture surrounding law. Perhaps most memorably, some scholars have considered administrative agencies like the FCC as an interpretive community, and have analyzed communications policy symbolically rather than institutionally.[8] There have also been approaches to law that are methodologically similar to this one via oral history.[9] Previous scholars have rejected legal formalism by turning to the critical legal studies movement,[10] but here we will instead turn to socio-legal studies[11]—a pluralistic scheme for studying the law that is inclusive of legal anthropology.[12]

Indeed, it may be clearest to say at the outset that telecommunications policy has always been ruled "from below" as much as from above. Midwestern farmers in the first decades of the twentieth century were running illegal telephone systems over barbed-wire fences and using their farm kitchen as the exchange.[13] In the 1960s, ordinary people with no technical experience were using then-illegal network attachments in their homes.[14] Commercial broadcasting was brought to the United Kingdom in part by Radio Caroline and other commercial broadcasters intentionally testing and even flaunting broadcast rules.[15] Yet aside from some discussion of radio pirates,[16] empirical analyses of these minor telecommunications criminals do not typically appear in law journals.

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8. STREETER, *supra* note 3, at 114–16.

9. *See, e.g.*, Robert B. Horwitz, *Broadcast Reform Revisited: Reverend Everett C. Parker and the "Standing" Case (*Office of Communication of the United Church of Christ v. Federal Communications Commission*)*, 2 COMM. REV. 311, 313 (1997).

10. *See, e.g.*, Thomas Streeter, *Beyond Freedom of Speech and the Public Interest: The Relevance of Critical Legal Studies to Communications Policy*, 40 J. COMM. 43 (1990).

11. *See, e.g.*, D.J. Galligan, *Introduction*, 22 J. L. SOC'Y 1 (1995).

12. *See, e.g.*, Peter Just, Review Essay, *History, Power, Ideology, and Culture: Current Directions in the Anthropology of Law*, 26 L. & SOC'Y REV. 373 (1992); *see also* Sally Falk Moore, *Certainties Undone: Fifty Turbulent Years of Legal Anthropology, 1949–1999*, 7 J. ROYAL ANTHROPOLOGICAL INST. 95 (2001).

13. CLAUDE S. FISCHER, AMERICA CALLING: A SOCIAL HISTORY OF THE TELEPHONE TO 1940, at 43 (1994).

14. *See, e.g.*, Use of the Carterfone Device in Message Toll-Telephone Service, *Decision*, 13 F.C.C.2d 420 (1968).

15. Douglas A. Boyd, *Pirate Radio in Britain: A Programming Alternative*, 36 J. COMM. 83, 86 (1986).

16. *See, e.g.*, Buck Endemann, Comment, *Keelhauling Pirates: How Ex Parte Seizure of Non-Interfering LPFM Does Not Further the FCC's "Public Interest,"* 43 SAN DIEGO L. REV. 661, 692–97 (2006).

It is obvious that changing the penal code's sanction for (or definition of) assault will not eliminate assault. Similarly, radio laws will always have radio pirates. Indeed, manipulating the formal criminal law may define illegality and change rules, penalties, and their enforcement, but all of this may have little relation to what happens in your neighborhood. The same is true for telecommunications policy, as this Article will show.

II. RETURNING WIRELESS TO ITS "STATE OF NATURE"

This Article considers the promise and viability of open spectrum regimes by investigating how a few interlocutors make order in the electromagnetic spectrum. The process theory of law would hold that invoking law in a social situation is a way to symbolically communicate, establish, maintain, or undermine order against a background assumption of absolute indeterminacy.[17] This way of thinking about law may have seemed unnecessary to discussion of the electromagnetic spectrum until quite recently. After all, it seems that order among users of the spectrum has been solidly achieved by government regulation of the time, power output, location, and frequency to be used by radio transmissions. Users of the spectrum may have seemed like only second- or third-hand users of the law, as their awareness of national spectrum allocation rules might have been limited to the concept of a "channel" when turning the knob on an old television set. Laws about spectrum allocation were fixed both in law books and in tuned crystals, and there might have seemed to be little that communicators could do to interpret or even interact with them.

But as alluded to in the Introduction, spectrum users are now being expected to interact with each other and the spectrum in novel ways. Unlicensed spectrum "parks"—like the U.S. allocation of 2.435–2.465 GHz[18] (most commonly used for "Wi-Fi" wireless data networking, cordless phones, and other unlicensed uses)—confine all users to a narrow slice of spectrum and dictate that users must accept whatever interference results. Some scholars have advanced the prospect that the liberalization of spectrum should continue such that most or all spectrum is open.[19]

The closest historical analog to this situation may be radio broadcasting circa 1920 in the United States. At this time, although there was something called a "license," there was no governmental enforcement authority. All users had a limited choice of frequencies (all commercial stations were at 360 meters or, after 1922, at either 360 or 400 meters),

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17. MOORE, *supra* note 2, at 49.
18. 47 C.F.R. §§ 15.245–248.
19. *See, e.g.*, Yochai Benkler, *Some Economics of Wireless Communications*, 16 HARV. J. L. & TECH. 25, 29 (2002) (providing a review and proposal of the liberalization of the entire spectrum).

faced power limits, and had to accept any interference that resulted.[20] At first, within the overall framework of shared licenses, stations that encountered interference made "simple agreements" and "handshake pacts" with each other to reduce interference.[21] Specifically, within the conditions for transmission specified by the government, individual stations haggled over the more limited options left open to them by federal law, creating new norms, formal agreements, and informal agreements at the local level that were within or even superseded the federal rules.[22] Stations arranged to manipulate the times they transmitted (e.g., making voluntary frequency-sharing schedules), the locations of their transmitters (e.g., dividing up the transmission area amongst themselves), their power within the limits specified by the government, and their frequencies within what the government allowed.[23] The U.S. Department of Commerce sponsored conferences to encourage this kind of self-regulation from 1922 to 1925.[24] However, before long, "owners of stations who believed themselves to be interfered with took matters in their own hands," leading "eventually to a warlike atmosphere"[25] and ultimately the breakdown of order into chaos.

Although it is difficult to clearly see such a distant past, a common interpretation among radio historians is that at some point, after the local arrangements began to fail, all systems of order in the spectrum failed. Stations "jumped without restraint to new wave lengths. . . [and] also jumped their power"[26] even beyond federal limits. "By the end of 1926 it was impossible in most geographical areas to receive a consistent broadcast signal" due to interference between stations.[27] This crisis is the genesis story of modern telecommunications regulatory agencies, which are often described as born to bring order from this chaos.[28] (Although this is a received view of the creation of such agencies, that view has attracted scholarly criticism.[29]) The solution by 1934 was a much more rigid

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20. *See* SUSAN J. DOUGLAS, INVENTING AMERICAN BROADCASTING 1899–1922, at 316 (1987).

21. GEORGE H. DOUGLAS, THE EARLY DAYS OF RADIO BROADCASTING 92–93 (1987).

22. *See id.*

23. *Id.*

24. *Id.* at 93.

25. *Id.*

26. 1927 FED. RADIO COMM'N. ANN. REP. 10–11, http://www.fcc.gov/Bureaus/Mass_Media/Databases/documents_collection/270701.pdf.

27. DOUGLAS, *supra* note 21, at 95.

28. *See, e.g.*, CHRISTOPHER H. STERLING & JOHN M. KITTROSS, STAY TUNED: A HISTORY OF AMERICAN BROADCASTING 141–47 (2002).

29. *See* Robert Horvitz, *Marconi's Legacy: National Sovereignty Claims in Radio*, 1ST COMMUNIA WORKSHOP ON "TECHNOLOGY AND THE PUBLIC DOMAIN" (2008), http://www.communia-project.eu/communiafiles/ws01p_Marconis%20Legacy%20 National%20Sovereignty%20Claims%20in%20Radio.pdf.

allocation of the electromagnetic spectrum that largely eliminated shared use of bands except among radio amateurs—centralizing the administration of the spectrum and creating the FCC and its foreign counterparts.[30]

Today's unlicensed electronic consumer devices might appear to be nothing like the radios of the 1920s. Yet the recent experience of users of shared frequencies (now often called "open spectrum," "unlicensed," or "license-exempt" regimes) show the striking parallels between 1927 and today. Chiefly, the experience so far shows the widespread reappearance of multiple interlocking and overlapping systems of rules derived from a wide variety of sources of authority—federal administrative law, municipal authorities, private mediators, bilateral contracts, friendships, rivalries, family ties, and neighborhood norms. Multiple fields of rulemaking have always existed, but they are now more salient.[31] As federal policy has thrown the spectrum open to "individual" firms and actors, it is clearer than usual that this is the stuff from which individual action is knit. Proposals for open spectrum now pose a question. Were the "broadcast wars" of the 1920s the interregnum between two regimes of order: the garden and the license? Or was instead all of licensing (1934 to 2005) the interregnum between two periods of open wireless: the broadcast wars of then and today?

A.   *To the Trenches of License-Exempt Spectrum*

To consider the uses of more open spectrum, this Article turns to the specific instance of wireless Internet. One of the most significant developments in the use of license-exempt spectrum from 2000 to 2005 has been the rapid emergence of a Wireless Internet Service Provider (WISP) industry based on license-exempt spectrum—a frequent estimate is that there are 3,000 commercial WISPs in the United States alone.[32]

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30. *See* Communications Act of 1934, ch. 652, 48 Stat. 1064 (codified as amended at scattered sections of 47 U.S.C.) (2006) (establishing the FCC).

31. In some contexts, the word "fields" automatically evokes Foucault. The connection intended here is legal anthropology's semi-autonomous social field. *See, e.g.*, Sally Falk Moore, *Law and Social Change: The Semi-Autonomous Social Field as an Appropriate Subject of Study*, 7 L. & SOC'Y REV. 719 (1973).

32. *See, e.g.*, Marlon K. Schafer, *Mandatory FCC Form 477 Info*, WIRELESS INTERNET SERVICE PROVIDERS ASS'N MAILING LIST (Feb. 2, 2006), http://www.mail-archive.com/wireless@wispa.org/msg03551.html; *FCC Form 477 Forum*, BROADBAND DSLREPORTS.COM, http://www.broadbandreports.com/forum/r13791564-FCC-Form-477 (last visited Feb. 23, 2011). During this time period the Wireless Internet Service Provider Association had 400 members in the United States. About 500 WISPs filed the FCC's Form 477, leading to concerns about underreporting. For a discussion of reporting, see Kristopher Twomey, *FCC Form 477*, ISP-PLANET (Mar. 6, 2006), http://www.isp-planet.com/fixed_wireless/politics/2006/form_477.html. WISPA then conducted a survey of sales by equipment manufacturers and subsequently estimated the total number of WISPs to be about 3,000, a figure that was then accepted in the government and has been often

Sophisticated users of the electromagnetic spectrum from this industry are in an interesting position. They are frequently well-educated, technically trained engineers within an established white-collar profession. If it is possible to speak so broadly about the engineer's disposition toward the law, it could be said that a person from this background is likely to be exceedingly conscientious about following it, even though when the rules about radiocommunication are strict, the engineer's own skills provide ample means to bend or break them.

As an introduction to this industry's experience of the law, consider Tim Pozar, an engineer with "traditional" radio experience and the founding member of the Bay Area Wireless Users Group of San Francisco, California.[33] In 2002, Pozar wrote the definitive legal guide for the emerging community of Wi-Fi engineers, and he began it with the sentence, "I am not a lawyer."[34] The guide, titled "Regulations Affecting 802.11 Deployment," started as a presentation transcript posted to Pozar's personal website and then became so well known that it was eventually included in a popular wireless reference book as an appendix.[35] A point worthy of note about Pozar's presentation is that he approached radio regulation like a quest: the law in this area was a distant thing that an engineer would be unlikely to know but quite likely to break.[36] In response, Pozar conscientiously interviewed telecommunications lawyers and read law books until he could produce a very comprehensive list of the relevant sources of authority at different levels and agencies of government and also their specific rules. His presentation included explanations of limits on the height of towers, rules against swapping antennas between different equipment manufacturers, a discussion of the risk of wireless networks interfering with aircraft RADAR, the limit of a wireless worker's maximum exposure to electromagnetic fields, and much more.[37] He concludes by recommending "[c]oordination with other users"[38] in unlicensed bands, and it is this coordination that provides local order without licenses.

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repeated. *See, e.g.*, John M. R. Kneuer, Deputy Assistant Sec'y for Comm. and Info., U.S. Dep't of Commerce, Speech on Promoting U.S. Broadband Deployment and Economic Growth at the Mississppi Technology Alliance Sixth Annual Conference on High Technology (Nov. 9, 2005).

33. *About*, BAY AREA WIRELESS USERS GROUP, http://www.bawug.org/about/ (last visited Feb. 23, 2011).

34. Tim Pozar, *Regulations Affecting 802.11 Deployment* (Mar. 10, 2004), http://www.lns.com/papers/part15/Regulations_Affecting_802_11.pdf.

35. ROB FLICKENGER, BUILDING WIRELESS COMMUNITY NETWORKS, app. A, at 137–56 (2003).

36. *See generally id.*

37. *See generally id.*

38. *Id.* at 156.

The case studies that appear below also reflect encounters with this distant law. These cases arose from a comparative cross-national study of WISPs in six countries: the United States, Canada, Ireland, the United Kingdom, New Zealand, and Australia. For the larger project, sixty-three groups were chosen that identified themselves as WISPs in 2003 and were affiliated with the "open wireless," "community wireless," "municipal wireless," or similar movements.[39] This includes groups that call themselves commercial, noncommercial, and governmental. The groups range from the quite formal to the quite informal. To be included, the group had to have a web presence in 2003. Extensive, ongoing participant observation was conducted with two of these groups (one in the United States, one in the United Kingdom), while members of an additional sixteen groups have so far been visited at least once by researchers who interviewed participants and organizers in an open-ended format. Researchers also attended meetings (if possible) and received a tour or demonstration of the network (if relevant). All groups (including the remaining forty-five) were analyzed by quantitative and qualitative content analysis of online material about them (often including extensive mailing list archives). This larger project is ongoing and the case studies presented below represent early results from the visits to those sixteen groups that are worthy of considerable attention on their own. Names of the people, places, and organizations involved in the following case studies have been changed.

Methodologically, this approach could be characterized as interviews with users of electromagnetic spectrum regulation, or more formally, what Yin would term a holistic, multiple case study research design organized around literal replication.[40] This Article will present material from two cases, but other cases from this overall study have appeared elsewhere,[41] and the research methods have been described in more detail elsewhere.[42]

III. CASE 1: MONROEMESH'S FAILURE TO SHARE

Monroe is a small city of about 210,000 people in the Midwestern United States, and is a county seat.[43] The main industries there are white-

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39. Or in some cases, the groups were referenced on web pages about those terms.

40. ROBERT K. YIN, CASE STUDY RESEARCH: DESIGN AND METHODS (3d ed. 2003). In Yin's terms, both case studies presented here represent failures of order (literal replication) that were arrived at in different ways. *See id.*

41. *See* Christian Sandvig, *An Initial Assessment of Cooperative Action in Wi-Fi Networking*, 28 TELECOMM. POL'Y 579 (2004); Christian Sandvig, *Wireless Play and Unexpected Innovation*, *in* DIGITAL YOUTH, INNOVATION, AND THE UNEXPECTED 77 (Tara McPherson ed., 2008).

42. Christian Sandvig, *How Technical Is Technology Research?*, *in* RESEARCH METHODS FROM THE TRENCHES 141 (E. Hargittai ed., 2009).

43. In the 2000 U.S. Census, Monroe's per capita income in 1999 dollars was about

collar services (notably health, finance, and insurance), retail trade, government, and education. (Monroe is known for its local university and very high levels of education.) These industries are slowly displacing a historical focus on light manufacturing in a period of economic growth that has been continuing for over ten years. Monroe is set among very slight hills. At the time the proto-WISP group that is the subject of this case study was founded, high-speed wired broadband Internet service was already widely available via cable modem and DSL, and prices were falling. This case study is based on interviews with Terry and Dave in 2003 and 2004. Terry and Dave are both white, well-educated men in their twenties who decided to found a WISP in Monroe—optimistically named MonroeMesh.[44]

Terry is a local engineer with a passion for tinkering with wireless equipment. Before founding MonroeMesh, Terry gained previous experience with a rare, proprietary unlicensed wireless data technology called RLAN.[45] In the late 1990s, using twelve radios scavenged from a friend's failed electronic coupon printing business, Terry built an RLAN network in a small town near Monroe as a hobby. The network wirelessly connected his friends to the Internet (via an ISDN line) and to a shared file server. The connection served most anywhere within an area of about fifteen square miles. Terry and friends then had mobile Internet connectivity at a time when this was so rare as to be almost unknown.[46] "We had an old Sparc 2 sitting at [a friend's] house with a 22-gig SCSI hanging off it—that was our central depository. We had mp3s, video, whatever we want," Terry said. "It was pretty kick ass."

This earlier technology, RLAN, used shared spectrum, but the other users were encountered so rarely that the fact of spectrum sharing was not especially obvious, and the high power of the RLAN radios gave an extra feeling of security. "RLAN was so powerful that, if you were close enough,

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$23,000. There are 3,000 people per square mile. 7.6 percent of the population has no secondary school diploma.

44. The network did not use what is called "mesh" technology—an advanced technique—but Terry and Dave had hoped to. In a typical wireless network there are dedicated routers to relay traffic and end nodes that originate it in a configuration like the hub and spoke of a bicycle wheel. In a home Wi-Fi network, for example, a dedicated device called an "access point" acts as the hub (and as a router), while the connected devices (laptops, game consoles, etc.) communicate only with the access point and not with each other. In the more complicated mesh network configuration that was just emerging at this time, every device could acts as a relay for other nearby devices and there may be no central routers.

45. RLAN was a proprietary first-generation wireless product operated at 900 MHz. It was developed by DCA, a company that was later acquired by Attachmate. RLAN was then discontinued.

46. Metricom Ricochet, the only widely known mobile Internet company at that time, did not serve Monroe.

it would overload the front end on whatever tuner you had . . . it was a very robust, very good solution," Terry explained. When it ever became noticeable that other users did exist and there was a technological skirmish between systems, the skirmish was fine with Terry because his radios always won. Once, in the manner of a confidential aside, he mentioned, "We walked over the analog cell phones. You heard a clicking sound in your earpiece if you were using a cell phone anywhere in town." He paused, then continued, "I thought that was pretty cool."

The introduction of the first cheap "Wi-Fi" wireless Internet consumer products in 1999 spurred new wireless networking projects across the world.[47] At the same time that Tim Pozar was getting excited about Wi-Fi in San Francisco, Terry and Dave met in the city of Monroe and formed a working group that included four other technically inclined people interested in capitalizing on the new possibilities of unlicensed spectrum. The initial goals of the hobbyists were carried over from the earlier RLAN network: "I wanted to be able to drink beer and have my PDA get me alerts from work," explained Terry. Dave added, "I wanted Internet access out at the lake."

They soon conceived of a city-wide transport network that a variety of local service providers could connect to and jointly pay for. For instance, the local radio station could join and then use MonroeMesh's transport network to link remote broadcasts (such as DJs or live music events) with the studio. This was already being done with 900 MHz ISM band equipment, but the radio station reported that because there were so many other users on that band in town "that first leg was horrible—they could rarely get more than voice grade communication." Dave and Terry saw the possibility for higher-quality digital sound broadcasts if they moved over to Wi-Fi. Additionally, a local Internet service provider (ISP) agreed to connect to the network and provide a connection to the Internet with an authentication scheme—the MonroeMesh city-wide network would then be a way to connect to the local ISP from a laptop while outside (and without dialing in or using any wires).

As a beginning, using their own money, the group built three nodes on tall buildings in Monroe (including one at the radio station), and the limited network functioned just as it was intended to. But as they planned for the network's expansion, Terry and Dave had more and more misgivings. Terry explained, "We did some surveying. In one instance, we

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47. *See* François Bar & Hernan Galperin, *Building the Wireless Internet Infrastructure: From Cordless Ethernet Archipelagos to Wireless Grids*, 54 COMM. & STRATEGIES 45, 52 (2004). "Wi-Fi" is a brand and not an acronym—as coined, it did not stand for anything. It was meant to evoke the "Hi-Fi" or "high fidelity" of audio equipment. It is an industry consortium's name for interoperating radios that comply with the IEEE 802.11 standards. *See id.*

were on top of [a particular] building, just looking around, and we found ten, fifteen networks. All just hammering away. All just blasting away, making noise. And in the same area! That's an issue."

Later along in the widespread adoption of Wi-Fi these numbers (ten or fifteen) seem small and would not be a concern, but this was 2002. The Wi-Fi equipment in question (an access point) usually sends out a signal called a beacon even when it has no traffic. This "hammering away" almost surely consisted of beacons detected by the site survey software Terry and Dave were using. Packet data traffic like Wi-Fi (and all Internet traffic) is notoriously "bursty"—seeing a few other users on the same band would not mean the band was full of traffic, simply that others had set their equipment to use that frequency if and when they had something to transmit. Both Dave and Terry were well aware of the technical details of the communications protocol; nonetheless, the electromagnetic spectrum felt full to them, and the presence of fifteen other possible users was "an issue."

As another way to facilitate the sharing of spectrum, the Wi-Fi communication standard calls for the band to be further divided into overlapping channels in a way similar to older cordless phones—if a cordless phone user heard static on one channel, the user could move a switch on the phone to transfer to a different frequency. The same held true for Wi-Fi.[48] But Terry explained that regardless of the number of channels there were, someone else might still be using them:

> If I were to use any of the channels that are available to me, one to eleven let's say. No matter what I've picked, I'm asking for loss. There's no technical way I can avoid loss with the gear that I'm given. Or I can get. Anything that we can find is going to fall down at some point. And even though these [other] networks are not necessarily very active, they're still producing traffic.

The notion of overlapping channels itself has been problematic for the engineering community, as traffic on an adjacent or even nearby channel implies some (though not complete) degradation in service quality. One comment on a trade press article that appeared around this time stated forcefully: "The 802.11b standard gives us 14 channels to work with, right? Wrong! Sorry, it's really only three useful ones."[49]

The MonroeMesh group's hesitation in this case does not seem to be

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48. For instance, the IEEE 802.11b standard defines fourteen channels; one through eleven are used in the U.S., one through thirteen in most of Europe, and only channel fourteen in Japan. Jim Geier, *Assigning 802.11b Access Point Channels*, WI-FI PLANET (Feb. 11, 2002), http://www.wi-fiplanet.com/tutorials/article.php/972261.

49. This quotation comes from a comment that has since been removed. It was originally posted on WI-FI PLANET. *Id.* For example, these channels would be one, six, or eleven in the United States. The channels in 802.11b center on frequencies in 5 MHz steps, but a transmission is 22 MHz wide, meaning that transmissions on adjacent channels overlap significantly. *See id.*

about responding to interference, but sharing—the only sharing arrangement acceptable to them would have been one without any possibility of degradation whatsoever Dave explained:

> You're sitting at a table with two network engineers that would rather build nothing than to build something that doesn't work the way it should. Because the user expects the network to be a utility. When they turn on the light switch, the lights come on. When they call 911, the ambulance is at their door. It's the same thing.

More critically, it seems that the notion of increasing the use of license-exempt spectrum creates an irresolvable tension for some wireless engineers—while municipal, community, and entrepreneurial groups like this one sometimes state that they aim to "democratize" access to the spectrum, their engineers hate the thought of sharing spectrum (or worse, losing a spectrum war) to an unskilled, uncredentialed consumer who purchased equipment at a local superstore and knows nothing about radio. While this group and others state that they hope to rely on cheap consumer equipment to reduce prices, their professional identity rebels at the idea of using consumer-grade equipment—Terry and Dave noted archly that "it makes no sense" to "use commodity equipment in an infrastructure role." This tension between credentialed engineers and amateurs has existed since the beginning of the idea of the spectrum.[50]

After their initial burst of activity, MonroeMesh experienced several frustrations trying to negotiate for the placement of their radios on tower sites. Terry and Dave were also astonished by the effect of the weather in the Midwestern United States on their outdoor equipment. Next they became disappointed at the limited reach and few features of the Wi-Fi equipment when compared to Terry's more powerful RLAN radios of the past. MonroeMesh ran out of steam and the group dissolved in 2004, with three stations and twenty users, and without formally incorporating or taking in any money. "Maybe twenty users wasn't enough to legitimate [sic] me donating gear and doing all this work," Terry said. "I'm sorry for being so cynical." Still, both Dave and Terry listed Wi-Fi experience on their resumes, and both quickly moved on to higher-paid jobs working on wireless systems—Terry with an out-of-state telephone company[51] looking to move into wireless; Dave in the IT department of a large organization.

A. *The Engineer's Perception of Congestion and Beauty*

The MonroeMesh case reinforces an important lesson about technology—the need to pay due attention to the way things look as well as

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50. *See* CAROLYN MARVIN, WHEN OLD TECHNOLOGIES WERE NEW: THINKING ABOUT ELECTRIC COMMUNICATION IN THE LATE NINETEENTH CENTURY 40 (1990).

51. Actually, it was a competitive local exchange carrier (CLEC).

the way they work. Dave and Terry's experience of the electromagnetic spectrum came to them from the user interface of their mapping software.[52] The popular software Netstumbler, for example, presents the user with a list of detected networks where each new station identified is added to the list as it is identified.[53] No measure of the amount of traffic is shown. No measure of the amount of traffic is shown. This means that Netstumbler's screen could show fifteen networks nearby, yet they might all be silent. Dave and Terry could see the spectrum as though it were "full" because fifteen networks are listed on the screen. While national spectrum regulators and the Wi-Fi protocol designers would see that same spectrum as empty, they would be looking at it through a different portal. Functionally, Netstumbler was open spectrum's user interface.

More significantly, when we look at the MonroeMesh case in order to understand the many overlapping obligations governing Terry and Dave's behavior, it is clear that their professionalization as engineers is the controlling one. While this may not be so for Terry, for other engineers who are now coming to wireless systems with a background in computer software rather than in radio, the uncertainties of the radio environment are traumatic. Terry and Dave did not want MonroeMesh to work as much as they wanted it to be beautiful to engineers, and this couldn't be accomplished within their other constraints. This suggests that a significant obstacle for proponents of open spectrum may be the cultural connotations of sharing and the socialization of engineers.

IV. CASE 2: THE PLANETREE FOREST SPECTRUM WAR

The next case study includes threats of litigation and (at the time of interview) an ongoing government investigation. To permit the parties involved to speak at all about these events (especially because the electromagnetic spectrum enforcement community is so small, even across six countries), this Article will not reveal which country of the six (United States, Canada, United Kingdom, Ireland, Australia, New Zealand) is the home of "Planetree Forest." While the cultures and laws of the six nations vary, the actual national law in this case makes surprisingly little difference to what happens in Planetree Forest.

This case study concerns the relationship between two WISPs, here called TownNet and SATNet. The materials for this case study come from interviews with the two cofounders of TownNet (Alan and Philip), a

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52. For a further discussion of mapping, see Christian Sandvig, *The RED Project: Rendering Electromagnetic Distributions*, VECTORS (Fall 2007), http://vectors.usc.edu/projects/index.php?project=87.

53. NETSTUMBLER.COM, http://www.netstumbler.com/2007/04/17/about/ (last visited Feb. 23, 2011).

private mediator working at a not-for-profit organization who was called in to adjudicate the following dispute, and two government officials from the national communications regulator who were in a position to be familiar with the regulations relevant to the dispute.[54] The lack of SATNet interviews make the picture of events unfortunately one-sided, but the two available parties (a SATNet employee and the SATNet founder) both declined requests for interviews—probably for reasons that will become clearer below. Public information about the dispute was also consulted. All descriptions here refer to the time of the interviews: the middle of 2004. As most of the information comes from TownNet interviews, the dispute will be told from the perspective of Alan and Philip, the cofounders.

Planetree Forest has a lower unemployment rate than surrounding areas and higher levels of education.[55] The main industries are farming and the light manufacture of furniture, precision machinery, and clothing, and the landscape is marked by farms, river valleys, and fifty-four small towns (the population of the largest is 3,000). At the time the two groups described here began operations, only dial-up Internet access was available.

TownNet was the creation of Alan and Philip, two white, well-educated professionals. Philip was a former telecommunications engineer, and Alan was a manager. Both lived in Planetree Forest. They gathered about six other local professionals—including two accountants, a marketing manager, a property developer, someone from the municipal government's IT department, and a telecommunications market researcher—who were dissatisfied that no broadband Internet service was available. They wrote a business plan that projected that they could build a sustainable (break-even) service using the latest wireless technology with about USD $50,000 for ten towns in Planetree Forest. At the time, large telecommunications carriers had publicly claimed that it was not profitable enough to deploy broadband service in Planetree Forest. In response to a national policy to accelerate the deployment of broadband in rural areas, government subsidies were available from several agencies at different levels of government. Alan and Philip of TownNet received a zero-interest loan of about USD $5,000 and quit their jobs. They subsequently received an additional $50,000 in the form of a state-level development grant and expanded the network to include sixteen towns. However, TownNet was not the only group interested in using new wireless technology to bring high-speed Internet to Planetree Forest.

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54. To protect the confidentiality of the TownNet founders, the government officials were not told that the interviews were in reference to the specific dispute.

55. The area ranks in the eighty-ninth percentile for per capita income when ranked against other areas in the country. There are 348 people per square mile. 21.9 percent of the population has no secondary school diploma.

A.   *SATNet and the Informal Spectrum Negotiation*

Another company, SATNet, operated on a for-profit basis and was run from a town outside the area. SATNet's founder had previous experience in information technology, and SATNet had been providing Internet service to hotels when they saw an opportunity to provide wireless Internet service in Planetree Forest. Both SATNet and TownNet offered very roughly comparable wireless Internet service,[56] and both designed their network to use license-exempt bands for many necessary links (although both also used other bands). Note the neighborhood relationships involved in their first contact, which was about potential interference, described here by Alan:

> What [SATNet] basically said to us was, "could you change the channel please?" But they didn't ask us, they told their customer who happened to be our customer's landlord. Who then told his brother-in-law, who was our customer. It was the brother-in-law who finally introduced both parties.

Surprisingly, it turned out that SATNet was also receiving a substantial government subsidy to provide service to Planetree Forest in competition with TownNet. SATNet may have received as much as about USD $30,000 from a different agency at a different level of government (from a fund for the promotion of local businesses).

To reconcile this competing use of public funds, the municipal government asked both parties to come in for a voluntary meeting. Alan reflected that:

> At first [SATNet] tried to sell us equipment, a client device they had built. [We didn't buy.] We initially signed a [non-disclosure agreement] with them. We were going to work together. We came up with this idea of sharing the spectrum. We said we'd use only a given channel. We came up with a reasonable plan and they seemed happy at the meeting.

A government official from the agency that gave TownNet the bulk of their funding asked for a second meeting, intended to be a "technical meeting" between the engineering staff of both groups. The second meeting went badly, as Alan explained:

> [SATNet] said, "We were here first, tough." Their stated objective was to close the space down so that no one else could move in. Part of the agreement was that they'd provide us with a list of where we could use what channel and we would provide a list of what areas we had covered. That agreement has sat in abeyance. They [didn't] do anything and we haven't changed anything.

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56. SATNet provided a speed of 512 Kbps for about USD $24.99 per month, and served eight towns in Planetree Forest. TownNet offered comparable service to sixteen towns (including eight towns also served by SATNet), with a speed of 512 Kbps for about USD $29.99 per month and 1 Mbps for $82.99 per month.

Worried, Alan of TownNet then posted to a mailing list for coordination between WISPs. His post read in part:

> I think we're going to have a problem with spectrum issues. Does anybody have any advice on arbitration over use of channels? These people won't negotiate—it's likely to end up in court.

SATNet forwarded Alan's post to TownNet's funding agency with the addendum: "This guy's a troublemaker."

B. *From Negotiation to Jamming*

By this point, TownNet and SATNet had an antagonistic relationship, to be sure, but antagonism should not necessarily be worrying. They are competitors requiring the same resource (part of the 2.4 GHz band) that they both saw as scarce. Next, according to Philip, SATNet's strategy for winning changed to enforcement of a first-come, first-served model of the band, and the instrument used changed from negotiation to technology. Philip elaborated:

> When we moved one [TownNet] link to 300 yards and crossed two of their long links we found that we couldn't do anything. We stick up an antenna and do Netstumbler and get a long list of [SATNet] out there. [Before], we were picking channels that were well separated, the noise floor appeared nice and quiet, and [now] at a matter of a few hundred yards with line of sight we couldn't see a thing. There was no signal, nothing. . . . Then customers started to complain that their own [indoor] home networks stopped working. . . . So [the regulator] in the end started some sort of investigation.

This mysterious failure of all of the open spectrum to be open occurred just after a number of relevant developments in the larger Wi-Fi engineering community.

First, widespread publicity appeared about wireless Internet's newly discovered susceptibility to "logical" jamming. Briefly, digital wireless systems use a "listen before talking" procedure to reduce the chance that a transmission will collide with one from another station. For example, the equipment used by TownNet and SATNet employ Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) that includes a process called "clear channel assessment." When a wireless card performs a clear channel assessment as a prelude to "talking," if another station is transmitting, the card will wait a "backoff" interval and then perform the assessment again.[57] Researchers noticed that directing a wireless card to transmit a continuous pattern of bits will cause all other devices within range to always conclude that the channel is busy, and wait indefinitely.[58]

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57. Chris Wullems et al., *A Trivial Denial of Service Attack on IEEE 802.11 Direct Sequence Spread Spectrum Wireless LANs*, *in* WIRELESS TELECOMMUNICATIONS SYMPOSIUM 129, 131 (2004).

58. *Vulnerability Note VU#106678: IEEE 802.11 Wireless Network Protocol DSSS*

Similarly, simple scripts appeared on the World Wide Web at this time that allowed a wireless device to "use" all of its available capacity by transmitting nonsense. Rumors were also flying in the wireless community about new equipment proposed by manufacturers that would increase the speed of data transmission by using all of the available channels simultaneously across multiple bands, using multiple radio chipsets.[59] Finally, online discussion boards reported that commercial telecommunications carriers had begun to raise the transmission power on their equipment to nearer the legal maximum,[60] presumably to drown out competing signals. It is not clear what exactly happened to the open spectrum in Planetree Forest in 2004, but Alan is convinced that:

> They were over power. [SATNet] was using amplifiers. There are a number of technologies that cause denial of service that are actually very difficult to pinpoint and I'm . . . convinced that they were using something. They really didn't like competing with anybody. [They thought,] "The more channels I grab means the less competition."

C.   *From Jamming to Extortion*

At this point, the municipal government asked TownNet and SATNet to return for a third of what Alan called (with a chuckle) "these arbitration-confrontation meetings." This time they also invited an outside mediator, and Alan said the SATNet tactic moved from jamming to extortion:

> We agreed that [SATNet] would let us use channel one and they'd use the rest. He went away with this agreement but he had this list of [other] demands still in place. He wanted us to pay for reconfiguring their network. [He said] we were going to pay them [thousands of dollars] to implement the changes that were necessary.

Even after the agreement, nothing changed immediately, until a few days later. Alan said, "[O]n the day the regulator knocked on their door, that all stopped and suddenly our customer[s' equipment] burst into life." Alan and Philip explained that *both* SATNet and TownNet were found to be using Taiwanese equipment that was not certified for operation in the country, and had secondary harmonics in a licensed band (thereby violating

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CCA Algorithm Vulnerable to Denial of Service, U.S. COMPUTER EMERGENCY READINESS TEAM, DEP'T. OF HOMELAND SEC., http://www.kb.cert.org/vuls/id/106678 (last visited Feb. 23, 2011); *see* Wullems, *supra* note 57, at 131.

59. For instance, rumors were that Sony's proposed "Hi-Bit Wireless" strategy for consumer electronics would involve multiple simultaneous Wi-Fi channels (and therefore multiple radios) in the same device. *See, e.g.*, *Sony Air Board in March*, AKIBALIVE (Jan. 19, 2004), http://web.archive.org/web/20080105114258/http://www.akibalive.com/archives/000514.html.

60. *See, e.g.*, John Foust, *2Wire and SBC Interference?*, BAY AREA WIRELESS USERS GROUP MAILING LIST (Jan. 20, 2004), http://www.mail-archive.com/wireless@lists.bawug.org/msg05848.html; John Foust, *Re: SBC Routinely Installing 2Wire 400 mW AP/FW*, BAY AREA WIRELESS USERS GROUP MAILING LIST (Apr. 21, 2004), http://www.mail-archive.com/wireless@lists.bawug.org/msg06334.html.

certification laws and causing harmful interference in an easily detectible way). While charges of jamming—especially by denial of service using random or nonsense traffic—would be almost impossible to prove, luckily the fact that they both bought very cheap uncertified equipment over the Internet gave a national regulatory official the reason to inspect the premises, and all interference then disappeared. Both TownNet and SATNet have continued to compete, but with no interference. Both providers were warned about the uncertified equipment and stopped using it. There were no formal legal sanctions.

D. *Primacy of Local Versus National Sources of Adjudication*

Local ties interconnect all aspects of TownNet's story. A local government employee was one of the founding members, and they were able to secure free access to antenna locations and some development money (at least the initial zero-interest loan) in part through existing relationships in the community where they lived. But one relationship not yet discussed is essential to understanding this case, and that is the one between the TownNet founders and the official who worked for the national communications regulator. The official also lived in Planetree Forest and wanted broadband in his community; after meeting the founders at an early public organizing meeting about broadband, they became friendly.

"He's very professional. But he does keep us informed," Alan noted. Philip seconded, "He has access to spectrum analyzers and all those kinds of things; we used to regularly bring him in because getting a hold of that stuff is expensive."

In another context, Alan explained, "He compartmentalizes his advice as well. Sometimes it was a formal warning." Philip added, "He still gives us quite a lot of technical help."

With this relationship in the foreground, the fact that the regulatory official, "in the end started some sort of investigation," shifts in meaning. At first glance, Alan and Philip successfully and justly defended themselves against a variety of assaults—requests to change frequencies, demands for outrageous payments, jamming of the airwaves. Their successful defense "in the end" required the mobilization of central state authority, which looms as a final arbiter after more local systems of order fail in adjudication. At second glance, Alan and Philip are well-connected local experts who are already enmeshed in the apparatus of the state at a variety of levels: through grants, their own board of directors, and their acquaintance with a federal enforcement officer. Their competitor is "run from out of town rather than here," "has just come from the outside," and is "notorious" because of earlier suggestions of dishonesty. He "has a

reputation," and is "not in it for the community." His character can be judged by poor engineering decisions (his network is bridged), poor results (his network is high latency), and a lack of manual skill (he cannot do his own crimping).[61] Rephrased, his network is simple, slow, and he cannot connect two wires together. Led by a nontechnical profiteer and outsider, SATNet had already been "selected for failure,"[62] and all that remained was to decide the venue for the defeat and choose its justification. The outcome was decided by these measures of SATNet's character, and the federal enforcement action was not a last resort when local measures failed, but was itself an implementation of the local decision. That is, SATNet was first and foremost *not* a violator of national spectrum allocation and certification rules through the use of uncertified equipment. Instead, SATNet was first and foremost (in Alan's words), "a bad neighbor." Even though both networks were warned, only one network was triumphant and TownNet was delighted with the result.

The Planetree Forest case does not force a choice between two competing conceptions of regulation—it is not true that this incident must either indicate that the federal government is the *resolution* for intractable local disputes, or that it is the *expression* of local decisions about character. Both of these can be true, even within the same case. To cement which of these is more in play in this particular incident, let us close this case study with Philip's observation about the role of government in the regulation of the spectrum. Reflecting on the successful (for them) conclusion of the TownNet versus SATNet confrontation, Philip stated, "Part of the problem with a lot of regulators is that they're too heavy with the regulation. If you're being a bad neighbor, someone needs to officially remind you that you're being bad. No more than that."

Philip is not asking for more central control of the spectrum because the force of SATNet's comeuppance was not derived from central authority—enforcement was here a reminder of who could mobilize federal enforcement on behalf of *local* norms and attach distant officialdom to their victory. Of course, the quotation also restates the common notion that more

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61. Bridged networks do not employ routing. Crimping is the process of connecting wires and electrical connectors by deforming them with a tool called a crimper. Latency refers to the time that elapses between a request for data and the beginning of data transfer.

62. "Selection for failure" is a concept introduced to legal anthropology by Moore to explain the action of multiple cultural dimensions that underpins some legal reasoning. Specifically, selection for failure has come to mean the process by which a party is culturally prejudged to lose or win in adjudication. The role of the law in these situations is then to externally rationalize and justify a decision arrived at much earlier, rather than to make any new decisions. *See* Sally Falk Moore, *Selection for Failure in a Small Social Field: Ritual Concord and Fraternal Strife Among the Chagga, Kilimanjaro, 1968–69*, *in* SYMBOL AND POLITICS IN COMMUNAL IDEOLOGY 109 (Sally Falk Moore & Barbara G. Myerhoff eds., 1975).

regulation is always bad. That is, regulators can never win, even when they can win your broadcast war.

V. CONCLUSION

It is worth remembering that "new laws are thrust upon going social arrangements in which there are complexes of binding obligations already in existence. . . . The social arrangements are often effectively stronger than the new laws."[63] There is no doubt that large national telecommunications carriers have complexes of binding obligations and ongoing social arrangements, but there are not that many of them. In counterpoint, a more open electromagnetic spectrum policy and the appearance of the Jeffersonian ideal of free competition between decentralized small enterprises like these WISPs have combined to produce an eruption of thousands of local spectrum confrontations where users with a wide variety of backgrounds and skill levels wrestle with new wireless technology, spectrum laws, and each other.

In these cases, we have seen that the engineer's allegiance to principles of engineering as a profession can be far stronger than any allegiance to communications regulation, and that even as engineers they have an allegiance to *their* system that is much stronger than any to *the* system. Similarly, it could be said that TownNet was the injured party in the Planetree Forest spectrum war—at least if jamming occurred—but relationships with members of the Planetree Forest community and a national regulatory official were critical in bringing the war to a resolution, whereas the facts of the dispute were not so critical. (Recall that SATNet was not charged with jamming anything.) Engineers in the field and regulators in the government disagreed as to whether a portion of unlicensed spectrum was empty or full, with all of the engineers in these two cases seeking unopposed access to a non-overlapping channel. In addition, these users of telecommunications laws "knew" the spectrum by both reading the law and using a free software program (Netstumbler).[64] The software program and some of the particularities of its design were very influential in seeing the spectrum as "full," in effect becoming the electromagnetic spectrum's user interface.

A.   *The New Role of the License-Exempt Regulator*

This Article opened by posing questions about the future of open spectrum. No evidence found so far in these two cases or in the larger

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63. MOORE, *supra* note 2, at 58.

64. While MonroeMesh only used Netstumbler in this case, TownNet "knew" the spectrum both through Netstumbler and by carefully monitoring the performance characteristics of its wireless network.

research project suggests that open spectrum will fail due to a tragedy of the commons. In several instances described here, engineers have been extremely overcautious in predicting the failure of unlicensed spectrum due to congestion. While this potential congestion has been something of an obsession, it has yet to appear. These engineers, like the MonroeMesh group, were sometimes unwilling to develop unlicensed systems because of a misapprehension that the mere existence of other users (inferred via 802.11b beacons) implied actual or imminent congestion. In one instance described—the alleged Planetree Forest jamming that occurred over a period of weeks in 2004—the spectrum appeared to be "actually" full, in that TownNet's equipment would not work in one area of Planetree Forest. However, this was an instance of aggression, not overgrazing (or congestion)—a critical difference.

Practically, this empirical evidence suggests that widespread use of wireless without licenses intimates a new kind of relationship with the electromagnetic spectrum. Regulators have never conceptualized the spectrum as something that has a user interface, and telecommunications policy research has never particularly focused on messy local situations. Nonetheless, the larger study of WISPs in six countries finds that whenever you have a local WISP, you have a local situation. Examples abound of local spectrum coordination and negotiation. These negotiations have occasionally turned hostile, as negotiations do, but this does not indicate a failure of negotiation. It is this image of spectrum use that regulators will find increasingly useful. Within the enforcement bureaus of the world, it is common to think that determining a source of unlicensed interference is a probably impossible task, but this is true only if the entity trying to do so is an enforcement bureau. Local providers have an intimate knowledge of what goes on on the rooftops of their town—and even what goes on inside. Mechanisms like searchable public databases in bands where registration is required would also aid local coordination, and WISPs have tried to set up their own databases for this purpose where registration is not required. A more clearly defined and promulgated set of unlicensed norms would also be a benefit. If under "open spectrum" models the government is not going to go away, this indicates a much increased role for enforcement (of, for example, certification, certification violations, and jamming) and public education (usually only weakly attempted by national regulators). This obviously implies more work: the unlicensed regulator is entering into this new relationship with a much larger number of local users.

B.   *Embedding Spectrum Negotiation in Software Will Not Change This Situation*

It is tempting to conclude that the kinds of choices made by the

groups discussed in this Article result only from temporary lags in wireless technology. An argument in this vein might say that if in the future the negotiations for available spectrum (e.g., the choice of channel) are fixed in software algorithms, these local wireless providers will have nothing to talk about, and "broadcast wars" will go away. (Or, they will go away again.) Benkler hopes for as much by framing the problem of interference as one for product manufacturers to sort out in a world without carriers.[65] However, for a variety of reasons beyond the scope of this Article, one may also argue that carriers are unlikely to vanish. In that case, removing a decision from human agency to software algorithm simply changes the tools available to carriers—it is no balm for their desire to both operate in license-exempt bands and at the same time have some control over their operating situation. The promise of new configurability and user-driven innovation[66] is one of the reasons that unlicensed is attractive in the first place. Restricting the parameters that users can manipulate to build new services via some prior specification of algorithms (or requiring secrecy that discourages users from writing their own algorithms) runs exactly counter to the overall project of unlicensed.[67] Indeed, it precludes the innovation these new bands are supposed to produce.

C.   *The Future of the Approach "From Below"*

This may be a historical moment when the study of telecommunications policy critically needs to pay attention to the law as it is lived. Unlike some other domains of law, communications policymakers and researchers have often assumed that the law is never particularly "operative" (Moore's term) in the lives of everyday people. Arcane communications rules are written for a small audience of industry insiders. In a magazine parody, a political writer noted that this culture in U.S. telecommunications policy was so insular it should be called "FCC World," and that it has "perhaps five thousand denizens."[68] Just after that article appeared in Spring 2003, that sort of thinking was jolted by an FCC vote on the relaxation of media ownership caps.[69] While the topic of media ownership caps is usually considered arcane, a record-breaking two million e-mails, telephone calls, and faxes poured into the FCC about it.[70] The

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65. *See generally* Benkler, *supra* note 19.

66. *See generally* ERIC VON HIPPEL, DEMOCRATIZING INNOVATION (2005).

67. *See generally* Christian Sandvig et al., Hidden Interfaces to "Ownerless Networks," Presented to the 32nd Conference on Communication, Information, and Internet Policy (2004) (unpublished paper), http://research.niftyc.org/Hidden_Interfaces.pdf.

68. Nicholas Lemann, *The Chairman*, NEW YORKER, Oct. 7, 2002.

69. For a summary, see Press Release, FCC, FCC Sets Limits on Media Concentration (June 2, 2003), http://fjallfoss.fcc.gov/edocs_public/attachmatch/DOC-235047A1.pdf.

70. *See, e.g.*, Comments in FCC Media Bureau Docket 02-277, 2002 Biennial

surprise for many analysts was that it was possible at all for two million people to become aware that administrative regulation on media ownership existed in the first place. This increasingly active public, recent consumer protection efforts, and liberalization of the electromagnetic spectrum are all reinforcing trends. For instance, consider the new availability of wireless devices that do not require licenses in many countries; the new regime of low power FM licenses from the FCC; the use of a non-exclusive "light-license" of £1 per year for some wireless broadband services (with a simple online form) by the U.K. Office of Communications;[71] and the creation of an online National Do Not Call Registry by the U.S. Federal Trade Commission.[72] These are examples of situations in which much larger numbers of people are now expected to be aware of and interact with an administrative regulator in fairly unprecedented ways. The public is more active in arcane venues (where it perhaps is not welcomed by insiders), while at the same time new federal decisions (presumably endorsed by insiders) about things like telephone privacy now presuppose the participation of every citizen of the country in an administrative regulation. In this environment, we need more attention to the law as it is lived, and users of telecommunications as users of telecommunications law. In this, theoretical frameworks like Moore's theory of law as process are valuable tools.[73]

While parts of this Article have described events that are somewhat sensational by the standards of telecommunications policy, the future of "open spectrum" remains bright. In that spirit, the Article will close with one final return to the city of Monroe and to Planetree Forest. While these case studies describe a variety of different actors and events, there are many things wireless engineers will always agree on. In fact, when asked to describe the biggest problems facing wireless communication, no one mentioned congestion or regulation. Dave of MonroeMesh sighed and replied wistfully, "If only we got another tall building." A year later in

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Regulatory Review–Review of the Commission's Broadcast Ownership Rules and Other Rules Adopted Pursuant to Section of the Telecommunications Act of 1996; Comments in FCC Media Bureau Docket 01-235, Cross Ownership of Broadcast Stations and Ownership; Comments in FCC Media Bureau Docket 01-317, Rules and Policies Concerning Multiple Ownership of Radio Broadcast Stations in Local Markets; Comments in FCC Media Bureau Docket 00-244, Definition of Radio Markets; *see also* Lemann, *supra* note 68.

71. This applies to fixed stations in 5 GHz Band C (5725 to 5850 MHz). "Light licensing" generally refers to the ability to obtain a non-exclusive license, pay a nominal licensing fee, or receive automatic license approval (also called "registration"), or all of these. *See Section 1*, OFCOM, http://stakeholders.ofcom.org.uk/market-data-research/telecoms-research/bbresearch/wireless_update/wirelessbroadband/section1 (last visited Feb. 23, 2011).

72. Rules and Regulations Implementing the Telephone Consumer Protection Act of 1991, *Report and Order*, 18 F.C.C.R. 14014, para. 28 (2003).

73. *See generally* MOORE, *supra* note 2.

Planetree Forest, the reply was also quick: The biggest problem? "It's the trees."