
POLICY LESSONS FROM PERSONAL COMMUNICATIONS SERVICES: LICENSED VS. UNLICENSED SPECTRUM ACCESS

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I. INTRODUCTION

Rapid advances in radio technologies are simultaneously affording better means of mitigating harmful interference while creating new demands on spectral resources. An important component of this transformation is the proliferation of unlicensed spectrum devices which previously were a relatively sleepy area of communications. These devices are generally permitted under Part 15 of the Federal Communications Commission's ("FCC" or "Commission") rules to emit radio frequency ("RF") energy, and require no specific authorization, such as registration or grant of a license, for their use.¹ As unlicensed device use has gathered momentum, it has put spectrum access in the hands of many. Despite the good that may come of open

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¹ 47 C.F.R. § 15.1 (2005). While no specific user or site license is required, the unlicensed wireless devices are constrained by interference parameters and must be pre-approved for use and sale through an authorization procedure under the auspices of the FCC. The authorization process ensures that devices will not be available to the public unless they comply with the FCC's rules, a measure intended to mitigate sources of harmful interference to protected, authorized devices. *See* §§ 2.90, 15.101(a). Unlicensed uses, however, do not receive protection from harmful interference. § 15.17.

spectrum access, an unintended consequence of the ubiquity of unlicensed devices may be to infringe upon the superior rights of incumbent spectrum users. The growing demand for unlicensed spectrum access therefore fuels a debate between licensed and unlicensed spectrum uses.²

The debate prompts a rethinking of current spectrum policy to ensure that the potential of these new technologies is not stifled. In this arena, unlicensed devices and licensed spectrum present diverging paradigms for the assignment of spectrum.³ Much of the current policy debate is shaped around the proper definition of spectrum rights—that is, a “property rights” approach⁴ versus a “commons approach”⁵ to spectrum management.⁶ So-called unlicensed spectrum use⁷ is both an important driver and potential beneficiary of these policy changes.

In modernizing spectrum policy, the FCC, which is responsible for overseeing the national airwaves in the public interest,⁸ faces the difficult task

² The FCC has continued to allocate more spectrum for unlicensed use (*e.g.*, at 3 GHz and at 70/80/90 GHz), while licensed users below 3 GHz continue to demand more spectrum for high value use such as mobile telephony and data services. *See generally In re Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band, Notice of Inquiry*, 17 F.C.C.R. 25,632 (Dec. 20, 2002).

³ *See* Michael K. Powell, Chairman, Fed. Commc’ns Comm’n, *The Age of Personal Communications: “Power to the People,”* Address Before the National Press Club (Jan. 14, 2004), *in* 12 COMMLAW CONSPECTUS 139, 144 (2004) (recognizing the benefits of both licensed and unlicensed spectrum).

⁴ *See* Dale B. Thompson, *Of Rainbows and Rivers: Lessons for Telecommunications Spectrum Policy from Transitions in Property Rights and Commons in Water Law*, 54 BUFF. L. REV. 157, 163–64 (2006) (“Under a property rights approach, property is held by a limited set of individuals, and an essential component of the property right is the right to exclude others from the use of that property.”).

⁵ *See id.* at 163 (“Under a commons approach, property is held by the public and all have the right to utilize that property.”).

⁶ *See, e.g.*, Eli Noam, *Spectrum Auctions: Yesterday’s Heresy, Today’s Orthodoxy, Tomorrow’s Anachronism. Taking the Next Step to Open Spectrum Access*, 41 J.L. & ECON. 765, 784–85 (1998); Yochai Benkler, *Some Economics of Wireless Communications*, 16 HARV. J.L. & TECH 25, 63 (2002). *But cf.*, R.H. Coase, *Comment on Thomas W. Hazlett; Assigning Property Rights to Radio Spectrum Users: Why Did the FCC License Auction Take 67 Years?*, 41 J.L. & ECON. 577 (1998). For a proposed synthesis, *see* Eli Noam, *The Fourth Way for Spectrum*, FT.COM, Mar. 13, 2003, <http://search.ft.com/searchArticle?queryText=noam&y=0&javascriptEnabled=true&id=030313008781&x=0> [hereinafter *Fourth Way for Spectrum*]; *see also*, Kevin Werbach, *Super-commons: Toward a Unified Theory of Wireless Communication*, 82 TEX. L. REV. 863, 867–77 (2004).

⁷ *See infra* Part III .B.

⁸ *See* 47 U.S.C. § 303(y) (2000) (“[T]he Commission from time to time, as public convenience, interest, or necessity requires, shall . . . allocate electromagnetic spectrum . . . [if] such an allocation would be in the public interest. . .”). The FCC administers spectrum allocated for use by non-federal government entities. The National Telecommunications and Information Administration (“NTIA”) is responsible for administering the spectrum allocated for use by the Federal Government. *See* 47 U.S.C. §§ 303, 305(a). The FCC and the NTIA have exercised joint jurisdiction over the radio frequency spectrum since the 1940s under a Memorandum of Understanding, FED. COMMC’NS COMM’N, MEMORANDUM

of integrating rules implementing both the property and commons approaches, as opposed to opting for one regime over the other. In an effort to modernize spectrum policy through an analysis of possible approaches, the FCC established the Spectrum Policy Task Force (“Task Force”),⁹ a group composed of senior staff members from several Bureaus and Offices. The Task Force’s November 2002 report¹⁰ noted that legacy regulation functioned to limit access to available spectrum and that such limitations are a more significant problem than the physical scarcity of spectrum itself.¹¹ The report further identified three distinct approaches to spectrum policy: an exclusive use, or property, approach; a commons approach; and a command-and-control approach.¹² Acknowledging that the command-and-control model dominated current policy, the Task Force nevertheless recommended altering the balance to provide greater use of the exclusive and commons models throughout the radio spectrum.¹³ Implementation of this recommendation will require increased regulatory flexibility and complexity.¹⁴

The historic command-and-control approach focuses on “transmitter operation,”¹⁵ affording a limited number of persons (both natural and juridic)

OF UNDERSTANDING BETWEEN THE FEDERAL COMMUNICATIONS COMMISSION AND THE NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION (2003), available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-230835A2.pdf.

⁹ Press Release, Fed. Comm’ns Comm’n, FCC Chairman Michael Powell Announces Formation of Spectrum Policy Task Force (June 6, 2002), available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-223142A1.pdf.

¹⁰ FED. COMM’NS COMM’N, SPECTRUM POLICY TASK FORCE REPORT (2002), available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-228542A1.pdf [hereinafter SPECTRUM POLICY TASK FORCE REPORT].

¹¹ *Id.* at 3.

¹² *Id.* at 35. The Task Force report defined these three legal rights approaches as: “Command-and-control” model. The traditional process of spectrum management in the United States, currently used for most spectrum within the Commission’s jurisdiction, allocates and assigns frequencies to limited categories of spectrum users for specific government-defined uses. Service rules for the band specify eligibility and service restrictions, power limits, build-out requirements, and other rules.

“Exclusive use” model. A licensing model in which a licensee has exclusive and transferable flexible rights to the use of specified spectrum within a defined geographic area, with flexible use rights that are governed primarily by technical rules to protect spectrum users against interference.

“Commons” or “open access” model. Allows unlimited numbers of unlicensed users to share frequencies, with usage rights that are governed by technical standards or etiquettes but with no right to protection from interference. *Id.*

¹³ *Id.* at 12.

¹⁴ *Id.* at 16.

¹⁵ See *In re* Interference Immunity Performance Specifications for Radio Receivers; Review of the Commission’s Rules and Policies Affecting the Conversion to Digital Television, *Notice of Inquiry*, 18 F.C.C.R. 6039, ¶ 9 (Mar. 13, 2003) (“[W]e believe it will be necessary to shift our current paradigm for assessing interference from approaches based primarily on transmitter operations towards new approaches that focus on the actual RF

the ability to use the spectrum, defined along dimensions of frequency, location and time. The recommended new approach will require a transformation from the current band-specific, rules-based methodology. The proposed regime is based on the rights and obligations of individual parties, thus it demands a detailed understanding of the legal relations among spectrum users. Despite the increased complexity arising out of this proposed approach, it has a distinct social benefit over the command-and-control model: it will enable a greater number of spectrum users to operate with greater flexibility.¹⁶

Proponents on each side of the property rights vs. commons debate claim that their preferred regime will promote efficiency, flexibility, and social welfare.¹⁷ The literature is replete with economic models, political appeals, and references to real estate.¹⁸ Those who argue for the success of the licensed, command-and-control regime point to the widespread use and success of cellular phones. Those who push for a commons approach contend that unlicensed devices also have been very successful, highlighting the sales of cordless phones, baby monitors, and Wi-Fi devices. In many ways, they both are correct.

Casting the debate as one in which only one regime is efficient and should therefore prevail over the other constrains the dialogue and fails to acknowledge that each approach offers advantages and disadvantages. Regulators attempting to modernize spectrum policy must apply an integrated approach while minimizing the negative impacts of each regime. There is precious little material offering a direct comparison demonstrating the advantages and disadvantages of the licensed and unlicensed regimes. This may be because the devices and services within both classifications

environment and interaction between transmitters and receivers, such as the interference temperature metric.”).

¹⁶ SPECTRUM POLICY TASK FORCE REPORT, *supra* note 10, at 15–16.

¹⁷ Compare Thomas W. Hazlett, *The Wireless Craze, the Unlimited Bandwidth Myth, the Spectrum Auction Faux Pas, and the Punchline to Ronald Coase’s “Big Joke”: An Essay on Airwave Allocation Policy*, 14 HARV. J.L. & TECH. 335, 405 (2001) (“[A licensed property rights approach] would allow for the efficient definition of rights, adjudication of disputes (including interference) and easy entry into unoccupied property.”) and Pablo T. Spiller & Carlo Cardilli, *Towards a Property Rights Approach to Communications Spectrum*, 16 YALE J. ON REG. 53 (1999) (arguing that allocating the spectrum is best suited to a licensing property rights approach) with Benkler, *supra* note 6, at 32–35 (“[T]he present state of our technological knowledge, and the relevant empirical evidence we have with the precursors of open wireless networks and with pricing in wired networks, lean toward a prediction that open wireless networks will be more efficient in the foreseeable future.”).

¹⁸ See, e.g., Benkler, *supra* note 6, at 49–67 (applying economic formulas to determine the social costs of wireless communication); James B. Speta, *Making Spectrum Reform “Thinkable”*, 4 J. TELECOMM. & HIGH TECH. L., 183, 185–86 (2005–2006) (focusing on the politics behind spectrum reform in communications legislation); Lawrence J. White, *Propertizing the Electromagnetic Spectrum: Why It’s Important, and How to Begin*, 4 N.Y.U. MEDIA L. & POL’Y 19, 21 (2000) (analogizing real estate and the resultant property rights that attach to spectrum).

are so diverse as to frustrate a direct comparison. The uses and applications of unlicensed devices run the gamut, ranging from remote control toys and cordless telephones, to wireless computer networks and inventory control systems.¹⁹ Moreover, the communications services that unlicensed devices can offer and those services that commercial licensed providers can offer are beginning to meld.²⁰

Fortunately for this analysis, in 1993 the FCC allocated two GHz of spectrum to a new service it called Personal Communications Services (“U-PCS” or “unlicensed PCS”).²¹ In an unusual tactic, the FCC assigned PCS spectrum both by licenses awarded in competitive bidding auctions and through an unlicensed model.²² Some may argue that a comparison between licensed PCS with unlicensed PCS is not exactly a fair one. Given the ubiquity of mobile phones, it is hard to argue that licensed PCS has not been a huge success at lowering prices and spurring competition with cellular service.²³ Conversely, unlicensed PCS has at best been a very late bloomer, and at worst, dead.²⁴ Nonetheless, the comparison still holds value and the classifications still provide lessons, even though the unlicensed side has yet to live up to its full potential. This article does not intend to offer ideas as to how to put this spectrum to higher and better uses. Nor does it attempt to diagnose the reasons why unlicensed PCS has thus

¹⁹ Kenneth R. Carter et al., *Unlicensed and Unshackled: A Joint OSP-OET White Paper on Unlicensed Devices and Their Regulatory Issues* (FCC, Office of Strategic Plan. & Policy, Working Paper No. 39, 13–21, 2003), available at http://hraunfuss.fcc.gov/edocs_public/attachmatch/DOC-234741A1.pdf. The technologies are versatile enough to be used in devices ranging from life improving medical equipment to cordless steak thermometers for a barbeque. *Id.* at 21.

²⁰ This is because the same technologies, Wi-Fi, for example, are used in private homes and are offered as a commercial service in places such as hotels and restaurants. The technology called “Wi-Fi” has become synonymous with cheap, ubiquitous broadband access as well as the promise of unlicensed spectrum devices. Wi-Fi refers to the suite of Institute of Electrical and Electronics Engineers (“IEEE”) wireless computer networking protocols that includes the protocols 802.11b and 802.11g in the 2.4 GHz band, and IEEE 802.11a in the 5.7 GHz band (among others). See *In re Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, Notice of Inquiry*, 19 F.C.C.R. 5136, ¶ 25 n.30 Mar. 11, 2004. This article limits its remarks to a comparison of unlicensed PCS services (not Wi-Fi) and commercial licensed services because the contrast is most striking and comparisons most valid.

²¹ *In re Amendment of the Commission’s Rules to Establish New Personal Communications Services, Second Report and Order*, 8 F.C.C.R. 7700, ¶ 30 (Oct. 22, 1993) [hereinafter *Second Report and Order*].

²² *Id.* at ¶ 1.

²³ See *infra* Part III.A.2.

²⁴ In fact, 10 MHz of spectrum available to unlicensed PCS laid fallow as there were no authorized devices for operation in half the band. The Commission accordingly reallocated the band to optimize its use. See *infra* Part III.B.2.

far failed to live up to expectations.²⁵ Rather, this article examines unlicensed Personal Communications Service in comparison to its sibling service, licensed PCS, seeking lessons for when to apply a licensed regime or an unlicensed one.

This article focuses its analysis on the legal relationships created by different licensing regimes, shifting the focus from the “ether” or the “spectrum” to remedying externalities: the legal recourses available when one person’s use of a radio device degrades the performance of another’s. Awareness of such recourses gives spectrum users greater certainty and more flexibility than under a command-and-control model. The ability to interpret how each party affects another provides a means for mitigating unintended consequences, and, hopefully, a better understanding of how spectrum users might relate to one another in a diminished command-and-control world.

II. WHY A LICENSE?

When the FCC grants permission to operate equipment utilizing radio frequencies, as required by the Communications Act or by FCC rules, it does so by granting a license.²⁶ Historically, rights granted by licenses assured that the number of users responsible for access to the spectrum was a finite, manageable number. These users were sophisticated and easily definable, with strong incentives to adhere to the rules governing their spectrum use.²⁷ In exchange for that use, licensees were afforded a bundle of

²⁵ The expectations for unlicensed devices, however, are addressed in the article’s analysis. This article does not suggest that unlicensed PCS has been a failure. While some might suggest that the unused U-PCS frequencies are wasting extremely valuable spectrum below 1 GHz, the fact remains that it represents 0.0003% of spectrum from 9 kHz to 300 GHz under the FCC’s jurisdiction. *See* 47 C.F.R. § 2.106 (2005). Moreover, the FCC has undertaken several proceedings to revitalize the unlicensed PCS bands. *See infra* Part III.B.2. Since these are open proceedings, this article makes no comments on how the FCC might improve these rules other than to summarize the proceeding as background. Rather, comments in this article are limited to broad lessons drawn from the experience with the state of the rules.

²⁶ The Communications Act of 1934, as amended, defines “license” as the “instrument of authorization required . . . for the use or operation of apparatus for transmission of energy, or communications, or signals by radio, by whatever name the instrument may be designated by the Commission.” 47 U.S.C. § 153(42) (2000). The statute further prohibits the use of any apparatus which emits radio energy within or from any subdivision of the United States except in accordance with the Act and under a license granted under the Act. 47 U.S.C. § 301. The major exceptions to the licensing requirement are those devices which operate under Part 15 of the FCC’s Rules. 47 C.F.R. § 15.1 (2005). Another notable exception to the licensing requirements, which is not the subject of this article, are Industrial, Scientific, and Medical Equipment (ISM), enabled by Part 18 of the FCC’s Rules. 47 C.F.R. pt. 18.

²⁷ *See* Ellen Goodman, *Spectrum Rights in the Telecosm to Come*, 41 SAN DIEGO L.REV. 269, 280–82 (2004).

legal rights, as defined by the license, to protect their services from harmful interference which might be caused by other users.²⁸

Radio frequency spectrum can be shared by various services but, unlike many other natural resources, it can be repeatedly reused, albeit not in the same place or at the same moment in time.²⁹ Competing uses of radio waves at the same point in time and space have a deleterious impact on other radio devices, inhibiting the ability of radio waves to be used as communications carriers. This effect is known as interference.³⁰ The problem of competing uses, inaccurately referred to as “scarcity,”³¹ is frequently referenced in legislation and court decisions as the justification for regulation of the airwaves.³²

Licensing is one form of intervention, as are technology,³³ pricing systems, and social norms,³⁴ for coordinating competing uses of the radio equipment. A system of licensing is, in essence, a capacity planning solution to the highly complex problem of allocating rival end user demand.

²⁸ See 47 U.S.C. §§ 302(a–b), 303(f), 303(m)(1)(E) (2000) (establishing the Commission’s rights to protect licensed users from interference).

²⁹ See Goodman, *supra* note 27, at 285 (“Spectrum is simultaneously finite and renewable, everlasting and degradable.”).

³⁰ The FCC’s rules currently define interference as “[t]he effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radio-communications system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.” 47 C.F.R. § 2.1 (2005). Before the level of use rises to a level such that the spectrum can be used by no one, users may first experience a level of interference that creates congestion in terms of lost signals and reduced capacity of the communications channel. This scarcity of spectrum may naturally ration the resource if users are able to queue usage, repeat signals, or if some users, who becoming frustrated with delays and congestion, opt to forgo their spectrum use entirely. An example, invoking the often used roadway metaphor, might be the person who decides to commute to work using public transportation after becoming frustrated sitting in rush hour traffic jams. In this case, the individual who takes the subway has stopped consuming the public good, e.g., the roadway. Even if he takes the bus, the absence of his individual automobile reduces the aggregate demand on the public good. For another analogy between infrastructure, such as roadways and telephones, to spectrum, see generally Brett M. Frischmann, *An Economic Theory of Infrastructure and Commons Management*, 89 MINN. L. REV. 917 (2005).

³¹ See Benkler, *supra* note 6, at 27 (describing the historical agreement that spectrum was scarce and thus necessitate expert regulation).

³² See e.g., *Nat’l Broad. Co. v. United States*, 319 U.S. 190, 211 (1943); *Red Lion Broad. Co. v. FCC*, 395 U.S. 367, 375–76 (1969). See also ERIK BARNOUW, *A TOWER IN BABEL: A HISTORY OF BROADCASTING IN THE UNITED STATES* 30–32 (Oxford University Press 1966); R. H. Coase, *The Federal Communication Commission*, 2 J.L. & ECON. 1, 25 (1959); Arthur S. DeVany, et al., *A Property System Approach to the Electromagnetic Spectrum: A Legal-Economic-Engineering Study*, 21 STAN. L. REV. 1499, 1504, 1548 (1968–69).

³³ See *Fourth Way for Spectrum*, *supra* note 5 (proposing a system of spectrum allocation where holders use technology to lease spectrum to others).

³⁴ Lawrence Lessig, *The New Chicago School*, 27 J. LEGAL STUD. 661, 662 (1998) (introducing “The New Chicago School” approach to regulation, aiming to synthesize economic and norm accounts of the regulation of behavior).

Future demand for the spectrum is completely random, making it unknowable *ex ante*.

To shortcut the demand allocation problem, licenses assign the right to use the spectrum to a limited number of users. These users serve as financial or risk intermediaries. In financial terms, licensees are specialists who take a position and attempt to resell it. Although there may be certain acceptable levels of contention between users for the public good, if left unchecked, total use may rise until the contention is so great that the resource is unusable.³⁵ In other capacity situations, over-demand may cause delay for other users, but does not preclude all use. In addition, in many other capacity planning problems, the system can afford the ability to queue rival uses, rationing capacity over time. In this circumstance, the so-called “tragedy of the commons”³⁶ may occur because, where there are no limits on any one individual’s use of the common resource, each person uses the common resource without regard to rival users such that the resource eventually may be depleted. The difference between the licensing solution to capacity planning and those solutions implemented in other capacity-planning problems is that in a licensing solution the benefits of spectrum use accrue to a single user directly, while the costs are borne by all persons in an unlicensed arena.

Most spectrum licenses are known as “radio station authorizations,” whereby the FCC assigns bands of adjacent frequencies to particular applications, then allocates the right to those frequencies to minimize the problem of interference.³⁷ This type of license permits operators to emit RF energy at a particular power level, within a designated location for a specified period of time, within an assigned frequency band.³⁸ The Communications Act of 1934, as amended (“Communications Act”), provides for the use of those bands but expressly precludes private ownership.³⁹ The licenses are “exclusive” only in the sense that the FCC will not grant a license to a second party with the rights to the same frequency and geographic area. The licensee is therefore assured of protection from harmful interference that could disrupt the normal operation in the licensed service area within the assigned frequency band.⁴⁰

³⁵ See Carter, *supra* note 19, at 13–21 (providing examples of the myriad uses and applications of unlicensed wireless devices).

³⁶ Garrett Hardin, *The Tragedy of the Commons*, 162 *Sci.* 1243, 1244 (1968).

³⁷ 47 U.S.C. § 303 (2000).

³⁸ 47 C.F.R. § 2.1(c) (2005).

³⁹ 47 U.S.C. § 301. *But see* Goodman, *supra* note 27, at 320–21 (“[C]ourts have still recognized in FCC licenses some of the attributes of private property.”).

⁴⁰ See *In re* Amendment of Part 90 of the Commission’s Rules to Facilitate Future Development of SMR Systems in the 800 MHz Frequency Band and implementation of Section 309(j) of the Communications Act – Competitive Bidding 800 MHz SMR, *Further Notice of Proposed Rulemaking*, 10 F.C.C.R. 7970, ¶¶ 42–43 (Nov. 4, 1994).

By contrast, unlicensed, or “Part 15,” devices, are granted some RF emissions rights despite operating without first obtaining a station or user authorization.⁴¹ Unlicensed devices are permitted to operate on a sufferance basis,⁴² subject to five cardinal rules. Part 15 device users: (1) have no vested right to continue using any frequency;⁴³ (2) must accept any interference generated by all other users, including other unlicensed users;⁴⁴ (3) may not cause harmful interference;⁴⁵ (4) must cease use if notified by FCC that the device is causing harmful interference;⁴⁶ and (5) must have equipment authorized (certificated) to show compliance with FCC standards before the device is marketed or imported.⁴⁷ Moreover, unlicensed devices are permitted to employ only very low energy compared with the vast majority of licensed devices.⁴⁸ As such, the likelihood of harmful interference to other radio operators is acceptably small, and therefore unlicensed devices remain free from the restrictions of a licensing process.

III. PERSONAL COMMUNICATIONS

In late 1993, the FCC amended its rules to allocate 160 MHz in two GHz of spectrum to PCS.⁴⁹ While it declined to adopt a precise definition of the services to be offered to consumers, the FCC “expected [PCS] to include advanced forms of cellular telephone service, advanced digital cordless phone service, portable facsimile services, wireless [private branch exchange] services, and wireless local area network [(“W-LAN”)] services, among others.”⁵⁰ The Commission allowed PCS providers to employ a mix of fixed and mobile services without technical specification—the first time it had implemented such flexibility for licensees.⁵¹ Assignment of PCS spectrum was made by licenses awarded in competitive bidding auctions, and by an unlicensed approach. Broadband PCS licenses were auctioned

⁴¹ 47 C.F.R. § 15.1 (2005).

⁴² In addition to limiting the technical constraints, one of the primary operating conditions under Part 15 is that the operator must accept whatever interference is received and must correct whatever interference is caused. Should harmful interference occur, the operator is required to immediately correct the interference problem, even if correction of the problem requires ceasing operation of the Part 15 system causing the interference. *See* 47 C.F.R. § 15.5.

⁴³ § 15.5(a).

⁴⁴ § 15.5(b).

⁴⁵ § 15.5(b).

⁴⁶ § 15.5(c).

⁴⁷ § 15.37(a).

⁴⁸ § 15.319.

⁴⁹ *See Second Report and Order, supra* note 21.

⁵⁰ *Id.* ¶ 22.

⁵¹ *Id.* ¶¶ 135–38. While PCS is intended to be used for mobile communications, licensees can offer fixed services on an ancillary basis to their mobile operations. 47 C.F.R. § 99.3 (1994).

beginning in 1995,⁵² and continued with the re-auction of NextWave C and F block licenses in 2000⁵³ and the auction of some thirty MHz in 2005.⁵⁴

As part of the creation of PCS, the band was reorganized.⁵⁵ Prior to the creation of PCS in the mid-1990s, Fixed Microwave Service, a non-auctioned, point-to-point, licensed service,⁵⁶ was the primary user in the band. The Commission created transition rules necessary to relocate Fixed Microwave Service from the band, and, if not relocated, to eventually reduce it to secondary user status such that it would not cause harmful interference to PCS users. The vast majority of relocation of Fixed Microwave users has been accomplished for both Broadband and unlicensed PCS.

A. Licensed PCS

1. Background

PCS licenses are used to provide spectrum for many of the more than 219 million mobile phones Americans use every day.⁵⁷ The FCC allocated a total of 120 MHz for PCS⁵⁸ with the intention that it would compete with pre-existing cellular service by offering mobile access to the public switched telephone network, and by providing data communications as a commercial service to the public on a retail basis.⁵⁹ In a subsequent order, the FCC assigned these licenses through competitive bidding, also known

⁵² See *In re* Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services, *Tenth Report*, 20 F.C.C.R. 15908, ¶ 71, n.147 (Sept. 26, 2005).

⁵³ See Auction of C and F Block Broadband PCS Licenses, Notice of Auction Scheduled for July 26, 2000, *Public Notice*, 15 F.C.C.R. 693 (Jan. 12, 2000).

⁵⁴ See Broadband PCS Spectrum Auction Scheduled for January 12, 2005, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction No. 58, *Public Notice*, 19 F.C.C.R. 18,190 (Sept. 16, 2004).

⁵⁵ *Second Report and Order*, *supra* note 21, ¶¶ 141–42.

⁵⁶ See 47 C.F.R. § 101.1 (2005).

⁵⁷ CELLULAR TELECOMMS. & INTERNET ASS'N, SEMI-ANNUAL WIRELESS INDUSTRY SURVEY (2006) [hereinafter CTIA SEMI-ANNUAL WIRELESS INDUSTRY SURVEY], available at <http://files.ctia.org/pdf/CTIAMidYear2006Survey.pdf>.

⁵⁸ The FCC created two classes of Licensed PCS: Narrow Band PCS and Broadband PCS. Narrowband PCS was authorized in the 901–902, 930–931, and 940–941 MHz bands (900 MHz band). 47 C.F.R. § 99.100 (1994). Broadband personal communications services was authorized in the 1850–1890, 1930–1970, 2130–2150, and 2180–2200 MHz bands (Blocks A through G). 47 C.F.R. § 99.200 (1994). These bands were channeled into two 30 MHz frequency blocks, one 20 MHz frequency block, and four 10 MHz frequency blocks.

⁵⁹ *Second Report and Order*, *supra* note 21, ¶ 14. Cellular and PCS are now such close substitutes and offered on a competitive basis that the average mobile phone user makes no differentiation between the two classes of radio service.

as an auction process.⁶⁰ The licenses were granted for a term of ten years with an express expectancy of license renewal similar to those expectations for cellular service licensees.⁶¹ To protect incumbent Fixed Microwave Service operations from interference, the FCC required PCS coordination distances from 62 to 195 miles.⁶² However, it allowed PCS to operate at power levels up to 100 watts for base stations and up to 2 watts for mobile devices.⁶³

The transition plan established three periods for the relocation of Fixed Microwave Services in favor of Broadband PCS.⁶⁴ In the initial period, an incumbent Fixed Microwave operator could voluntarily negotiate with Broadband PCS licensees for relocation costs.⁶⁵ This period was followed by a period of mandatory good faith negotiations.⁶⁶ At the end of the mandatory negotiation period, the Broadband PCS licensee could seek involuntary relocation of the Fixed Microwave licensee by providing the incumbent with comparable facilities.⁶⁷ Broadband PCS licensees could make use of the trade associations PCIA⁶⁸ and ITA⁶⁹ to remove common microwave links and relocation process costs.⁷⁰

⁶⁰ The Omnibus Budget Reconciliation Act of 1993, Pub. L. No. 103-66, 107 Stat. 312, directs the Commission to employ competitive bidding procedures by March 8, 1994, to select among mutually exclusive applications for licenses to use the electromagnetic spectrum, provided that the service is one in which the licensee receives compensation from subscribers for the use of those frequencies. See *In re* Implementation of Section 309(j) of the Communications Act Competitive Bidding, *Notice of Proposed Rulemaking*, 8 F.C.C.R. 7635, ¶¶1-2 (Oct. 12, 1993).

⁶¹ *Second Report and Order*, *supra* note 21, ¶ 131. Licensees must serve with a signal level sufficient to provide adequate service to at least one-third of the population in their licensed area within five years of being licensed, two-thirds of the population in their licensed area within seven years of being licensed, and ninety percent of the population in their licensed area within ten years of being licensed. Population is defined as the 1990 census population. Failure by any licensee to meet these requirements will result in forfeiture of the license and the licensee will be ineligible to regain it. *Id.* at ¶ 134.

⁶² *Id.* at tbl. 3.

⁶³ *Id.* at ¶ 156.

⁶⁴ *In re* Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies, *Third Report and Order and Memorandum Opinion and Order*, 8 F.C.C.R. 6589, ¶ 15 (July 15, 1993).

⁶⁵ *Id.*

⁶⁶ *Id.*

⁶⁷ *Id.* ¶ 16. “Comparable facilities” is defined as being “equal to or superior to existing facilities.” *Id.* at ¶ 36. Factors in determining comparable facilities include, but are not limited to, “system reliability, capability, speed, bandwidth, throughput, overall efficiency, bands authorized for such services, and interference protection.” *Id.*

⁶⁸ The Personal Communications Industry Association (“PCIA”) works “to facilitat[e] the emergence and growth of core wireless services.” The PCIA Legacy: We Build Industries, http://www.pcia.com/about_pcia/history.htm (last visited Nov. 1, 2006).

⁶⁹ The Enterprise Wireless Associates (formerly “ITA”) “works to preserve spectrum rights and access for enterprise wireless customers.” Enterprise Wireless Alliance, <http://www.enterprisewireless.org/about/about.html> (last visited Nov. 1, 2006).

⁷⁰ See PCIA Microwave Clearinghouse, http://www.pcia.com/microwave/micro_home.

To spark the creation of a national market for PCS, the FCC granted licenses for service areas defined using Rand McNally's Major Trading Areas ("MTAs") and Basic Trading Areas ("BTAs").⁷¹ At the time of the licensing, there were 49 MTA-based service areas and 487 BTA-based services areas.⁷² Licensees were permitted to aggregate service areas nationwide without restriction and, except for licensees with cellular interests, were allowed to aggregate up to forty MHz in any one service area.⁷³ In order to service its customers, PCS licensees were required to build networks of FCC-compliant radio towers.⁷⁴ Nationwide licensees were required to construct a minimum of 250 base stations within five years of being licensed, and at least 500 base stations within ten years.⁷⁵ In MTAs, licensees were required to construct base stations to provide coverage to approximately twenty-five percent of the geographic area of their licensed service area within five years of being licensed, and fifty percent of the geographic area of their licensed service area within ten years of being licensed.⁷⁶ Licensees in BTAs had to construct at least one base station and begin providing service in their licensed service area within one year.⁷⁷ All licensees were required to notify the Commission when these benchmarks were met.⁷⁸

2. Network Infrastructure and Business Models

PCS has been a huge boon for the American people. The U.S. wireless market is highly contested, with four nationwide carriers⁷⁹ providing mobile voice and data services over cellular and broadband PCS systems.⁸⁰

htm (last visited Nov. 1, 2006).

⁷¹ See 47 C.F.R. § 24.202 (2005) ("Broadband PCS service areas are Major Trading Areas (MTAs) and Basic Trading Areas (BTAs) as defined in this section. MTAs and BTAs are based on the Rand McNally 1992 Commercial Atlas & Marketing Guide, 123rd Edition, at pages 38-39[, with some exceptions and additions.]").

⁷² *Second Report and Order*, *supra* note 21, ¶ 64.

⁷³ *Id.* ¶ 78, n.70.

⁷⁴ *Id.* ¶ 134.

⁷⁵ 47 C.F.R. § 99.103(a) (1994).

⁷⁶ § 99.103(b).

⁷⁷ § 99.103(c).

⁷⁸ *Id.*

⁷⁹ "As of year-end 2005, there were four mobile telephone operators in the United States that analysts typically describe as 'nationwide': Sprint Nextel Corp. ('Sprint Nextel'), Verizon Wireless, LLC ('Verizon Wireless'), T-Mobile, and Cingular Wireless, LLC ('Cingular Wireless' or 'Cingular')." *In re* Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services, *Eleventh Report*, FCC-06-142, ¶ 25 (Sept. 29, 2006) (internal citations omitted).

⁸⁰ *Id.* ¶¶ 61-64. A third type of spectrum license, SMR, also provides mobile service, but it is distinct from cellular and PCS in that it does not connect to the public switched

The benefit of this competition has been lower prices⁸¹ and a growing diversity of service offerings. As a result, the ranks of wireless subscribers swelled from 16 million in December 1993 to 219 million in June 2006.⁸² In addition to their growing numbers, the services available for purchase by these subscribers also burgeoned.⁸³ Competition to offer a variety of services forced wireless carriers on a spending spree; carriers have cumulatively spent more than \$199 billion to upgrade their networks in recent years.⁸⁴ Today, companies are investing heavily in third-generation, or “3G,” networks⁸⁵ capable of providing high-speed data connectivity comparable to current fixed-line communications.⁸⁶

B. Unlicensed PCS

1. Background

Similar to licensed PCS, unlicensed PCS was created with the intention to fill a wide range of new wireless uses for voice and data services.⁸⁷ Originally, the FCC allocated forty MHz, at 1890–1930 MHz, for unlicensed PCS devices.⁸⁸ U-PCS devices were permitted in the 1910–1930 MHz and 2390–2400 MHz bands.⁸⁹ The FCC’s rules governing U-PCS devices are similar in most major respects to other Part 15 devices, including the low power restrictions, the requirement that the devices not cause harmful interference, and that the users must accept all interference they receive. The FCC imposed several additional service rules on U-PCS devices operating in the 1910-1930 band. Foremost are rules requiring that the devices monitor the spectrum prior to transmission.⁹⁰ These rules were implemented because the FCC believed that U-PCS systems could share

telephone network, permitting connectivity only between like devices within one network. SMR has largely been used for dispatch services. *Id.* ¶ 64.

⁸¹ *Id.* ¶ 151 (“[T]here is ample evidence of a sharp decline in mobile telephone prices in the period since the launch of PCS service. One analyst estimated that the average per-minute cost of wireless calling plunged 72 percent in the past five years alone.”) (citation omitted).

⁸² CTIA SEMI-ANNUAL WIRELESS INDUSTRY SURVEY, *supra* note 57.

⁸³ Cellular Telecomms. & Internet Ass’n, Taxes, Fees, and Surcharges, http://www.ctia.org/industry_topics/topic.cfm/TID/27/CTID/14 (last visited Nov. 1, 2006).

⁸⁴ *Id.*

⁸⁵ See, e.g., Sanford Nowlin, *3G: The Next Big Leap*, SAN ANTONIO EXPRESS-NEWS, Aug. 10, 2006, at 1E (“Sprint Nextel, Cingular Wireless and Verizon Wireless have spent about \$10 billion to launch next-generation networks in the United States.”).

⁸⁶ *Id.*

⁸⁷ *Second Report and Order*, *supra* note 21, ¶ 1.

⁸⁸ *Id.* ¶ 3.

⁸⁹ 47 C.F.R. § 15.307(a) (2005).

⁹⁰ 47 C.F.R. § 15.323(c).

the band with Broadband PCS without causing harmful interference to those systems.⁹¹

To further minimize the potential of U-PCS devices interfering with other users of the 1910–1930 band, unlicensed operations are subdivided into two classifications: isochronous (principally voice) operations in the 1920–1930 MHz portion, and asynchronous (principally data) operations in the 1910–1920 MHz portion of the band.⁹² These classifications follow different radio transmission requirements as demanded by the different types of services. Data communications tend to require short, “bursty” asynchronous transmissions. The FCC elected to optimize the 1910–1920 MHz band in order to facilitate spectrum sharing among asynchronous devices.⁹³ By contrast, voice communications tend to exhibit longer and more predictable transmissions. Voice devices, such as a system of wireless handsets, can be synchronized.⁹⁴ Currently, the most widespread ap-

⁹¹ *In re* Amendment of Part 2 of the Commission’s Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems; The Establishment of Policies and Service Rules for the Mobile-Satellite Service in the 2 GHz Band; Amendment of the U.S. Table of Frequency Allocations to Designate the 2500–2520/2670–2690 MHz Frequency Bands for the Mobile-Satellite Service; Petition for Rule Making of the Wireless Information Networks Forum Concerning the Unlicensed Personal Communications Service; Petition for Rule Making of UTStarcom, Inc., Concerning the Unlicensed Personal communications Service, *Third Report and Order, Third Notice of Proposed Rulemaking and Second Memorandum Opinion and Order*, 18 F.C.C.R. 2223, ¶¶ 39–40 (Feb. 10, 2003) [hereinafter *Third Notice of Proposed Rulemaking*]. In the United States, the 1910–1930 MHz band is allocated to the fixed and mobile services on a primary basis. See 47 C.F.R. § 2.106 (2005). The 1910–1930 MHz band is part of bandwidth allocated internationally to the fixed and mobile services on a primary basis and has been designated as a candidate band for administrations wishing to implement IMT-2000 services *Id.* at n.5.388. International footnote 5.388A states that the 1910–1930 MHz and other frequency bands may be used by high altitude platform stations as base stations to provide IMT-2000 services. *Id.* at n.5.388A.

⁹² Asynchronous devices are defined as those “that transmit RF energy at irregular time intervals, as typified by local area network data systems,” and isochronous devices are defined as those “that transmit at a regular interval, typified by time-division voice systems.” 47 C.F.R. § 15.303(a)–(d) (2005). Specific requirements for the operation of asynchronous devices in the 1910–1920 MHz band are codified at 47 C.F.R. § 15.321 (2005) and specific requirements for the operation of isochronous devices in the 1920–1930 MHz band are codified at 47 C.F.R. § 15.323 (2005).

⁹³ See *In re* Amendment of Part 2 of the Commission’s Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems; Petition for Rule Making of the Wireless Information Networks Forum Concerning the Unlicensed Personal Communications Service; Petition for Rule Making of UTStarcom, Inc., Concerning the Unlicensed Personal Communications Service; Amendment of Section 2.106 of the Commission’s Rules to Allocate Spectrum at 2 GHz for use by the Mobile-Satellite Service, *Sixth Report and Order, Third Memorandum and Order, and Fifth Opinion and Order*, 19 F.C.C.R. 20,720, ¶ 8 n.13 (Sept. 22, 2004).

⁹⁴ The monitoring rules require asynchronous devices to monitor the spectrum before use for at least 50 microseconds prior to initiating a transmission. See 47 C.F.R. § 15.321

plication of the 1920–1930 MHz U-PCS band is for wireless private branch exchanges (“PBX”).⁹⁵ Twenty-seven original U-PCS devices are currently authorized to operate under Part 15(d) equipment authorizations; none are authorized to operate in the 1910–1920 MHz band.⁹⁶

Before the FCC permitted U-PCS, the 1910–1930 MHz band was allocated to Fixed Microwave Service for point-to-point links.⁹⁷ The 1993 Order establishing U-PCS created a not-for-profit organization, the Unlicensed PCS Ad Hoc Committee for 2 GHz Microwave Transition and Management (“UTAM”), which was conditionally designated to manage this relocation.⁹⁸ The Commission subsequently established policies for the relocation of incumbent microwave systems from this band and confirmed its designation of UTAM to manage the transition.⁹⁹ Under these policies, all manufacturers of U-PCS equipment are required to participate in UTAM¹⁰⁰ and are required to pay fees, initially set at twenty dollars per handset deployed,¹⁰¹ to offset UTAM’s costs for relocating the microwave systems.¹⁰² The relocation requirements¹⁰³ also restrict U-PCS devices in their geographic operation in a way that other Part 15 devices are not. U-PCS handset devices may only operate in locations approved by UTAM for U-PCS.¹⁰⁴

(2005). Isochronous devices are limited to specific channels and must monitor for only 10 or 20 milliseconds, depending on the design of the system. § 15.323.

⁹⁵ PBXs or “switches” are “computers that direct telephone calls and data transmissions through a network of private extensions.” *Telecom Tech. Servs. v. Rolm Co.*, 388 F.3d 820, 823 (11th Cir. 2004).

⁹⁶ The FCC’s Equipment Authorization System Generic Search database allows searches of equipment authorizations in specific frequency ranges. *See* OET Generic Search Report, <https://gullfoss2.fcc.gov/prod/oet/cf/eas/reports/GenericSearch.cfm?calledFromFrame=N> (last visited Nov. 1, 2006).

⁹⁷ *See* 47 C.F.R. § 101.69 (showing the transition of use for the 1850–1990 MHz band from fixed microwave to use for PCS and emerging technologies).

⁹⁸ *Second Report and Order*, *supra* note 21, ¶ 88; Amendment of the Commission’s Rules to Establish New Personal Communications Services, *Fourth Memorandum Opinion and Order*, 10 F.C.C.R. 7955, ¶ 1 (May 12, 1995) [hereinafter *Fourth Memorandum Opinion and Order*].

⁹⁹ *See Fourth Memorandum Opinion and Order*, *supra* note 98, ¶ 1.

¹⁰⁰ 47 C.F.R. § 15.307(a)–(c) (2005).

¹⁰¹ *Fourth Memorandum Opinion and Order*, *supra* note 98, ¶ 9. The fee schedule has changed so that the cost per unit has been lowered substantially to \$0.50 after a \$50,000 one-time, upfront deposit by the manufacturer. *See* UTAM Home Page, <http://www.utam.org/ClearingFees.html> (last visited Oct. 24, 2006) (noting that the fees were changed to promote the use of devices such as cordless telephones, walkie-talkies and monitors in the bandwidth).

¹⁰² UTAM has incurred more than \$60 million in liabilities relocating the spectrum. *See In re Amendment of the Commission’s Rules to Establish New Personal Communications Devices*, *UTAM Report to the FCC*, GEN Docket No. 90-314, at 9 (July 1, 2002).

¹⁰³ The FCC rules concerning U-PCS relocation are codified at 47 C.F.R. §§ 101.69–101.81 (2005).

¹⁰⁴ § 15.307(c)–(e).

In order to keep U-PCS devices from operating in places where microwave users have not been relocated, the rules contemplate two classes of U-PCS devices: “coordinatable” and “noncoordinatable.” Coordinatable U-PCS devices, like wireless PBXs, can be designed for operation only in places that allow adequate coordination with incumbent fixed microwave facilities.¹⁰⁵ For FCC approval, these devices must have a mechanism that will disable them when they are moved outside that area.¹⁰⁶ A noncoordinatable U-PCS device is not tied to a geographic area.¹⁰⁷ The FCC will not approve the application for a device that UTAM deems noncoordinatable.¹⁰⁸ However, these provisions are designed to expire once the Commission determines that there is no longer a need to coordinate with fixed microwave users.¹⁰⁹

The relocation of incumbent microwave users has been quite successful. In fact, UTAM reports that it has cleared the band of most microwave link operators. UTAM’s homepage notes that, as of 2005, “remaining microwave link[s] operating in this band, of which there are only a small handful, lost their primary status and UTAM no longer needed to be concerned with any potential interference to these incumbents. As a result, many of the controls put on by UTAM are no longer required.”¹¹⁰ This success is attributable to the considerable efforts and financial resources UTAM and its industry members expended in clearing the U-PCS bands of incumbent fixed microwave links.¹¹¹

2. *The Uncertain Future of Unlicensed PCS*

Despite the success of UTAM in transitioning the band from microwave link operators, the future of unlicensed PCS is uncertain at best. It is generally agreed that U-PCS developed rapidly despite numerous challenges and difficulties, but its full potential remains untapped.¹¹² UTAM, along with the Wireless Information Networks Forum (“WINForum”), asserted that delays in the widespread development of U-PCS were due to the relocation

¹⁰⁵ § 15.307(d).

¹⁰⁶ § 15.307(e).

¹⁰⁷ § 15.303(e).

¹⁰⁸ § 15.307(c).

¹⁰⁹ § 15.307(f).

¹¹⁰ UTAM Homepage, <http://www.utam.org/index.html> (last visited Nov. 1, 2006).

¹¹¹ See, e.g., *In re* Amendment of Part 2 of the Commission’s Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services, *Comments of UTAM, Inc.*, FCC 03-16, at 3 (Apr. 14, 2003) (accessible via FCC Electronic Filing System).

¹¹² See Ellen Goodman et al., *An Overview of Problems and Prospects in U.S. Spectrum Management*, 698 PLI/PAT 327, 356 (2002) (“While the Commission has noted that [U-PCS] bands were underutilized, several UPCS operators/manufacturers have argued that UPCS spectrum use is increasing rapidly, particularly as incumbent users of these bands are being reallocated. . . . Utilization of the unlicensed bands is still at an early stage and is likely to grow. . . .”).

of microwave incumbents from the U-PCS band and the strict Part 15D spectrum etiquette required by the rules.¹¹³ Development was initially also slowed by spectrum users' preference for the technological flexibility, wider bands,¹¹⁴ and geographic freedom afforded by other kinds of Part 15 operation over U-PCS, coupled with the fact that there was no handset fee.¹¹⁵ As a result, the band of spectrum dedicated to asynchronous devices lay fallow.

Given the early lackluster performance of the service, the Commission initiated several proceedings seeking to allocate the band to higher value uses.¹¹⁶ Two of the bands have been realigned, with five MHz of spectrum given to Nextel Communications and five MHz reassigned for Advanced Wireless Service ("AWS").¹¹⁷ In August 2004, the Commission assigned the 1910–1915 MHz band¹¹⁸ to Nextel for the provision of licensed fixed and mobile service as part of the planned re-banding of the 800 MHz for interference abatement among public safety systems.¹¹⁹ This spectrum was given in exchange for the spectrum properties Nextel relinquished in the re-banding. To accomplish the exchange, the Commission adopted a UTAM-sponsored reimbursement plan in which Nextel was required to pay to UTAM a *pro rata* share of the band-clearing costs.¹²⁰ As such, Nextel was required to pay twenty-five percent of the costs UTAM incurred to clear the U-PCS band as of the date Nextel began using the band.¹²¹ The following month, the Commission paired the block of spec-

¹¹³ *In re* Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services, *Reply Comments of UTAM, Inc./WINForum*, FCC 03-16, at 5-6 (Nov. 8, 2001) [hereinafter *Reply Comments of UTAM, Inc./WINForum*].

¹¹⁴ The spectrum available for other types of Part 15 devices can be as wide as 25 MHz, but only 10 MHz for either class of U-PCS.

¹¹⁵ See *supra* Part III.B.I.

¹¹⁶ *Third Notice of Proposed Rulemaking*, *supra* note 91, at ¶ 2. See also *In re* Improving Public Safety Communications in the 800 MHz Band, Report and Order, Fifth Report and Order, Fourth Memorandum Opinion and Order, and Order 19 F.C.C.R. 14969, ¶¶ 227–28 (Aug. 6, 2004) (noting that the public would be best served by reallocating the 1910–1915 MHz band away from U-PCS) [hereinafter *Improving Public Safety Communications*].

¹¹⁷ See *In re* Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems, *Sixth Report and Order, Third Memorandum Opinion and Order, and Fifth Memorandum Opinion and Order*, 19 F.C.C.R. 20,720, 20,722 at n.1 (Sept. 22, 2004) ("Advanced Wireless Services is the collective term we use for new and innovative fixed and mobile terrestrial wireless applications using bandwidth that is sufficient for the provision of a variety of applications, including those using voice and data (such as internet browsing, message services, and full-motion video) content.").

¹¹⁸ This band is paired with the 5 MHz between 1990 and 1995 MHz. *Improving Public Safety Communications*, *supra* note 116, at ¶ 217.

¹¹⁹ *Id.*

¹²⁰ *Id.* ¶ 223.

¹²¹ *Id.* ¶ 240.

trum at 1915–1920 with 1995–2000 MHz, making it available for AWS.¹²² In order to compensate UTAM for expenses incurred in relocating incumbents from the 1915–1920 MHz band, the FCC required new AWS licensees to pay twenty-five percent of the total costs UTAM incurred, including future obligations.¹²³

In the same order, the FCC turned its attention to modifying its Unlicensed PCS rules for the 1920–1930 MHz band in order to provide additional flexibility. The FCC changed the channelization requirements, doubling the maximum channel band to 2.5 MHz.¹²⁴ Most notably, the FCC did away with the “isochronous” designation in the specific operating requirements and removed “listen before talk” rules (the “packing rule”).¹²⁵ Instead of imposing spectrum etiquette, the rules now only require that a U-PSC device “must incorporate a mechanism for monitoring the time and spectrum windows that its transmission is intended to occupy.”¹²⁶ This increased flexibility will go a long way toward putting unlicensed PCS devices on par with other unlicensed devices.

IV. SPECTRUM POLICY LESSONS FROM PCS

All spectrum policy creates legal rights; how and to whom those legal rights are assigned is pivotal to shaping the way the market for the communications services offered develops. This is especially true given the range of options of licensed and unlicensed approaches. Both Broadband and unlicensed PCS were expected to provide a variety of similar mobile communications services, albeit on different geographic scales. The difference in the two licensing regimes’ geographic footprints causes two very different market outcomes. This difference is increased by the legal statuses that create a centralized market of service providers in the licensed regime and a generally decentralized market of unlicensed equipment manufacturers in the unlicensed regime. The fundamental policy question is: what will be the beneficial effect of aggregating control over the spectrum resource?

The legal rights to use radio waves to carry and receive communications signals clearly would be of only marginal value if granted to a limited handful of entities for their own use. Thus, in the Broadband PCS world, the spectrum necessarily becomes an input to a final service offered for

¹²² *In re* Amendment of Part 2 of the Commission’s Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems, *Sixth Report and Order, Third Memorandum Opinion and Order, and Fifth Memorandum Opinion and Order*, 19 F.C.R. 20,720, ¶ 41 (Sept. 22, 2004).

¹²³ *Id.* ¶ 53.

¹²⁴ *Id.* ¶ 77.

¹²⁵ *Id.* ¶ 81.

¹²⁶ 47 C.F.R. § 15.323(c) (2005).

sale to the public. In addition to the protection from interference, the license also serves as a barrier to competitive entry by limiting the number of firms which have access to the primary input.¹²⁷ Whether explicit or implicit in the regulatory intent in granting the license, this barrier to entry affords the licensee protection against expropriation of its network investment by competition that would decrease the profits from providing a wireless service. Thus, licensees are willing to spend lavishly for these legal rights and on further capital investments in fixed infrastructure to expand their networks.¹²⁸

By contrast, unlicensed operation tends to collapse the value chain, reducing the importance of the wireless service provider and increasing the importance of equipment manufacturers and retail suppliers. Unlicensed PCS is an equipment market in which end users buy their own network gear and connectivity, and provide service for their own communications needs. In addition to sidestepping the normal delays associated with the licensing process, the devices can enjoy spectrum which is not encumbered by license fees.

Generally, unlicensed devices benefit from lower costs and more rapid development cycles. Until recently, the scope of unlicensed devices was limited, providing only short-range applications such as toys, gadgets, and novelties, but unlicensed devices are becoming more pervasive.¹²⁹ Driven by rapid advances in technology, entrepreneurship, and enabling government policies, unlicensed RF devices are increasingly able to offer applications in all areas of industry, government, and in private homes.¹³⁰ An unlicensed regime increases consumer investment in the network, providing an incentive for greater creativity in evolving network applications.¹³¹ Moreover, because the equipment retailer is not receiving reoccurring service

¹²⁷ Noam, *supra* note 6. In this sense, the spectrum license functions in the same manner as a traditional form of intellectual property right, such as a patent or copyright, which affords a period of exclusivity from competition.

¹²⁸ Some have argued that the payment of a license fee hampers the deployment of networks and increases the cost of service to the end user. *See, e.g., id. But cf.,* Evan Kwerel, *Spectrum Auctions Do Not Raise the Price of Wireless Services: Theory and Evidence* (FCC, Office of Plan. & Policy, 2000), available at <http://wireless.fcc.gov/auctions/data/papersAndStudies/SpectrumAuctionsDoNotRaisePrices.pdf> (arguing that the cost of a wireless license is a sunk cost which does not affect the end user's price). Whether or not the carrier treats the cost of the spectrum license as a sunk cost, the cost of the license and the capital expenditures are, nonetheless, rival uses of the firm's cash.

¹²⁹ *See, e.g., In re Amendment of the Commission's Rules to Establish New Personal Communications Devices, UTAM Report to the FCC*, GEN Docket No. 90-314, at 4 (July 1, 2006) (accessible via FCC Electronic Filing System) (noting that since the microwave operations were relocated in 2005 there has been a spike in deployment of new nomadic devices).

¹³⁰ Unlicensed devices now ranges from remote control toys, wireless computer networking systems, telephones and inventory control systems. *See* Carter, *supra* note 19.

¹³¹ *See* Werbach, *supra* note 6; Goodman, *supra* note 27, at 364-65.

revenues, the retailer has an incentive to provide innovative product offerings to entice existing users to purchase upgraded equipment on a regular basis.

When the services offered by wireless communications are not well defined or unknown at the time rules are drafted, an unlicensed regime offers certain advantages for the development of the services, such as competition, product innovation, and user investment in wireless networks. Under an unlicensed scenario, network operators can limit the risk of stranding network equipment investments by passing the costs of the wireless equipment on to the consumer. If the end user eventually does not demand the wireless service, or can get a better deal from a competitor, the network provider does not lose the investment in the unlicensed gear. By contrast, granting licenses to a small, identifiable group of commercial service providers can help to promote the Commission's policy goals such as ubiquitous coverage, universal service, common carriage, or continuity of service. Given the success, however, of the FCC's equipment-authorization approach in controlling interference caused by unlicensed operation, it is very possible that such an approach could be used as a vehicle to achieve other policy goals as well.

A. Distributing Use

Aggregation over control of the spectrum in the form of a license is one means by which to distribute competing uses of the spectrum. Distributing use, though problematic, is necessary due to the variable nature of demand on the resource and the fact that increased use imposes an external cost on all users. Without some form of legal rights (including sharing rules), there is no means of determining use priority by which spectrum users can exclude others. To the extent technical measures can be used to tolerate competing uses, such prioritization is unnecessary.

The Broadband PCS licensee is afforded the privilege to use much higher power RF, giving the licensee the ability to cover a large geographic area with service. Within these service areas, the licensee's use is not subject to the collective background emissions of unlicensed and errant users that would degrade its communications channel. Free from the cost of other uses, the licensee is able to coordinate the spectrum use within its band. It typically does so by the spectrum-sharing technologies incorporated in its network, such as Code Division Multiple Access ("CDMA")¹³² or Time Division Multiple Access ("TDMA").¹³³ Driven by competitive pressures

¹³² CDMA is "a digital, spread spectrum, packet based access technique generally used in RF radio systems." NEWTON'S TELECOM DICTIONARY 210 (22nd ed. 2006).

¹³³ TDMA is defined as "[o]ne of several technologies used to separate multiple conversation transmissions over a finite frequency allocation of through-the-air bandwidth." *Id.* at 892.

from wireless service providers operating in other bands, the licensee strives to maximize use within its band.¹³⁴ Such a spectrum licensee will optimize its efficiency of use due in part to its technical advantages in coordination over unlicensed operation.¹³⁵ There is little incentive for such licensees to take on the costs associated with deploying more sophisticated, robust receivers to reduce unusable spectrum, which would enable other users to share the band.¹³⁶ The licensee will set its level of spectral efficiency so as to maximize its profits. This set level does not directly equate to the best possible level of use socially, and may in fact fall below that amount.

License regimes with an imposed sharing technique are generally more efficient than those in which competing uses are not coordinated. Total social welfare, however, may be greater under the uncoordinated system if the cost of mitigating interference is slight as compared to the efficiency gain. The cost of interference, which may be intolerable to Broadband PCS users, might be perfectly acceptable to an unlicensed user not paying recurring fees.¹³⁷ However, the fact that unlicensed devices are an increasingly viable means of communication runs contrary to the conventional wisdom that without the formal regulation and licensing of radio operations, interference inevitably will lead to the tragedy of the commons. As a technical matter, because they receive no interference protection, unlicensed devices have to be designed to be robust enough to tolerate a hostile environment, if they are to work at all.¹³⁸ In general, this survivability approach is how unlicensed devices deal with interference.

The rules governing U-PCS include additional limitations on the emission of RF energy, however, that change the regulatory analysis. The emission privilege is limited by a spectrum etiquette mandated for unlicensed

¹³⁴ See *In re Unlicensed and Unshackled: A Joint OSP-OET White Paper on Unlicensed Devices and Their Regulatory Issues*, *Comments of AT&T Wireless Services, Inc.*, ET Docket No. 03-126, at 5 (Aug. 21, 2003) (accessible via FCC Electronic Comment Filing System).

¹³⁵ See James B. Speta, *A Vision of Internet Openness by Government Fiat*, 96 NW. U. L. REV. 1553, 1572 (2002) ("Where there is a single licensee either operating its own service or acting as a bandwidth manager, that licensee can mandate the use of equipment or protocols that fully utilize the spectrum. But where each device controls itself, the best that can be done is to use protocols that permit the spectrum to be used approximately sixty percent of the time.").

¹³⁶ This may be conceptually similar to the obligation for motorists to install mufflers in their cars. The muffler is a cost burden that the motorist might not normally undertake unless he is particularly sensitive to noise. However, the resulting externality of no motorist installing a muffler might be that the average highway would be unacceptably loud to those using it and certainly to those living nearby.

¹³⁷ Carter, *supra* note 19, at 13-21.

¹³⁸ *Id.* Due to the comparatively hostile spectral environment, highly efficient technologies such as spread spectrum, UWB, and OFDM have been evolved and provide some relief from the problem of interference. *Id.*

PCS devices. The etiquette, in the form of a “listen-before-talk” rule, is a spectrum-sharing technique that reduces the probability of conflicting signals by requiring the devices to monitor for other spectrum signals for a fixed period of time before emitting their own.¹³⁹ U-PCS devices must also limit transmission for a fixed duration.¹⁴⁰ Limitation on the privilege to emit radio energy increases overall use efficiency by allowing one spectrum user to use the spectrum while other users are idle.¹⁴¹ This is the only instance of an etiquette mandated on spectrum devices in the Commission’s rules.¹⁴²

U-PCS is the only spectrum use on which the FCC has imposed an etiquette requirement.¹⁴³ The Commission considered a similar etiquette when it created rules for unlicensed operation under another section of Part 15, termed the Unlicensed National Information Infrastructure (“U-NII”).¹⁴⁴ In that proceeding, the FCC ultimately rejected mandatory spectrum etiquette for U-NII devices.¹⁴⁵ The U-NII order instead allowed for the market to develop technique-specific designs for spectrum sharing.¹⁴⁶ U-NII devices, such as Wi-Fi, can provide the same functionality as U-PCS devices without having to obey the spectrum etiquette obligations.¹⁴⁷ Sales of these devices (employing fault-tolerant receivers and industry sharing standards) have surged while U-PCS devices have not been so pervasive. U-PCS industry associations such as UTAM/WINForum contend that among the reasons for the lack of widespread development of U-PCS is the strict Part 15 spectrum etiquette required by the rules.¹⁴⁸ When com-

¹³⁹ This can be compared to a dinner conversation where speakers give deference to other speakers for purposes of politeness and conversational efficiency. See Patrick S. Ryan, *Application of the Public-Trust Doctrine of Natural Resource Management to Electromagnetic Spectrum*, 10 MICH. TELECOMM. & TECH. L. REV. 285, 298 (2004).

¹⁴⁰ An upper limit on duration may increase spectral inefficiency if the limit is not chosen with regard to optimal performance. See Durga P. Satapathy & Jon M. Peha, *Performance of Unlicensed Devices with a Spectrum Etiquette*, 1 PROCEEDINGS OF IEEE GLOBECOM 414, 416 (Nov. 1997).

¹⁴¹ *Id.* at 414.

¹⁴² *Id.*

¹⁴³ This requirement is now all but moot. See *supra* notes 123–25 and accompanying text.

¹⁴⁴ See 47 C.F.R. §§15.401–15.407 (2005).

¹⁴⁵ *In re* Amendment of the Commission’s Rules to Provide for Operation of Unlicensed NII Devices in the 5 GHz Frequency Range, *Report and Order*, 12 F.C.C.R. 1576, ¶¶ 63–71 (Jan. 9, 1997).

¹⁴⁶ See Yochai Benkler, *Overcoming Agoraphobia: Building the Commons of the Digitally Networked Environment*, 11 HARV. J.L. & TECH. 287, 335 (1998) (“This proposal would have, in effect, chosen one spectrum-sharing technique. While reasonable, it is not the sole option for operating without interference. The Commission decided to avoid technique-specific regulation, and to allow equipment manufacturers flexibility in designing their system.”).

¹⁴⁷ See *supra* notes 123–25 and accompanying text.

¹⁴⁸ Reply Comments of UTAM, Inc./WINForum, *supra* note 113, at 5–6.

paring between classes of Part 15 devices, the minimal set of access protocol rules governing power density of the U-NII world may be sufficient to distribute uses without establishing legal priority.¹⁴⁹

The Part 15 Rules, which strictly protect legal priority for licensed users, have been very effective in ensuring that interference caused by unlicensed devices have not presented a major problem.¹⁵⁰ The enforcement actions taken by the FCC's Enforcement Bureau against individual Part 15 users have received relatively little notice in spectrum policy debates. Perhaps this is due to the FCC's effective control over interference through requiring manufacturers to subject their devices to the Part 15 authorization process. Normally, interference cases occur when Part 15 devices become faulty and cause intermittent interference to licensed services, lasting anywhere from a few minutes to a few hours. After a brief investigation, the source of the interference is usually identified by FCC field personnel and the faulty equipment is repaired or replaced at the owner's cost. In fact, between 2000 and 2004 the FCC took action in 35,993 cases, of which 3,838 were interference-related cases. Of the interference cases, only 65—a scant 1.69%—were cases involving Part 15 of the FCC's rules.¹⁵¹ In addition, UTAM reports that there have been no instances of interference between U-PCS and microwave users.¹⁵²

What we can conclude is that when the cost of interference is less than the benefit of being free from the cost associated with a licensed regime, an unlicensed regime is likely to benefit spectrum users. A certain amount of interference between devices is acceptable; however, beyond a certain limit it constitutes harmful interference and therefore will require some form of external intervention to distribute competing use.

B. Relocation

PCS provides the only glimpse of how an unlicensed regime fairs in relocating incumbent spectrum users. Unlicensed operation has traditionally been afforded through underlay rights without the need to relocate incumbent spectrum users. With the exception of unlicensed PCS, there is really no such thing as “unlicensed spectrum.”¹⁵³ Rather, unlicensed devices are

¹⁴⁹ Benkler, *supra* note 146, at 335.

¹⁵⁰ It can be argued that the dearth of interference cases suggest that the Part 15 rules are overly stringent, not allowing for more flexibility which might result in a greater number of interference problems. Such an argument might hold that the benefit of greater flexibility (higher power levels, fewer restrictions on wave modulation, etc.) would outweigh the cost of any increased interference.

¹⁵¹ Special thanks to George Dillon of the FCC's Enforcement Bureau, who was indispensable in obtaining these examples from the Commission's documents.

¹⁵² *In re Amendment of the Commission's Rules to Establish New Personal Communications Devices*, UTAM Report to the FCC, GEN Docket No. 90-314, at 1 (July 1, 2005).

¹⁵³ See 47 C.F.R. § 2.106 (2005).

permitted, with caveats, to emit RF radiation in almost any portion of the spectrum, even in frequency bands for which licenses have been granted. Most operations share the spectrum with other radio services in those bands that have been allocated to industrial, scientific and medical equipment (“ISM”).¹⁵⁴ Therefore, the evidence indicates that a regime comprised of a small number of licensed service providers can be more effective at relocation than when the cost of band clearing is borne by the sales of end-user equipment.

The relocation of existing users may be essential to ensuring that spectrum is put to its best use. Relocating incumbent users presents agency, hold-out, strategic behavior, transaction cost, and externality problems.¹⁵⁵ The experience in clearing the incumbent, non-government, point-to-point, fixed microwave links which previously occupied the bands, has presented problems for both licensed and unlicensed PCS. Relocation is one way to prevent the problem of interference, but presents additional concerns regarding uncertainty of future use and the need to finance the relocation in advance of these future uses. Since one cannot tell in advance, due to the variability of communications demand, where and when rival uses between the incumbent and new user will occur, it is necessary to first remove the existing user, deploy a network of equipment where use is likely to be, and then sell final service.¹⁵⁶

In order to achieve relocation, the rules stipulate a voluntary negotiation period followed by a mandatory negotiation period during which new PCS licensees could arrange to relocate incumbent users.¹⁵⁷ In addition, common relocation costs could be shared among licensees through an FCC-approved plan implementing the clearing houses, PCIA and ITA. By contrast, UTAM, the clearinghouse selected by the FCC to relocate incumbent microwave links in the unlicensed band, collects a fee based on equipment sold in order to cover the necessary costs, averaging these costs nationwide. UTAM/WINForum has asserted that “delays in the widespread development of U-PCS are due to the ongoing relocation of microwave incumbents from the U-PCS band.”¹⁵⁸ Financing this form of relocation depends on the sale of service by a handful of sources. This arrangement presented agency problems such as a reduced ability to relocate the most worthwhile links first. Comparatively, licensees with the right to interference protection can better raise capital. In addition, the profit motive ensures better prioritization and the averaging of costs from relocation of worthwhile and less worthwhile links.

¹⁵⁴ See 47 C.F.R. pt. 18.

¹⁵⁵ See generally Peter Cramton et al., *Efficient Relocation of Spectrum Incumbents*, 41 J.L. & ECON. 647 (1998).

¹⁵⁶ See *supra* notes 35–40 and accompanying text.

¹⁵⁷ See 47 C.F.R. § 90.677 (2005).

¹⁵⁸ Reply Comments of UTAM, Inc./WINForum, *supra* note 113, at 23.

One other requirement necessary to completing relocation for U-PCS devices has the unintended consequence of actually changing, in effect, the rights regime. Unlicensed PCS handset devices must contain a feature that ensures it will only operate in a location where a U-PCS installation has been approved by UTAM. This requirement, intended to resolve interference by tying operation to geography, is in effect a license. The requirement is a prerequisite to the grant of the privilege to emit radio energy. The fact that the grant of the privilege comes not from the FCC directly, but indirectly from the band manager, UTAM, does not alter the analysis.

V. CONCLUSION

Licensed and unlicensed spectrum regimes are important policy tools for governing communications networks. The property rights debate between licensed and unlicensed operation is not so simplistic an inquiry as to result in only one prevailing regime. Instead, the FCC faces the far more difficult task of integrating both regimes in parallel while minimizing the negative impacts of each.

A side-by-side comparison leads to the conclusion that U-PCS is not truly unlicensed. The licensed versus unlicensed paradigm therefore breaks down because it shows that, in some way, both classes of service have the same form of legal relations. In order to effectively relocate incumbent users, a licensed regime may be necessary, but it is not sufficient. The privilege of emitting radio energy should be coupled with the right to be free from harmful interference to compensate for the cost of band-clearing. Instead of completing relocation through the sales of unlicensed devices, relocation for unlicensed devices might be accomplished by prescription, rules ending the licensees expectation of license renewal, or some form of national trust fund.¹⁵⁹ In sum, relocation will be an important part not merely in the property rights debate, but as an integral part of a well-considered and forward-looking approach to policy reform, encouraging efficient spectrum use, balancing competing demands, and advancing the public interests.

¹⁵⁹ See e.g., Commercial Spectrum Enhancement Act, Bill Number H.R.1320, 108th Congress (creating a trust fund to relocate federal users from the 216–220 MHz, 1432–1435 MHz, 1710–1755 MHz, and 2385–2390 MHz bands and enabling auctions for new users with a reserve price 110% of estimated relocation costs).