

APPLICATION OF THE PUBLIC-TRUST DOCTRINE AND PRINCIPLES OF NATURAL RESOURCE MANAGEMENT TO ELECTROMAGNETIC SPECTRUM

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Cite as: Patrick S. Ryan, *Application of the Public-Trust Doctrine and Principles of Natural Resource Management to Electromagnetic Spectrum*, 10 MICH. TELECOMM. TECH. L. REV. 285 (2004), available at <http://www.mttl.org/volten/Ryan.pdf>

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[S]o neither can the king intrude upon the common property, thus understood, and appropriate it to himself or the fiscal purposes of the nation, the enjoyment of it is a natural right which cannot be infringed or taken away, unless by arbitrary power, and that, in theory at least, could not exist in a free government

—Arnold v. Mundy¹

INTRODUCTION

The Electromagnetic spectrum is among our most valuable natural resources. Yet while the past few decades have seen a rich body of environmental law develop for other natural resources, this movement has largely passed over the electromagnetic spectrum. This Article argues that to remedy that situation, the public-trust doctrine, which is now a cornerstone of modern environmental law,² should be extended to the electromagnetic spectrum. This extension would not be a leap: the public-trust doctrine has already been used to guarantee the public access to various bodies of water (not just navigable water),³ and to protect recreational lakes and beaches,⁴ wildlife preserves,⁵ and even the air.⁶ Electromagnetic spectrum is at least as valuable as these other resources, so access to it should be similarly guaranteed in order for the public to enjoy its full potential.

This Article will first show that there is a problem with the way that the electromagnetic spectrum is regulated, that its regulation stifles innovation and has favored incumbents by wrongly giving them exclusive

1. 6 N.J.L. 1, 50 (N.J. 1821).

2. See Joseph L. Sax, *The Public-Trust Doctrine in Natural Resource Law: Effective Judicial Intervention*, 68 MICH. L. REV. 471 (1970) (being one of the most influential and most-cited law review articles ever written); see also Heidi Gorovitz Robertson, *Methods on Teaching Environmental Law: Some Thoughts on Providing Access to the Environmental Law System*, 23 COLUM. J. ENVTL. L. 237, 254–56 (1998) (describing Sax's influence on environmental-law scholarship and discussing many of his proposals for teaching environmental law).

3. *Phillips Petroleum Co. v. Mississippi*, 484 U.S. 469 (1988) (expanding the public-trust doctrine's application from navigable water to any body of water regardless of its proximity to navigable water).

4. *Nat'l Audobon Soc'y v. Superior Court (Mono Lake)*, 658 P.2d 709 (Cal. 1983) (applying the public-trust doctrine to a lake's recreational and ecological public-trust values); see also *Matthews v. Bay Head Improvement Association*, 471 A.2d 355 (N.J. 1984) (expanding the public-trust doctrine to mandate access over dry land on private property to a public intertidal zone).

5. *Owsichek v. Alaska Licensing & Control Bd.*, 763 P.2d 488, 493 (Alaska 1988) (enlarging the public-trust doctrine's application to "wildlife" on the basis of an interpretation of the public trust in the Alaska Constitution).

6. *Save Ourselves, Inc. v. Louisiana Envtl. Control Comm'n*, 452 So. 2d 1152, 1154 (La. 1984) (acknowledging that all natural resources, including air, are potentially covered by the public-trust doctrine).

access to a natural resource at no charge, and that the situation has been exacerbated by mistakenly assuming that auctions are a panacea for past spectrum-allocation problems. The Article will then argue that the public-trust doctrine, as well as other more general concepts borrowed from environmental-law scholarship—such as sustainable consumption, electromagnetic pollution, and ecological imbalance—should be imported into a new spectrum-management paradigm. Two technologies, Ultra-Wideband and Software Defined Radio, may be well-suited for a new regulatory paradigm that is freer than the one that the spectrum has always had, and that provides for access to the spectrum's being guaranteed by the public-trust doctrine.

I. THE WAY THE SPECTRUM IS PRESENTLY REGULATED AND WHAT IS WRONG WITH IT

The electromagnetic spectrum is regulated in a way that causes it to be utilized inefficiently, and the only practical way to rectify that situation is for courts to apply the public-trust doctrine to the spectrum. However, to realize why change is needed in the way the spectrum is regulated, we must look first at the way that the spectrum is regulated, then see how the present regulatory scheme developed historically and, finally, evaluate whether that regulatory scheme is adequate for present-day technologies. Only in that way will the defects in the present regulatory system, and the need to remedy the situation with the public-trust doctrine, become apparent.

A. Command and Control

At present the FCC employs a command and control philosophy to manage the electromagnetic spectrum.⁷ This means that the FCC centrally controls the spectrum, that neither individuals nor companies may broadcast on it without first getting the FCC's permission in the form of a license, and that they must later go back to the FCC for permission to make any changes in the way they use the license. FCC Chairman Michael Powell has described this system of regulation as a paternalistic, "mother may I" relationship:

While the wireless world has changed rapidly, government spectrum policy continues to be constrained by allocation and licensing systems from a bygone era. Change is inhibited by the "mother may I" phenomenon—businesses must go to the FCC

7. See *supra* Section II for further elaboration on command and control and its historical roots.

for permission before they can modify their spectrum plans to respond to consumer demand.⁸

Under such a paternalistic, command and control regime, the government *attempts* to avoid market inefficiencies by centralized decision making akin to a communist-style, centrally-planned program. In doing so, the government truncates economic experimentation, stifles innovation, and substitutes inefficient theoretical models for natural economic progress. Under the current FCC system, nearly *every activity* is separately licensed, and these licenses require individual, separate amendments and approvals for any change to existing technology or use. For example, an unused television channel in rural Wyoming could not be used for bringing Internet services to a remote town because television broadcasting channels must only be used for broadcasting television content.⁹ Television broadcasters are *commanded* by the FCC to use the frequency *only* for television broadcasting,¹⁰ and any change to an FCC command is then *controlled* by complicated procedures under the Administrative Procedure Act (“APA”),¹¹ which sets forth due-process requirements for enacting most FCC rules.

1. Low-Power FM Radio

There are many examples of how FCC command and control stifles innovation and even free speech; one case being the non-profit organizations such as schools, churches, and others who hoped to operate their own low-power¹² FM radio stations.¹³ The theory for allowing new low-power radio stations was simple: now that most radio receivers have digital “dials,” making it possible for a user to precisely access, say, 89.5 FM on her radio instead of approximating a range in the vicinity of 89.5 (an older radio dial would cover a range of about 89.3 to 89.7 FM at any given time), these new low-power FM broadcasters could send signals at

8. Michael K. Powell, Broadband Migration III: New Directions in Wireless Policy, Remarks at the Silicon Flatirons Telecommunications Program, University of Colorado at Boulder (October 30, 2002), available at <http://www.fcc.gov/Speeches/Powell/2002/spmcp212.html>.

9. See, e.g., 47 C.F.R. § 73.609 (2002) (delineating specific television broadcast zones); 47 C.F.R. § 73.277 (2002) (specifying that all transmissions must comply with uses specific to the applicable transmission license).

10. Ironically, broadcasters may also opt to simply leave the spectrum unused. See discussion *infra* Section II.D.

11. 5 U.S.C. § 553 (1993).

12. The FM stations are said to be “low power” because they transmit at low levels with a limited reach. For example, a low-power station would only reach intended listeners within a few miles radius, rather than the hundreds of miles that some standard (high-power) FM broadcasters use.

13. DAVID BOLLIER, SILENT THEFT 152 (2002).

low power over a very specific frequency and reach their intended listeners without disturbing existing high-power broadcasters.

Like older trains whose tracks needed to be surrounded by open land lest everything burn in their path from flying sparks,¹⁴ traditional high-power broadcasters clumsily transmitted their signals over an unnecessarily wide range occupying multiple frequencies at once, burning the surrounding spectrum. Now that digital tuning permits more precise “dialing” and digital displays have replaced most radio dials (just as diesel motors have replaced coal burning trains, and as CDs and MP3s have replaced analog tapes), more broadcasters can technically use the frequencies that lie between the existing broadcasters by transmitting on specific frequencies at low power.¹⁵ Schools, churches and community organizations loved the idea, and the FCC received more than 1,200 applications for the frequencies.¹⁶ However, the massive broadcasting lobby intervened, and government decided instead to reduce the number of low-power FM radio stations by 75 percent.¹⁷ While the epitaph for the low-power FM initiative has not yet been written, circumstantial evidence shows that the idea may already be dead or dying because the FCC restrictions have made many business plans unviable.¹⁸ As one commentator stated, the FCC standards for low-power FM were such that it would be impossible for even a toaster to comply with them.¹⁹ Consequently, the low-power broadcasters had to withdraw their applications from urban areas, where they would have been the most useful.

14. Much discussion about property rights and torts has arisen from this example. See *LeRoy Fibre Co., v. Chicago Milwaukee & St. Paul R.R.*, 232 U.S. 340 (1914), a famous railroad dispute where the plaintiff sued the railroad for sparks from a train which burned his crops. The railroad said that the plaintiff unreasonably stacked his crops too close to the railroad's tracks, even though the crops were on plaintiff's own property. Although the plaintiff won, in Justice Holmes' convincing dissent he suggested that the farmer may have been negligent if other, more sensible stacking locations were available. See also Ronald H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 30-33 (1960). Coase essentially embraces Holmes' dissent, applying what is known now as the “Coase Theorem,” suggesting that the farmer should be liable if he is the cheaper cost avoider of the damage.

15. See Heavenly Music, *THE ECONOMIST*, March 14, 2002, at 16, 20-21 (describing the additional frequencies on either side of a broadcaster as “saddle bags on a horse” and noting that incumbent broadcasters have much to lose by additional competitors, which would threaten to cut into their advertising revenue).

16. *Id.*

17. *Id.*

18. See Michael Roberts, *Frequency Free-for-All*, WESTWORD, Oct. 11, 2001, available at <http://www.westword.com/issues/2001-10-11/message.html> (describing the complex rules and stating that only a few remote stations will likely be operating).

19. Stuart M. Benjamin, *The Logic of Scarcity: Idle Spectrum as a First Amendment Violation*, 52 DUKE L.J. 1, 14 (2002).

2. One-Way Paging and Cordless Phones

Another example of how FCC regulations stifle innovation was seen when it prohibited early cellular-phone operators from deploying certain features, such as Short Messaging Services (SMS),²⁰ which had been popular in Europe since wireless phones had first been launched there.²¹ Perhaps unintentionally, the FCC policy protected competitors instead of encouraging competition, since cellular companies not being allowed to send alphanumeric text to their subscribers without FCC authorization helped the pager companies, who did transmit such text. Then, however, an amendment to the rules²² later allowed cell-phone companies to transmit text, which hurt many paging companies that had deployed expensive networks in reliance upon the earlier regulations. Ultimately, advanced cellular services and PCS licenses forced paging companies to seek death embraces with former paging competitors through consolidation,²³ or go straight for Chapter 7 liquidation bankruptcy.²⁴ Traditional paging licenses still exist, but they only allow one-way signals, which do not allow the receiving party to reply.²⁵ This restriction will inevitably die out in the coming years in favor of two-way communications,²⁶ requiring operators to obtain separate licenses for operating on different

20. It is technically possible for digital services, such as SMS and data to be sent over any frequency, but uses were heavily regulated. Many cellular operators responded by selling their licenses and buying PCS licenses instead. See Alex Markels and Joann Lublin, *AT&T: The Second Breakup*, WALL ST. J., Sept. 21, 1995, at B10 (discussing profitable cellular companies' strategic decision to sell their businesses in order to buy PCS licenses and sell new services).

21. See *The Tortoise and the Hare*, THE ECONOMIST, March 16, 2002 at 63. Note that in Europe paging never really took off because consumers could both send and receive messages from their mobile phones in addition to using them for voice services. See Connie Ling, *Text-Messaging System's Popularity Surges*, WALL ST. J. EUROPE, Oct. 24, 2001, at 24 (attributing the development of SMS to Europe's governmental coordination and standardization through the GSM group and noting that it is extremely popular and very profitable).

22. See Amendment of Parts 2 & 22 of the Comm'n Rules to Permit Liberalization of Tech. & Auxiliary Serv. Offerings in the Domestic Pub. Cellular Radio Telecomm. Serv., 5 F.C.C.R. 1138 (1990) (memorandum opinion and order).

23. See William Glanz, *Beeper Rivals Combine in Bid to Diminish Debts*, THE WASH. TIMES, Apr. 3, 2001, at B9 (detailing struggling paging companies Metrocall's and Web Link Wireless's plans to merge operations and then file for bankruptcy protection, because they were over-saddled with debt in a shrinking market).

24. Yuki Noguchi, *Pager Firm is Latest to Pull the Plug*, THE WASH. POST, Dec. 7, 2000, at E5 (discussing the Chapter 7 liquidation filing of TSR paging, which was once the U.S.'s sixth-largest paging company).

25. For a description of traditional paging definitions and licenses, see FCC Website on Paging at <http://wireless.fcc.gov/services/paging/>.

26. See Yuki Noguchi, *Paging Oblivion*, THE WASH. POST, May 28, 2001, at E1 (explaining one-way paging's uncompetitiveness in the face of other services such as two-way messaging and mobile phones).

channels.²⁷ The spectrum that has been allocated for one-way paging is a confusing mixture of hundreds of individual site licenses and geographical licenses,²⁸ and as it dies off the frequencies will have to be reassigned for other purposes lest they remain underused or idle.²⁹ In essence, an entire industry was created and then disassembled over the period of a few years through government's central planning.

The foregoing example and others like it make the FCC an easy target for cynicism because it has long been a proponent of centralized planning. Many readers will recall that it used to be strictly prohibited for a US citizen to plug any device into a home telephone outlet that was not produced and installed by a Bell company.³⁰ Similarly, 1980s cordless-phone technology was not substantially different from that used in children's walkie-talkies after the fifties, but centralized planning required private industry to wait several decades for a technological matrimony between walkie-talkies and telephones.³¹

The government is not blind to the quite obvious problem that FCC regulations are needlessly complex, inhibit innovation, and lead to inefficient spectrum allocation. This very fact has been openly acknowledged by President George W. Bush in a Presidential Memorandum:

The existing legal and policy framework for spectrum management has not kept pace with the dramatic changes in technology and spectrum use. Under the existing framework, the Government

27. Most forms of two-way communications require separate licenses, such as cellular, PCS, ESMR, etc. Two-way paging also requires a different license than one-way paging. *See Charles P. B. Pinson, Inc. v. F.C.C.*, 321 F.2d 372, 373 (D.C. Cir. 1963) (describing the separate licenses required for one-way and two-way paging in the context of a license renewal hearing).

28. Bennett Z. Kobb, *WIRELESS SPECTRUM FINDER* 21 (2001).

29. *See In the Matter of Revision and Update of Part 22 of the Public Mobile Radio Services Rules*, 95 F.C.C.2d 769, § 107 (1983) (explaining that in the early 1980s paging was seen as an important growth area, and many new channels were allocated to it by administrative fiat: "in each community nationwide there are now a total of 73 paging channels available where there used to be only 8. . . . Only in a handful of cities have we received more applications . . . than there are frequencies available. To state the situation broadly, virtually all those who want paging channels can apply for and receive them").

30. *See In re Use of Carterfone Device in Message Toll Telephone Service*, 13 F.C.C.2d 420 (1968) (citing the then-applicable FCC regulation's prohibition on customer-connected equipment ("[n]o equipment, apparatus, circuit or device not furnished by the telephone company shall be attached to or connected with the facilities furnished by the telephone company, whether physically, by induction or otherwise"), and allowing users to install their own equipment as long as it fit within certain guidelines).

31. *See* Steve Bickerstaff, *Shackles on the Giant: How the Federal Government Created Microsoft, Personal Computers, and the Internet*, 78 TEX. L. REV. 1 (1999) (recounting the history of the Bell companies' deregulation and the many battles that were needed to allow users to connect terminal equipment not provided by the Bell system).

generally reviews every change in spectrum use, a process that is often slow and inflexible, *and can discourage the introduction of new technology*. Some spectrum users, including Government agencies, maintain that the existing spectrum process is insufficiently responsive. . . .³²

Low-power FM, paging, and cordless phones are all examples of past problems that validate President Bush's assertions. Although the President has set up special committees to study the problem,³³ it is unlikely that change will take place quickly. Turning to the future, new technologies such as Ultra-Wideband and Software Defined Radio (described below in Section III) continue to be stifled by this command and control system.

B. Is Command And Control Always Bad, Or Is It A Matter of Application?

Command and control, while perhaps too restrictive when applied to the *entire* electromagnetic spectrum (as it is today),³⁴ is not necessarily wrong in all instances if it is narrowly applied to the *devices* and people that access it. In environmental law, after all, command and control has successfully created liability mechanisms that hold corporate officers accountable for complying with emissions standards that govern the toxic substances of their factories, machinery, and products.³⁵ Here, regulation threatens the company and its officers with fines and other forms of liability, rather than hijacking the resources that they use; and it has had a direct effect on the devices that they employ in their businesses.³⁶ This can be a useful paradigm for wireless communications as the emphasis moves increasingly away from a regulatory bear-hug on the entire resource, thereby opening it up to advances in science and technology.

The difference between regulating a resource and regulating devices that gain access to it can be illustrated by a simple environmental example: the government regulates automobile emissions not through severe restrictions upon the natural resources involved in operating an

32. Memorandum on Spectrum Policy for the 21st Century, 39 PUB. PAPERS 23 (May 29, 2003) (emphasis added) [hereinafter Presidential Memo on Spectrum Policy].

33. *See id.*

34. With limited exceptions, such as some the 2.4 GHz used for "WiFi," garage door openers, cordless phones, etc.

35. *See* Michael P. Vandenberg, *The Social Meaning of Command and Control*, 20 VA. ENVTL. L.J. 191, 196 (2001) (describing two generations of "command and control," with the first, of the 70s and 80s, attaching to the "low hanging fruit" of large, industrial polluters, and the second generation (which is perhaps more relevant to the problem found in wireless) consisting of "individuals" who are "diffuse," "small," and sometimes "non-point" sources").

36. *See, e.g., United States v. Aceto Agr. Chems. Corp.*, 872 F.2d 1373, 1375 (8th Cir. 1989) (attaching disposal liability to pesticide manufacturers).

automobile (such as the land it drives upon), but instead by regulating the motor's output characteristics³⁷ through its appurtenances (such as a catalytic converter for the exhaust system),³⁸ and measures compliance by testing the exhaust fumes. Most state automotive-emissions programs have a two or three-pronged approach that compare the motor's characteristics to the manufacturer's specifications,³⁹ attach an exhaust probe to see that output is within specifications,⁴⁰ and regulate the automobile's consumable (such as gasoline) to ensure that it burns within specified standards without the draconian step of rationing fuel.⁴¹ The natural resources themselves are left alone, but the devices that use them (i.e., the automobiles and their motors) *are* regulated. The electromagnetic spectrum, however, does not benefit from this type of sensible regulation.⁴²

With electromagnetic spectrum, the resource itself is regulated. There are also device restrictions, but they are disproportionately applied and antiquated. As FCC Chairman Powell has stated, there has been much more emphasis on transmitters than receivers,⁴³ more specifically on *who* transmits.⁴⁴ At least half the equation, consisting of the resource's consumer and her receiver, is missing from the regulatory scheme, while a sweeping overlay of regulation commands and controls the entire resource.⁴⁵

37. See Thomas O. McGarity, *Regulating Commuters to Clear the Air: Some Difficulties in Implementing a National Program at the Local Level*, 27 PAC. L.J. 1521, 1536–37 (1996) (discussing manufacturers' role in vehicle emissions, which was one of voluntary cooperation in 1954 that became obligatory after Congress passed the Motor Vehicle Air Pollution Control Act in 1965).

38. *Id.* (discussing catalytic converters and the role of other pollution-control devices).

39. *Id.* at 1528–30 (discussing the role of inspection-and-maintenance organizations to verify compliance, including the visual-inspection component, with it being assumed that the original manufacturer specifications complied with rules and regulations in force at the time of the motor's release into the stream of commerce).

40. *Id.* (noting that relatively inexpensive equipment exists for tailpipe testing, and that more expensive equipment is available to test emissions under simulated road conditions).

41. *Id.* at 1561 (discussing leaded gasoline's phase-out).

42. The preceding analogy is inspired by LAWRENCE LESSIG, *THE FUTURE OF IDEAS: THE FATE OF THE COMMONS IN A CONNECTED WORLD* 76–77 (2002). Lessig discusses the highway system and notes that regulations control the devices that can be used on the highway but they do not control who goes where.

43. Powell, *supra* note 8. Airwaves are first allocated into separate "licenses," and then the licenses are given to "licensees." The license itself regulates the use, or purpose, and the FCC exerts a double role to make sure that the licensees comply with the license. The FCC can also change the terms of the license.

44. See Thomas W. Hazlett, *Physical Scarcity, Rent Seeking, and the First Amendment*, 97 COLUM. L. REV. 905, 926 (1997) (describing the "vacuity" of the notion of physical scarcity, and noting that technological improvements in transmitters and receivers can dramatically improve frequencies' use).

45. Lessig, Benkler, and Benjamin (and many others) have advanced convincing arguments that this sweeping regulation is an unconstitutional breach of free speech. See

C. A Cacophony of Competing Regulations

If one problem with FCC regulation of the electromagnetic spectrum is its command and control philosophy applied to the natural resource itself, another is the FCC regulations' vast complexity. Reading the FCC regulations requires lots of post-its, bookmarks, paperclips, patience and, quite often, highly-specialized legal advice. FCC Part 15,⁴⁶ for example, pertains to devices operating in unlicensed frequencies below a certain power threshold, but Part 15 also includes certain spectrum areas that are "prohibited" from *any* broadcast, such as the FAA and other frequencies used for military or safety applications.

FCC Part 2⁴⁷ is a massive collection of technical data sprawling several hundred pages. It covers international regulations, nomenclature and assignment of frequencies, and the complete table of frequency allocations. FCC Part 68 regulates the connection of terminal equipment to the telephone network,⁴⁸ and any device that is regulated under Part 68, such as the limits set for intentional and unintentional radiation, must also comply with Part 15's provisions. Part 68 is important for future wireless applications, because any change in FCC regulation or policy is likely to affect all the interrelated FCC compliance regulations simultaneously.

Even the most banal wireless applications (such as cordless phones) are regulated under Part 68 (for their connection to the network), Part 15 (for their radiation limitations in broadcasting capacity), and Part 2 (for their placement in the frequency allocation zoning map). The trend suggests that future technologies are likely to increase dramatically the existing confusion in the FCC regulations. While regulators used to be able to categorize transmitters and receivers with relative ease in a long-gone era when television and radio were the primary subjects of regulation, new technological advances are supplanting these categorizations and creating hybrid applications that no longer fit neatly within any single FCC provision. Examples of these re-categorizations include frequencies originally intended for UHF television that have been reallocated for cellular,⁴⁹ and frequencies originally intended for garage-door

LAWRENCE LESSIG, CODE AND OTHER LAWS OF CYBERSPACE 182 (1999); Yochai Benkler & Lawrence Lessig, *Net Gains*, NEW REPUBLIC, December 14, 1998, at 12; Benjamin, *supra* note 19.

46. 47 C.F.R. § 15 (1998).

47. Frequency Allocations and Radio Treaty Matters; General Rules and Regulations, 47 C.F.R. § 2 (1998).

48. Connection of Terminal Equipment to the Telephone Network, 47 C.F.R. § 68 (1998).

49. *See In the Matter of an Inquiry Relative to the Future Use of the Frequency and 806-960 MHz; and Amendment of Parts 2, 18, 21, 73, 74, 89, 91 and 93 of the Rules Relative to Operations in the Land Mobile Service Between 806 and 960 MHz*, 46 F.C.C.2d 752 (1974)

openers⁵⁰ that are now used for cordless phones, wireless in-home LAN, car alarms, and electronic dog fences. Categorization is quickly losing its meaning, and future regulations will likely have to address purely technical criteria rather than application-specific criteria.

Practically every FCC chapter pertaining to one device has relevance to a related broadcasting or receiving device, and little of the regulations is wholly understandable. Also, the regulations as they are written today accommodate legacy technologies and out-of-date references (not unlike Microsoft Windows, which amazingly still takes several minutes to boot because of a concept known as “backwards compatibility”).⁵¹ Frustrated with these complicated regulations, Mr. Frank Burns, a citizen respondent, once filed a concise comment in response to the FCC’s Ultrawideband rulemaking procedure. His comment rings of the dissatisfaction of many citizens:

I want to record my opinion that the widespread availability of wireless spectra [sic] is in the best interests of our ecological human aspirations. Please, in the future, make it possible for ordinary people to understand the issues and voice their opinions—without having first to hire lawyers as translators.⁵²

What should be the work of scientists has been commandeered by lawyers who must draft massive orders modifying dozens of separate regulations at once.⁵³ The emphasis that the FCC has historically placed on law and lawyers over technology has created a highly unbalanced organization. Almost 33 percent of the wireless division’s staff is attorneys, while only 14 percent have a background in the sciences.⁵⁴

(discussing the rulemaking procedure dealing with reallocation of UHF channels for cellular telephone services).

50. The 2.4 GHz frequency band was originally designated for home devices but has now blossomed to include everything from wireless networking to invisible dog fences. See Kenneth R. Carter, Ahmed Lahjouji and Neal McNeil, *Unlicensed and Unshackled: A Joint OSP-OET White Paper on Unlicensed Devices and Their Regulatory Issues*, Federal Communications Commission Office of Engineering Technology, OSP Working Paper No. 39, May 2003, available at <http://www.fcc.gov/osp/workingp.html>.

51. See *Bill’s Big Roll-Out*, THE ECONOMIST, Sept. 18, 1999, at 67 (discussing Windows 2000’s launch and the trade-offs between backward compatibility and system stability).

52. Comment of Frank Burns, filed in Revision of Part 15 of the Commission’s Rules Regarding Ultra-Wideband Transmission Systems, ET Docket, 98-153 F.C.C. (1998), available at http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6005940073.

53. For example, the authorizations for cellular required the modification of at least eight different rules. See 46 F.C.C.2d at 752.

54. Kalpana Srinivasan, *FCC Workers Need Technical Training*, AP ONLINE, Mar. 11, 2001. In the wireless division—at least in 2001—there were almost three times as many lawyers as engineers (100 vs. 35), and almost 1/3 of the entire staff are lawyers (100 out of 315); The article also notes that there was a time in the past when lawyers could “bluff” their way through, but with new technologies this is probably no longer possible.

Although it is far too early to suggest that organizations like the Environmental Protection Agency (“EPA”) should manage electromagnetic spectrum, it is instructive to note that 6 percent of the EPA staff are attorneys while 53 percent are scientists, engineers, or environmental specialists.⁵⁵ Intuitively, the balance of science and law at the EPA seems to make much more sense than the one at the FCC.

D. Recent Redirection in FCC Policy

Happily, it is now the government’s official position that the system of command and control over the disposition of the electromagnetic spectrum can no longer be reconciled with our modern understanding of science and economics. The most obvious manifestation that this is now the government’s position can be seen on the FCC’s website in a section on spectrum policy.⁵⁶ In the summer of 2002, the FCC founded this special section, called the Spectrum Task Force,⁵⁷ and it has committed itself to providing “specific recommendations . . . to *evolve* the current ‘command and control’ approach to spectrum policy into a more integrated, market-oriented approach that provides greater regulatory certainty, while minimizing regulatory intervention.”⁵⁸ Unfortunately, what is needed is not an evolution, but instead a revolution if the FCC is to survive in the world of new technologies and to accommodate market demands for products like Wi-Fi, that are growing at one of the most amazing rates of any commercial product in recent history.⁵⁹

The FCC has been forced to embrace new inventions,⁶⁰ and it has openly acknowledged that its historical role of preventing chaos from

55. See Environmental Protection Agency Website, Human Resources and Organizational Services, EPA’s Workforce—Major Occupations, at <http://www.epa.gov/epahrist/occupate.htm>.

56. See FCC Spectrum Policy Task Force Website, at <http://www.fcc.gov/sptf>.

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

58. See FCC Spectrum Policy Task Force Website, *supra* note 56 (emphasis added).

59. A booklet entitled THE DEFINITIVE GUIDE TO PUBLIC WLAN (BrainHeart Magazine 2003) notes that so far more than 20 million Wi-Fi devices have been sold, and that the integration of Wi-Fi into Intel’s Centrino chip indicates that its proliferation is only at the beginning.

60. See Remarks of Jonathan S. Adelstein, Commissioner, Federal Communications Commission, Workshop on Cognitive Radio Technologies, Office of Engineering and Technology, Federal Communications Commission, Washington, DC (May 19, 2003), available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-234658A1.pdf (holding a workshop on cognitive radio technology, Commissioner Adelstein states “In the broader framework, cognitive radio technologies offer the promise of helping us leave the world of command and control behind and create an environment where a framework for innovation can leverage their potential benefits. The potential of these technologies to ‘do more with less’ can help us make room to accommodate both more users and the newest service offerings.”).

arising from unmanaged frequencies may be made unnecessary by new technology.⁶¹ For today, a “cacophony of competing voices”—the chaos that the FCC was formed to prevent—may not be a problem arising from there being too many speakers, but from the nature of the receivers. FCC chairman Powell has explained that “interference is often more a product of receivers; that is, receivers are too dumb or too sensitive or too cheap to filter out unwanted signals. Yet, our decades-old rules have generally ignored receivers.”⁶² This statement represents the early stages of a welcome policy shift from bear-hug regulation of the entire electromagnetic spectrum to more surgical regulation of the devices that access it.

The new form of regulation may be able to take many forms, such as “etiquette” standards.⁶³ The “etiquette” aspect is rather intuitive, it is a sort of technical mandate for politeness and conversational efficiency. Just as mayhem breaks out when many people try to speak to each other at the same time at dinner or over coffee, spectrum etiquette proposals impose a technical “listen-before-talking” rule that requires devices to monitor its transmissions in polite deference to other speakers.⁶⁴ There are hot technical debates about the details, such as how long one person can speak (transmit), how loud they can speak (transmission power level), etc.,⁶⁵ but the basic framework is simply a listen-before-talking

61. See Powell, *supra* note 8. Clarifying the role of the Spectrum Policy Task Force, Chairman Powell states:

[W]e are still living under a spectrum “management” regime that is 90 years old. It needs a hard look, and in my opinion, a new direction. Historically, I believe there have been four core assumptions underlying spectrum policy: (1) unregulated radio interference will lead to chaos; (2) spectrum is scarce; (3) government command and control of the scarce spectrum resource is the only way chaos can be avoided; and (4) the public interest centers on government choosing the highest and best use of the spectrum. . . . Today’s environment has strained these assumptions to the breaking point. Modern technology has fundamentally changed the nature and extent of spectrum use.

Id.

62. *Red Lion Broad. Co. v. F.C.*, 395 U.S. 367, 376 (1969).

63. Powell, *supra* note 8.

64. See Yoichi Benkler, *Overcoming Agoraphobia: Building the Commons of the Digitally Networked Environment* 11 *Harv. J.L. & Tech.* 287, 334–35 (Winter 1998). Benkler describes the FCC’s consideration and abandonment of “mandated spectrum etiquette” that preceded the U-NII Order.

65. See Durga P. Satapathy & Jon M. Peber, *Performance of Unlicensed Devices With A Spectrum Etiquette*, *Proceedings of IEEE Globecom*, Vol. 1, Nov. 1997, at 414, available at <http://www.contrib.andrew.cmu.edu/usr/dsaq/globecom97.pdf>.

66. See Panel Discussion of Pierre De Vries, Victor Bahl, Stuart Buck, Tim Shepard & Michael Gallagher, *Spectrum Etiquette: Two Proposals*, Conference at Stanford University on Spectrum Policy (March 2, 2003), video available at <http://cyberlaw.stanford.edu/spectrum/schedule/>.

concept. The Internet functions to some extent this way, in the form of de-facto agreements on protocols.⁶⁷

E. A Short History of FCC Regulation of the Spectrum

A discussion of electromagnetic spectrum can never be fully understandable without a brief review of the history and logic behind the still-operational (legacy) system. (Hazlett has advanced a masterful historical recounting,⁶⁸ as have Benjamin et. al,⁶⁹ and Lessig.⁷⁰) Since the purpose of this Article is to expand interest in the spectrum to specialists in other fields (such as environmentalists), it will not be assumed that the reader has knowledge of broadcasting history. The command and control philosophy and the regulations' complexity will be better understood if one comprehends the era that produced them.

1. Logic of the 1927 System

Relative to our interaction with nature, our interaction with wireless technologies is of very recent vintage. It was not until 1897—just barely over one century ago—that Guglielmo Marconi first transmitted a wireless signal,⁷¹ and it took another ten years (1907) for Lee de Forest to develop a workable amplifier and oscillator for broadcast purposes.⁷² A few years later, Congress passed the 1927 Radio Act (which was done in response to a broadcasting crisis),⁷³ long before we really knew how radios worked, and long before mobile-phone technologies were even considered viable.

The 1927 Act was subsumed into the Communications Act of 1934, and the portions of these Acts relating to the electromagnetic spectrum largely applied railroad regulations to communications.⁷⁴ Even today, many of the 1927 Radio Act's basic premises still govern,⁷⁵ in spite of the fact that groundbreaking progress in wireless technology has taken

67. See LESSIG, *supra* note 45, at 184 (noting the distinction between “dumb” and “smart” receivers, and notes the similarities of protocol recognition in the Internet/Internet. Just as different machines have different addresses, the Net sorts out and receives only those packets intended for a given receiver).

68. Thomas W. Hazlett, *The Wireless Craze, the Unlimited Bandwidth Myth, the Spectrum Auction Faux Pas, and the Punchline to Ronald Coase's “Big Joke”: An Essay on Airwave Allocation Policy*, 14 HARV J.L. & TECH. 335 (2001).

69. STUART BENJAMIN, DOUGLAS LICHTMAN & HOWARD SHELANSKI, *TELECOMMUNICATIONS LAW AND POLICY* (2001).

70. LESSIG, *supra* note 42, at 218–33.

71. See SUNGOK HONG, *WIRELESS: FROM MARCONI'S BLACK BOX TO THE AUDION* (2001).

72. *Id.*

73. Hazlett, *supra* note 68, at 367.

74. See Gerald Torres, *Who Owns the Sky*, 19 PACE ENVTL. L. REV. 515, 536 (2002).

75. HONG, *supra* note 71, at 18.

place in the past 20 years. Although the mating of computer technology to spectrum management dates back to the microprocessor's introduction in about 1971,⁷⁶ the first (mass) commercial deployment of digital signalization (as opposed to analogue signalization) was the 1991 GSM launch in Europe.⁷⁷ Other digital standards were simultaneously being developed in the United States, though the first United States commercial mass deployment of a digital standard was the 1993 launch of the Nextel Communications' network.⁷⁸ Thus, since about 1991, a system created to handle 1927 radio technology has been regulating digital radio communications.

But long before digital technology, commentators questioned the efficacy of regulatory bodies such as the FCC. In 1959, economist R. H. Coase was very critical of the FCC and its allocation-by-fiat methodologies,⁷⁹ asking why electromagnetic spectrum should be centrally planned when the rest of our economy was market-based. This critique has taken several decades to emerge, but it has advanced rapidly in recent years, particularly among economists.⁸⁰

To explain the rationale behind the present (i.e. annum 1927) system, Coase selected a quotation from Justice Frankfurter in the famous 1943 case, *NBC v. United States*:

76. See Intel Corporation web site, Celebrating 35 Years of Innovation, at <http://www.intel.com/labs/innovations/> (noting that the microprocessor was introduced in 1971 with the introduction of the 4004 "chip" on a computer).

77. See GSM World, History of GSM, at <http://www.gsmworld.com/about/history>. The web page notes a July 1, 1991 launch date for GSM in Europe. The website also notes that GSM uses a form of Time Division Multiple Access, or TDMA, digital processing and other aspects of GSM.

78. See *Fleet Call, Inc. Changes Name*, WALL ST. J., Mar. 24, 1993, at A5 (describing the system launch planned for August, 1993); see also Gautam Naik & Dennis Kneale, *Radio Flier: Old Dispatch Systems Are Ticket to Riches For Former FCC Man*, WALL ST. J., Aug. 31, 1994, at A1 (noting Nextel's history, its acquisition of numerous dispatch licenses to convert to digital use, and its plan for launching the U.S.'s first nationwide digital network).

79. R. H. Coase, *The Federal Communications Commission*, J.L. & ECON. 1, 12-13 (Oct. 1959).

80. See, e.g., Comments of 37 Concerned Economists, Before the F.C.C., In the Matter of Efficient Use of Spectrum Through Elimination of Barriers to the Development of Secondary Markets, WT Docket No. 00-230 (Feb. 7, 2001), available at <http://www.aei.brookings.org/publications/related/fcc.pdf>. (Accessed July 23, 2003) (enumerating many reasons why the centralized spectrum-allocation system makes no sense). The list of signatories: Martin Neil Baily, Jonathan Baker, Timothy Bresnahan, Ronald Coase, Peter Cramton, Robert W. Crandall, Richard Gilbert, Shane Greenstein, Robert W. Hahn, Robert Hall, Barry Harris, Robert Harris, Jerry A. Hausman, Thomas W. Hazlett, Andrew Joskow, Alfred E. Kahn, Michael Katz, Robert E. Litan, Paul Milgrom, Roger G. Noll, Janusz Ordover, Bruce Owen, Michael Riordan, William Rogerson, Gregory Rosston, Daniel L. Rubinfeld, David Salant, Richard L. Schmalensee, Marius Schwartz, Howard Shelanski, J. Gregory Sidak, Pablo Spiller, David Teece, Michael Topper, Hal Varian, Leonard Waverman and Lawrence J. White. *Id.* Coase's article is discussed in further detail *infra* Section II.

The plight into which radio fell prior to 1927 was attributable to *certain basic facts* about radio as a means of communication—its facilities are limited; they are not available to all who may wish to use them; the radio spectrum is not large enough to accommodate everybody. There is a fixed natural limitation upon the number of stations that can operate without interfering with one another. Regulation of radio was therefore as vital to its development as traffic control was to the development of the automobile. In enacting the Radio Act of 1927, the first comprehensive scheme of control over radio communication, Congress acted upon the knowledge *that if the potentialities of radio were not to be wasted*, regulation was essential.⁸¹

Indeed, the “certain basic facts” and the “potentialities of radio” were not truly known in 1927, when the Radio Act was passed. They were clearly not known in 1943, when Justice Frankfurter wrote the above passage, since this was years before the merger of Moore’s Law⁸² and wireless.⁸³ Even in 1959, at the time of Coase’s article, mobile uses were far from commercial deployment, and yet “[i]t was . . . in the shadows cast by a mysterious technology that our views on broadcasting policy were formed.”⁸⁴ In 1959, too, the personal computer was still about 20 years away from full commercialization.⁸⁵ It was, therefore, virtually inconceivable in 1943 that computer technology would be used to create systems like agile radio, which has the ability to listen before transmitting, to find an unused area of electromagnetic spectrum in which to send a signal, and then to free up almost instantaneously the frequency that it uses for use by other transmitters.

To be clear, Moore’s Law and its application to wireless, the personal computer, and the development of agile radio are part of natural *progress*, not *new discoveries*, and the Congress that passed the 1927 Radio Act didn’t need to foresee the specific forms that progress would take in order to understand what restrictions on radio broadcasting—as it existed in 1927—were needed to prevent chaos. Still, the doubts about the future of technology that existed in 1927 still exist today, and government should take responsibility for creating a flexible mechanism that

81. *Nat’l Broad. Co. v. United States*, 319 U.S. 190, 213 (1943) (emphasis added).

82. See J. William Gurley, *Digital Music: The Real Law Is Moore’s Law*, FORTUNE, Oct. 2, 2000, at 268 (describing Moore’s law’s prediction that storage and processing capacity will double every 18 months).

83. See *Spread Betting*, THE ECONOMIST, June 21, 2003, at 22–24 (discussing the merger of computing technology, “Moore’s Law,” and wireless transmissions to create massive economies in spectrum usage through spread spectrum devices).

84. Coase, *supra* note 79, at 40.

85. See Intel Corp. web site, *supra* note 76.

encourages progress. It is highly doubtful that even today we know and fully understand Justice Frankfurter's "certain basic facts" and the "potentialities of radio."⁸⁶ After all, we have been studying the environment for decades, but we are still learning something new every day, and our laws and policy systems are constantly evolving to accommodate scientific advances. Indeed, two new technologies discussed below suggest that the danger of broadcasting chaos (which exerted so strong an influence on the 1927 Act's form) may in the near future no longer be a concern. The problem is, however, that two axioms have emerged without a clearly identifiable regulatory system that can address them: (a) analog transmissions will soon be dinosaurs, and (b) the "chaos" that exists in broadcasting in 2003 is of a different nature than the chaos which existed in 1927. In order to accommodate these axioms, a systematic overhaul is needed, *not* amendments to thousands of pages of antiquated rules.

2. The Spectrum Giveaways

Two salient occurrences in the history of spectrum regulation are the infamous "spectrum giveaways" that have taken place over the past 75 years. The first giveaway occurred during the pre-auction licensing period spanning 1927 to 1992, when the government granted free exclusive licenses for use of parts of the electromagnetic spectrum⁸⁷ (with the FCC usually holding hearings to determine who should receive a license based on its interpretation of the "public interest").⁸⁸ During this time, licenses were granted to major broadcasters like NBC and CBS,⁸⁹ but the hearing process proved long and difficult and many doubted its impartiality. In response, the FCC started holding a lottery, beginning in 1982, for awarding frequencies to private parties,⁹⁰ reasoning that (a) lotteries are impartial (assuming winners are randomly selected), (b) they are

86. See generally *The Race to Computerise Biology*, THE ECONOMIST TECH. Q., Dec. 14, 2002, at 16 (discussing the emergence of "bioinformatics" and the technological wonders that come with it—suggesting that it is several generations away—but that it could be a quantum leap in progress); see also *Computing's New Lodestone*, THE ECONOMIST, Mar. 18, 2000, at 81 (describing mergers of electromagnetics and microprocessor technology in future applications).

87. Initially, the Federal Radio Commission managed spectrum, and its activities were subsumed and replaced in 1934 with the creation of the Federal Communications Commission. See BENJAMIN ET AL., *supra* note 69, at 31.

88. Some early hearings were little more than presentations by someone hoping to build a broadcasting facility. See *id.* at 82–84.

89. NBC made its first network broadcast in 1926. The Broadcast Archive Website, at <http://oldradio.com/archives/prog/nbc.htm>. CBS made its first broadcast in 1927. *Id.* at <http://oldradio.com/archives/prog/cbs.htm>.

90. See 47 U.S.C. § 309(i)(1) (2000) (authorizing a "system of random selection"—a lottery—in cases where more than one qualified applicant requests a license).

more efficient and easier to administer than hearings, and (c) they allow new technologies to enter the market quickly.⁹¹ The lottery method ended in disaster, however, because companies hired lawyers en masse to produce thousands of applications to increase their chances of winning. So many applications were filed one year, for example, that the government had to engage a structural engineer to make sure that a building's floor would not collapse under the applications' weight.⁹² In 1992, after much frustration, the FCC started moving towards an auction system with the Personal Communications Services ("PCS") auctions.⁹³ In light of the fact that it was only when the auctions commenced that the federal government began receiving money for use of the spectrum, the period from 1927 through 1992 is referred to here as the "first giveaway."

The "second giveaway," unlike the first, is marked more by a single event. By the mid 1990s the television band consisted of 67 channels,⁹⁴ and the second giveaway refers to the granting in 1997 of an additional channel to each of the 1,472 licensed broadcasting stations in the United States.⁹⁵ Notwithstanding the fact that so many free channels were obtained, at present broadcasters either under-use these channels or leave them completely idle, and experts estimate that only 11 percent of the electromagnetic spectrum that is allocated to television broadcasting is used at any given time.⁹⁶ This statistic should not be confused: it does *not* show that there is a lack of demand for the range of the electromagnetic spectrum allotted to television; it shows that there is a lack of demand for broadcast TV, and *only* broadcast TV. Since the part of the spectrum allocated to TV can only be used for TV because of command and control, the market is unable to use the spectrum for other purposes or test demand for other uses (such as wireless communications, Internet, etc).⁹⁷

91. See Andrea M. Settanni, *Competitive Bidding for the Airwaves: Meeting the Budget and Maintaining Policy Goals in a Wireless World*, 2 COMM'LAW CONSPECTUS 117 (1994).

92. Nicholas W. Allard, *The New Spectrum Auction Law*, 18 SETON HALL LEGIS. J. 13, 26 (1993).

93. In the Matter of Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies, 7 F.C.C. Rcd. 1542 (1992) (setting aside spectrum to be auctioned to provide PCS services); see also BENJAMIN ET. AL., *supra* note 69, at 64-70.

94. A "channel" constitutes 6 MHz of electromagnetic spectrum.

95. See THOMAS W. HAZLETT, *THE U.S. DIGITAL TV TRANSITION: TIME TO TOSS THE NEGROPONTE SWITCH 3* (AEI-Brookings Joint Center for Regulatory Studies, Working Paper 01-15, 2001).

96. *Id.* at 3-5.

97. For a very simple example, the reader is asked to consider her own use of television. In the most likely scenario, the reader uses cable or satellite to receiver her signal, which is an example that broadcast television frequencies are completely useless to her. In the unlikely event that the reader is one of the minority of television viewers that uses an antenna, scrolling through the "VHF" channels and then through the "UHF" channels, the reader will instantly see that only a small fraction are used, the rest is static.

The FCC justified granting an extra channel to so many broadcasting companies by saying that it helped provide a transition from analog to digital technology, reasoning that a period would be required when both analog and digital signals were transmitted.⁹⁸ And so after some debate and much political maneuvering,⁹⁹ the FCC ultimately gave the channels to the broadcasters in 1997 free of charge,¹⁰⁰ under the assumption that the extra channels would be returned when 85 percent of the analog broadcasts had been replaced by the digital standard.¹⁰¹ According to the FCC's decision,¹⁰² the digital switchover is supposed to take place by 2006; however, most authorities on the subject believe that the 2006 date will not happen, and that the switchover could be delayed for at least another decade beyond that.¹⁰³ Moreover, commentators have convincingly argued that in the near future, *no* electromagnetic spectrum should be allocated to broadcasters, since most consumers receive their signals via cable or satellite.¹⁰⁴

Governmental giveaways on a massive scale are not unusual in American history. In 1862, the government passed the Homestead Act¹⁰⁵ and gave away thousands of acres to citizens, who would acquire property rights by living on, using, and improving the land for a certain amount of time. As author Thomas Donaldson noted in 1880:

[W]ithin the circle of a hundred years since the United States acquired the first of her public lands, the homestead act stands as

98. See *In the Matter of Advanced Television Sys. and Their Impact Upon the Existing Television Broad. Service*, Fourth Report and Order, 10 F.C.C. Rcd. 10541 (1995).

99. See Arthur E. Rowse, *A Lobby the Media Won't Touch: How the Media Lobby Wields Its Power in Washington—and How It Gets Away With It*, WASH. MONTHLY, May 1, 1998, at 8 (discussing the impact of Dole's stepping down to run for president. Dole had previously insisted that the broadcasters pay for additional channels, but when he ran for president Newt Gingrich and Trent Lott sent a letter to the FCC directing them to give the channels to the broadcasters at no cost); see also Paul Taylor, *Superhighway Robbery*, NEW REPUBLIC, May 5, 1997, at 20 (quoting Bob Dole as calling the second giveaway a "giant corporate welfare program," and William Safire's labeling the giveaway a "rip-off on a scale vaster than dreamed of by yesteryear's robber barons").

100. See *In the Matter of Advanced Television Sys. and Their Impact Upon the Existing Television Broad. Service*, Fifth Report and Order, 12 FCC Rcd. 12809 (1997).

101. *Id.*

102. *Id.*

103. George Leopold, *U.S. May Press for Spectrum Revenues as DTV Deadline Fades*, EE TIMES, Mar. 1, 2001 (noting that little has happened since the granting of the additional channels and suggesting 2015 as a more realistic date).

104. HAZLETT, *supra* note 95. Hazlett's basic premise is that the target penetration level for the switch over from analog to digital—85%—has already been met or exceeded by cable, and satellite uses higher bands and is much more efficient. Hazlett suggests the possibility of subsidizing some rural areas to assure universal service objectives.

105. See generally LAWRENCE M. FRIEDMAN, *LAW IN AMERICA* 41–43 (2002) (describing the Homestead Act and the granting of property to railroads as a mechanism to promote growth).

the concentrated wisdom of legislation for settlement of the public lands. It protects the Government, it fills the States with homes, it builds up communities, and lessens the chances of social and civil disorder by giving ownership of the soil, in small tracts, to the occupants thereof. It was copied from no other nation's system. It was originally and distinctively American, and remains a monument to its originators.¹⁰⁶

Based on a similar theory, to promote progress the government gave at no cost approximately 130 million acres of land away to private railroad companies.¹⁰⁷ The ostensible purpose was to promote growth and expansion of our young economy, and the prevailing view was that the railroads would not do this alone.¹⁰⁸ This giveaway made sense for a time, but it had its limits. This limit was reached in 1869, when things got a bit out of control and the Illinois legislature conveyed the *entire* Chicago waterfront to the railroad.¹⁰⁹ Happily, the courts stepped in to correct this mistake in the landmark public-trust decision *Illinois Central*.¹¹⁰ Elsewhere in the United States, railroad giveaways created public-private land and access clashes which are still in place today.¹¹¹ The giveaways that have taken place in the broadcast spectrum over the past 75 years have reached their limits, and action must be taken to reverse them. It is unlikely that government will do it itself, so citizens must find a way to do it themselves, and the public-trust doctrine may be a mechanism for this change.

3. The Mistaken Focus on Lost *Revenue* from Giveaways: Instead Focus Should Be on Lost *Access*

The giveaways were unfortunate, although the amount of revenue that the government “lost” in giving away its licenses has recently overshadowed discussions of the core problem: access. Is it important to review how much broadcasters paid or did not pay for an exclusive broadcasting? Probably not, but many commentators seem to think so,

106. THOMAS DONALDSON, *THE PUBLIC DOMAIN: ITS HISTORY WITH STATISTICS* 350 (1884).

107. See Merry J. Chavez, *Public Access to Landlocked Public Lands*, 39 *STAN. L. REV.* 1373, 1376 (1987).

108. *Id.*

109. See discussion *infra* Parts I.E.3, IV.A.1.

110. *Illinois Cent. R.R. v. Illinois*, 146 U.S. 387 (1892).

111. Chavez, *supra* note 107, at 1380–81. The Bureau of Land Management has inherited the management of about 200 million acres of land in the U.S., and that access over private lands to federal lands is a major problem. Private owners who benefited from free land during the homestead years can and do charge access fees for people to cross their property in order to access public lands.

and since so much energy has been devoted to this topic it will be briefly addressed here.

None of the giveaways granted property interests in the spectrum,¹¹² but there is a presumption that the licenses will be renewed because that is what has almost always been done in the past.¹¹³ And in fact, only a handful of licenses have ever been revoked in the past seven decades.¹¹⁴ The frustration with the first series of “giveaways” stems from the belief that the government should have auctioned licenses from the 1920s to the 1990s instead of granting them at no cost, and the first giveaway has been characterized as “the biggest handout of public assets since the land grants to the railroads.”¹¹⁵ This analogy is perhaps a good one, for the FCC has given away about 98 percent of the spectrum that it has assigned, and has only auctioned about 2 percent.¹¹⁶ Although no prices were put on the spectrum’s value during the first giveaway, economists have described this period as a time when “[t]axpayers literally squandered billions of dollars.”¹¹⁷ This statement, although possibly true, is based largely on extrapolations of value based on PCS auctions, and since this form of mobile technology did not exist prior to the 1990s, there really is no way to accurately value the spectrum during the first giveaway. Therefore, the statement probably holds much more political value than economic truth.

Because of the perception of revenue loss (now that auctioning had become a norm), the second giveaway incited much more fury than the first among citizens and policy makers, since it took place in the midst of the PCS auctions. The most common price attached to the second giveaway is \$70 billion, which has been calculated by applying the C-block¹¹⁸

112. See 47 U.S.C. § 301 (2000).

It is the purpose of this chapter, among other things, to maintain the control of the United States over all the channels of radio transmission; and to provide for the use of such channels, but not the ownership thereof, by persons for limited periods of time, under licenses granted by Federal authority, and no such license shall be construed to create any right, beyond the terms, conditions, and periods of the license.

Id.

113. See BENJAMIN ET.AL, *supra* note 69, at 112 (suggesting that the expectation of renewal is a product of large broadcasters’ political clout).

114. BOLLIER, *supra* note 13, at 150 (stating that only half a dozen licenses have been revoked in the past 68 years).

115. Scott Woolley, *Dead Air*, FORBES, November 25, 2002, at 138.

116. See J.H. SNIDER, NEW AMERICA FOUNDATION, THE CITIZEN’S GUIDE TO THE AIR-WAVES 28 (2003), available at <http://ilyagram.org/archives/airwaves.pdf>.

117. See Hazlett, *supra* note 68, at 400.

118. During the Personal Communications Services (PCS) auctions, the FCC auctioned off licenses in separate blocks. Frequency blocks C and F were designated as “entrepreneur’s blocks,” and participation in these auctions required that the companies be entrepreneurs

PCS auction prices to the television grant.¹¹⁹ Former FCC Chairman Reed Hundt has used another railroad analogy, declaring the second spectrum giveaway to have been “the largest grant of public property to an industry since the federal government gave about 10 percent of the public domain to three dozen railroad companies in the late nineteenth century.”¹²⁰ There have also been numerous political statements decrying the second giveaway; John McCain, for example, has made it a central platform for years, and has called it “one of the great rip-offs in American history.”¹²¹ McCain’s political position as Senator and former Presidential candidate has made his “great rip-off” statement one of the most-repeated quotations in recent journalistic history on the topic.

However, as stated, commentators cannot seem to get away from the lost revenue topic,¹²² and the problem with assessing a specific dollar figure is that the costs from which it was extrapolated were based on the first series of spectrum auctions in American history. It is therefore difficult, if not impossible, to tell what the spectrum auctions would have brought. The \$70 billion of “lost revenue” from the second giveaway assumes not only that the entrants would have paid \$70 billion, but also that they could have afforded another several billion for network capital expenditures to build it.¹²³ Not only is it a *complete unknown* what the market entrants would have paid had the frequencies been auctioned, as seen through experience with *NextWave*, *GWI*, and the European 3G auctions (discussed below),¹²⁴ there is some doubt that the spectrum would have been used, even if it had been auctioned, for reasons other than lack of demand. The massive additional deployment costs involved in building a nationwide network designed to operate over an

without existing telephony operations. See Patrick S. Ryan, *The Courts as Spectrum Regulator*, 4 GERMAN L.J. 2, 156 (2003).

119. See Romesh Ratnesar, *A Bandwidth Bonanza: How the Networks Plan to Make Even More From A \$70 Billion Handout*, TIME, Sept. 1, 1997, at 60; Deroy Murdock, *Sell the TV Spectrum*, THE WASH. TIMES, Apr. 2, 1997, at A17; Norman Ornstein & Michael Calabrese, *Hey, Give Back Those Airwaves, or Pay Up*, THE WASH. POST, Oct. 14, 2001, at B1.

120. Reed Hundt, *The Future of The Net—Comments on Lawrence Lessig’s Code and Other Laws of Cyberspace and The Future of Ideas*, 68 BROOK. L. REV. 289, 306 (2002) (expressing the views of an author who was FCC Chairman from 1993–1997).

121. Christopher Stern, *Mixed Signals: Broadcasters’ Promise of a Digital TV Age Has Not Been Met, and Now Congress Is Having Second Thoughts About Its Role*, THE WASH. POST, Dec. 17, 2000, at H1 (quoting McCain as having added: “They used to rob trains in the Old West, now we rob spectrum”).

122. See BOLLIER, *supra* note 13, at 151. (discussing again the \$70 billion figure, as well as McCain’s “rip-off” quotation, and criticizing the FCC for the move).

123. Deborah Orr, *Get ‘em While They’re Cold*, FORBES, Nov. 13, 2000, at 356 (estimating the cost of building Europe’s 3G wireless networks at \$175 billion).

124. See Ryan, *supra* note 118 (discussing the *NextWave* and *GWI* cases and the long time that the frequencies went unused because of financial and legal problems).

exclusively-licensed frequency range are in the range of multiple billions of dollars.¹²⁵

As will be shown below in Section IV, the public-trust doctrine can help reverse governmental conveyances to private entities if they meet certain criteria. It is not unrealistic to suggest that the spectrum giveaways have reached proportions that merit reversal by the public-trust doctrine. If the statistic that only 11 percent of the broadcast spectrum is in fact (on average) used for broadcasting¹²⁶ is at all accurate, then the governmental giveaway clearly is a serious misallocation problem. As will be seen later, one of the reasons that the Supreme Court reversed giveaways in other areas (such as when Illinois conveyed the entire Chicago waterfront to a private entity) was a heavy reliance on the notion that the private party would never make full and best use of the mass of property that it was allocated. Therefore, it makes sense for the discussion on the giveaway to include *access* and *use*, more than just focusing on the lost revenue. Rents paid by holders of spectrum *do not* offset the public's losses in the access and use of spectrum. By analogy, if the Grand Canyon were privately owned and closed off to everyone, a one-time fee from a private owner could never compensate the public for its loss of access, regardless of the price paid.

4. Auctions Are Not a Panacea: Money Exchanges Hands while Spectrum Remains Idle

The years 1996 to 2000 saw a worldwide race to auctions, and it is in the wake of this craze that governments both in the United States and in Europe lost their grip on their fiduciary responsibility to the natural resources that they were entrusted to manage. Auctions were seen as a panacea. For example, in Germany, former Finanzminister Hans Eichel raved about the "unexpected revenues for the repayment of [national] debt."¹²⁷ Everyone focused on the money and lost sight of the public: even though the revenue received was ostensibly intended to benefit the public, the public's *access* to the natural resource has so far been advanced little by the auctions. Both sides of the Atlantic walked in lock step: just as the Europeans were amazed at the American success at the PCS auctions, the Americans were equally amazed at the values attained at the European 3G auctions.¹²⁸ Those auctions were the next generation

125. See Orr, *supra* note 123.

126. See HAZLETT, *supra* note 95, at 3–5.

127. See Eichel: *So viel Geld nicht erwartet*, FRANKFURTER ALLGEMEINE ZEITUNG, Aug. 18, 2000, Vol. 191, at 15.

128. See D. Daniel Sokol, *The European Mobile 3G UMTS Process: Lessons from the Spectrum Auctions and Beauty Contests*, 6 VA. J.L. & TECH. 17 (2001) (discussing the auction process for 3G and UMTS licenses in various European countries).

of the US PCS auctions, and at them much more spectrum was sold for many consumer uses (notably Internet),¹²⁹ and for gold-rush valuations. Former FCC Chairman William Kennard enthusiastically stated that Europe has “unleashed the economic potential of 3G and the wireless web, we in America will have to move quickly to stay ahead in the New Economy.”¹³⁰ Kennard’s “economic potential” comment must, then, be based not on the “potential” that the wireless networks add to productivity—since the networks were all theoretical and not yet constructed—but instead on the “potential” of extracting money for exclusive rights to spectrum.

The European 3G auctions raised nearly \$90 billion dollars in Germany and England alone,¹³¹ but they have left a wake almost equally as large in liquidations,¹³² possible bankruptcies,¹³³ and financial turmoil among the many smaller companies;¹³⁴ indeed, even very shortly after the auctions it became clear that the debt taken on by the auction winners was too much for them to bear.¹³⁵ The turmoil is not over, particularly for non-diversified companies, and some commentators have predicted numerous additional European bankruptcies or liquidations.¹³⁶ For example, in the case of German operator MobilCom, all deployment has been frozen and most 3G assets sold,¹³⁷ while other companies, such as Sonera and Quam, have been liquidated and have in some cases returned their

129. See Alan Zeichick, *3G Wireless Explained*, RED HERRING, Oct. 2001, available at <http://www.redherring.com/mag/issue83/mag-3g-83.html> (describing the differences in the various wireless “generations”—e.g., 2G and 3G—and noting the services that 3G is expected to offer, emphasizing data).

130. William E. Kennard, Remarks at the Museum of Television and Radio (Oct. 10, 2000), available at <http://www.fcc.gov/Speeches/Kennard/2000/spwek023.html>.

131. See William Boston, *Wireless Windfall Ignites Debate in Germany: License Auction May Raise More Than \$50 Billion; How to Spend the Money?*, WALL ST. J., May 3, 2000, at A18 (noting that licenses raised \$50 billion in Germany and \$40 billion in England, greatly exceeding expectations).

132. Almar Latour, “*Dunno Group*” *Does Know a Thing About Phones*, WALL ST. J. EUR., Nov. 22, 2002 at R1 (discussing problems with 3G and stating that Quam, a joint venture between Telefonica and Sonera in Germany liquidated after investing \$9 billion into their venture).

133. See Almar Latour et al., *Wireless Concerns in Europe Suspend ‘3G’ Investments*, WALL ST. J., July 26, 2002 at A2 (discussing Telefonica and Sonera suspended joint ventures in Germany, Italy, Austria in Switzerland. The article suggests that there would “likely be a series of capitulations by the European mobile-phone operators”).

134. *Id.*

135. See Axel Schnorbus, *Das Schicksal der Mobilcom ist wieder ungewiss*, FRANKFURTER ALLGEMEINE ZEITUNG, Jan. 1, 2003, Volume 8, at 22 (discussing the very uncertain future of the UMTS branch of Mobilcom, one of the German 3G winners).

136. Almar Latour & Kevin J. Delaney, *Companies: MobilCom May Fail in Germany*, WALL ST. J. EUR., Sept. 16, 2002, at A9.

137. *Rhine or Shine*, THE ECONOMIST, Mar. 7, 2002, at 64.

licenses to the government.¹³⁸ The European Commission's watchdog for subsidies has already launched investigations into illegal state-aid that may be keeping certain companies afloat,¹³⁹ and in fact Germany itself is under investigation by the European Commission for preferences to its own broadcast lobbies in violation of European law.¹⁴⁰ As it turns out, in Europe only corporate giants who are able to write-off the billions that they paid for the 3G licenses to *zero* and consider their payments *total losses* are likely to survive.¹⁴¹

Auctions are an *alternative* to hearings, "beauty contests," and lotteries, but whether or not they are *better*—particularly in the case of the European auctions—is untested. Even if auctions are proven to be a successful market mechanism in general terms,¹⁴² it does not necessarily follow that they are the best method for enabling access to a natural resource whose optimum use and enjoyment depend on advances and changes in technology. European governments, entrusted with management of the electromagnetic-spectrum resource, have so far failed to increase public access to it.¹⁴³

5. NextWave: Evaluating the Public Purpose of Auctions

As will be seen in Section IV, the public-trust doctrine can reverse certain conveyances if the government grants *too much* property with *too little* public purpose to private entities. In parallel, it is also possible for

138. Almar Latour & Buster Kantrow, *Sonera Pushes Back 3G Launch Until the First Quarter of 2003*, WALL ST. J. EUR., Sept. 2, 2002, at A7.

139. See EC Press Release DN IP/03/92, EUR 50 million rescue aid for MobilCom cleared in-depth probe into additional aid of EUR 112 million, Jan. 21, 2003, available at http://europa.eu.int/rapid/start/cgi/guesten.ksh?p_action.gettxt=gt&doc=IP/03/92|0|RAPID&lg=EN&display= (discussing a European probe into German state-aid for troubled Mobilcom).

140. See European Commission Press Release DN: IP/03/1103, Broadcasting services: Commission refers Germany to Court over allocation of radio spectrum, July 24, 2003, available at http://europa.eu.int/rapid/start/cgi/guesten.ksh?p_action.gettxt=gt&doc=IP/03/1103|0|RAPID&lg=EN&display=

141. Almar Latour et al., *Wireless Firm's Troubles Jolt Europe's Telecom Industry*, WALL ST. J., Apr. 2, 2002, at A14 (discussing the massive financial troubles of the companies that bid for 3G licenses in Europe and predicting numerous bankruptcies).

142. See *The Heyday of the Auction*, THE ECONOMIST, July 24, 1999 at 67 (discussing the advances of auctions in recent years).

143. See *Vivendi Universal vende por un euro simbólico su participación en Xfera al resto de accionistas*, EL MUNDO, Aug. 2, 2003, available at <http://www.elmundo.es/elmundo/2003/08/01/economia/1059762950.html> (Vivendi once paid approximately \$800 billion to own 25% of XFERA, a Spanish 3G operator which has frozen deployment because of financial difficulties. Vivendi recently sold its participation for a symbolic price of one euro); see also *Xfera rompe el acuerdo con Vodafone*, EL MUNDO, Jan. 9, 2003, available at <http://elmondodinerio.elmundo.es/mundodinerio/2003/01/15/Noti20030115134626.html> (noting that XFERA, the fourth license winner in Spain, has completely frozen deployment and is negotiating with the government and other investors regarding the license commitments).

government to auction property and then, in case of sellers' remorse, attempt to repossess it and resell it to entities willing to pay higher prices. This is what happened with NextWave. The *NextWave* story shows that auctions can cause inefficient allocation of the spectrum. Here, a company bid too much for the exclusive right to part of the spectrum just before a market dip. When the government tried to repossess the license, the market turned around. Hung up on construing a statute, due partially to a basic struggle between strict interpretation, teleological interpretation, and liberal interpretation, the federal courts split on the how to construe the words "debt" and "creditor."¹⁴⁴ NextWave ultimately succeeded in retaining its licenses while going through bankruptcy, though the electromagnetic spectrum that it had an exclusive right to use was not deployed for over seven years, and the public was harmed because it was prevented from gaining any access to a valuable national resource that was tied up in a bankruptcy battle.

NextWave fought tenaciously to retain its licenses through bankruptcy proceedings, but in the interim the FCC repossessed the NextWave licenses and re-auctioned them. Through the re-auctioning, it raised \$16 billion in commitments from the auction winners,¹⁴⁵ over three times the amount that NextWave had originally bid. Verizon Wireless, for example, bid over \$8 billion for its share of the re-auctioned licenses.¹⁴⁶ The auction rules required that the winning bidders pay deposits for their licenses, and the re-auction deposits amounted to nearly \$3 billion, which the FCC retained even after the NextWave case was overturned by the Court of Appeals.¹⁴⁷ In March 2002 the FCC agreed to return 85% of the money,¹⁴⁸ but it held on to the rest until late 2002.¹⁴⁹ So billions of dollars changed hands, but the spectrum's use went nowhere.

Ultimately, the United States Supreme Court decided in favor of NextWave.¹⁵⁰ The question that the Supreme Court reviewed was limited to whether § 525 of the Bankruptcy Code "prohibits the FCC from revoking licenses held by a debtor in bankruptcy upon the debtor's failure

144. See Nicholas J. Patterson, *The Nature and Scope of the FCC's Regulatory Power in the Wake of the NextWave and GWI PCS Cases*, 69 U. CHI. L. REV. 1373 (Summer 2002) (describing the split between the Second and Fifth Circuits).

145. Yochai J. Dreazen, *FCC Ends Obligations from NextWave Auction*, WALL ST. J., Nov. 15, 2002, at B2.

146. Yochai J. Dreazen & Jesse Drucker, *FCC to Ease Spectrum-Auction Snarl*, WALL ST. J., Sept. 12, 2003, at A3.

147. *Nextwave Pers. Communications, Inc. v. F.C.C.*, 254 F.3d. 130 (D.C. Cir. 2001).

148. Kathy Chen, *FCC to Return 85% of Deposits in Wireless Sale*, WALL ST. J., Mar. 28, 2002, at A3.

149. Dreazen, *supra* note 145, at B2.

150. *NextWave v. F.C.C.*, 123 S.Ct. 832, 836 (2003).

to make timely payments owed to the Commission for purchase of the licenses.”¹⁵¹ In a relatively concise opinion, Justice Scalia analyzed various statutes, applying strict construction at several points and ultimately concluding that “debt” expressly means “liability on a claim.”¹⁵² Scalia then cited several cases supporting “plain meaning” interpretation and ruled that “a debt is a debt, even when the obligation to pay is also a regulatory condition.”¹⁵³ Scalia’s strict construction of the Bankruptcy Code led to victory for NextWave, since their contention was that the obligation to pay the government for their licenses—which was made as an agreement to be paid in installments—should be tolled and treated just like any other payment obligation in bankruptcy court.

In *NextWave*, the course that the FCC followed was probably based on economic considerations rather than on legal interpretations,¹⁵⁴ and while trying to keep billions of dollars, its actions kept a large amount of electromagnetic spectrum unavailable to the public for years. Unfortunately, there is not yet an alternative mechanism available to the public to let it use the spectrum in situations like this. If, however, the public-trust doctrine had been made available, the public could have theoretically used and enjoyed the valuable natural resource that was tied up in a legal battle, with no harm to anyone.

II. THE RELATIONSHIP OF OTHER ASPECTS OF NATURAL RESOURCES LAW TO ELECTROMAGNETIC SPECTRUM

As stated at the outset, a sub-theme of this Article deals with the relationship of other topics of natural-resources law in connection with electromagnetic spectrum in hopes of attracting the wisdom of others who have helped initiate widespread change in regulation over the past few decades. One of the hot topics today is that of “sustainable consumption,” which is a corollary to the established natural-resources principle of “sustainable development.”¹⁵⁵ Another area to be analyzed is that of pollution, which was central to Coase’s 1960 article where he

151. *Id.*

152. *Id.* at 834.

153. *Id.* 839.

154. This was the insinuation at oral argument of the case before the Supreme Court, where Justice David Souter told lawyers representing the FCC that: “The FCC made an economic decision, not a regulatory decision.” See Tom Mauro, *Supreme Court Appears Receptive to NextWave’s License Claim*, AMERICAN LAWYER MEDIA (Oct. 9, 2002), available at <http://www.law.com/jsp/article.jsp?id=1032128704447>. Souter continued, “[w]hen the value [of the licenses] went up, the FCC wanted to reauction them.” *Id.*

155. See United Nations Website, Division for Sustainable Development, at <http://www.un.org/esa/sustdev/>.

used the example of factory smoke and the harmful effects that it has on neighbors.¹⁵⁶

*A. Coase and Hardin: A Common Point of Departure for
Environmentalists and Spectrum Advocates Alike*

Environmental law has passed over the electromagnetic spectrum,¹⁵⁷ and that is somewhat unfortunate; there are in fact several common core principles that form the point of departure for environmentalists, natural-resource specialists, and spectrum advocates alike. As has been previously mentioned, one of the most famous of these principles is found in the work of economist R.H. Coase. His 1959 article, *The Federal Communications Commission*,¹⁵⁸ argued that the government's policy of giving spectrum away for free could instead be replaced by auctions, and expanding on this study, Coase's 1960 article, *The Problem of Social Cost*,¹⁵⁹ argued that economists should consider transaction costs in their theoretical modeling of pricing. Coase has told us repeatedly that *both* articles are based on the same study on broadcasting, even though the 1960 article does not discuss broadcasting directly.¹⁶⁰ Economist George Stigler later labeled Coase's conclusions the "Coase Theorem" (Coase did not initially call it that himself),¹⁶¹ which was perhaps best summarized by Coase in the 1991 lecture that he gave in Stockholm when he received the Nobel Prize for it:

[t]he Coase Theorem demonstrates . . . that government actions (such as government operation, regulation or taxation, including subsidies) could not produce a better result than relying on

156. Coase, *supra* note 14, at 1.

157. An important exception to this is standard setting in regard to EMF guidelines, which is discussed separately in *supra* Section II.E.

158. Coase, *supra* note 79.

159. Coase, *supra* note 14.

160. The first footnote in *The Problem of Social Cost* states that "out of the study of . . . [b]roadcasting which I am now conducting. The argument of the present article was implicit in a previous article dealing with the problem of allocating radio and television frequencies . . ." Coase, *supra* note 14, at 1 n.1. Coase again reiterated this point in his short autobiography which appears on the Nobel Prize Website: "The main points [of the Coase Theorem] were already to be found in *The Federal Communications Commission*," and further explains that "[h]ad it not been for the fact that . . . economists at the University of Chicago thought that I had made an error in my article on *The Federal Communications Commission*, it is probably that *The Problem of Social Cost* would never have been written." At <http://www.nobel.se/economics/laureates/1991/coase-autobio.html>.

161. Ronald H. Coase, 1991 Alfred Nobel Prize Lecture in Economic Sciences, The Institutional Structure of Production, delivered 9 Dec. 1991, in R.H. COASE, *ESSAYS ON ECONOMICS AND ECONOMISTS* 10 (1994) (discussing his article *The Problem of Social Cost*, *supra* note 14, Coase says that the "Coase Theorem [was] named and formulated by George Stigler, although it is based on work of mine . . . I do not disagree with Stigler").

negotiations between individuals in the market. Whether this would be so could be discovered not by studying imaginary governments *but what real governments actually do*. My conclusion: Let us study the world of positive transaction costs.¹⁶²

Coase's suggestion to study "what real governments actually do" and to include positive transaction costs is a simple but profoundly useful proposition. Spectrum advocates regularly cite Coase's studies as central building blocks for their work, even if today they disagree with certain aspects of it.¹⁶³ Likewise, environmentalists have analyzed Coase's views from virtually every angle in application to natural resources.¹⁶⁴ There are frighteningly few safety valves available to citizens to keep government action in check, and the government's actions favor lobbies and antiquated systems.

In addition to Coase, another theoretical basis that is equally as important to environmentalists and natural-resource specialists is the concept of the "commons," and the question of how government should treat the commons. A commons is a resource open to all: the example that Garrett Hardin gives in his famous essay, *The Tragedy of the Commons*, is that of a pasture open to herdsmen.¹⁶⁵ The "tragedy" develops when each herdsman, acting out of individual interest, continues to send cattle to graze on the pasture and too many cattle graze, thereby ruining the pasture for all. Environmentalists have called Hardin's essay

162. *Id.* at 11 (emphasis added).

163. See Yochai Benkler, *Some Economics of Wireless Communications*, 16 HARVARD J.L. & TECH. 1, 48–49 (2002) (reviewing Coase's 1959 property rights proposition and then suggesting that the 1960 article itself disproves it because of the high transaction costs that would be involved in a property rights model); Hazlett, *supra* note 68, at 338 (citing both of Coase's articles and discussing their importance as a starting point for allocation theory); Thomas W. Hazlett, *Assigning Property Rights to Radio Spectrum Users: Why Did FCC License Auctions Take 67 Years?*, 41 J.L. & ECON. 529 (1998) (discussing the history of spectrum pricing focusing on the important historical contributions of Ronald Coase and Leo Herzel. The article was written for a symposium which, in part, was a tribute to Ronald Coase's important contributions to wireless spectrum management).

164. See WILLIAM H. RODGERS, JR., ENVIRONMENTAL LAW 1244 (4th ed. 1994) (stating that "all of the teaching materials on environmental law pay homage to the famous article by Ronald Coase"); Daniel S. Levy & David Friedman, *The Revenge of the Redwoods? Reconsidering Property Rights and the Economic Allocation of Natural Resources*, 61 U. CHI. L. REV. 493 (1994) (labeling the Coase Theorem as "one of the most influential" theories in law and economics, and analyzing its application to natural resources).

165. Garrett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968); see also Garrett Hardin, *The Tragedy of the Unmanaged Commons: Population and the Disguises of Providence*, in COMMONS WITHOUT TRAGEDY: PROTECTING THE ENVIRONMENT FROM OVERPOPULATION—A NEW APPROACH 162, 168 (Robert V. Andelson ed., 1991) (saying, after years of his article's having received scholarly attention and critiques, that "[t]he title of [the] 1968 paper should have been 'the Tragedy of the Unmanaged Commons'").

“[p]erhaps the most influential article ever written in the environmental field,”¹⁶⁶ and likewise, nearly every spectrum advocate has discussed Hardin’s thesis at one point or another.¹⁶⁷ For spectrum advocates, the fear of a similar grazing tragedy develops if too many broadcasters are allowed unbridled access to the same electromagnetic “pasture.”

Although this Article will not focus extensively on Coase’s allocation theories nor on Hardin’s tragedy of the commons (many others have done that with great success),¹⁶⁸ acknowledging the importance of their articles¹⁶⁹ to both environmentalists and spectrum advocates helps set the stage for applying the public-trust doctrine to the environment (where the doctrine has already been applied) and to the spectrum.

B. Sustainable Consumption

In a strict sense, a non-depletable resource like the electromagnetic spectrum *should not* be consumed, but because of legacy technologies, large parts of it are in fact “consumed” in the sense of being made unavailable to users.¹⁷⁰ Utilization of electromagnetic spectrum takes place in seconds or nanoseconds (and that will be all the more true in a future all-digital world), and a given frequency is only occupied for the precise period that it is used to transmit or receive a signal. Electromagnetic spectrum is finite in scope¹⁷¹ and limited by geographic range (a signal can only transmit so far),¹⁷² yet when a particular frequency is not used, it remains in its natural state in exactly the same condition that it was before and after it was used. In this sense, unlike other natural resources,

166. RODGERS, *supra* note 164, at 39; *see also* Carol Rose, *Scientific Innovation and Environmental Protection: Some Ethical Considerations*, 32 ENVTL. L. 755, 759 (2002) (stating that nearly all environmental-law textbooks include a selection from Hardin’s article in the introduction).

167. *See* LESSIG, *supra* note 42, at 229 (citing an excerpt from spectrum–property advocate Thomas Hazlett’s writings discussion of the “commons” problem and stressing that Hazlett believes that there is a tragedy while Lessig does not).

168. *See* Stuart Buck, *Replacing Spectrum Auctions with a Spectrum Commons*, 2002 STAN. TECH. L. REV. 2 (presenting a recent and well-researched analysis of commons theory as it applies to wireless-spectrum allocation).

169. *But see* LESSIG, *supra* note 42, at 22–23 (challenging Hardin’s proposal and distinguishing “nonrivalrous goods,” which are not subject to “tragedy” at all, and noting that there is by no means a consensus that there is a “tragedy” even for all rivalrous goods).

170. *See* BLACK’S LAW DICTIONARY 312 (7th ed. 1999) (defining “consumption” as the use of a thing in a way that exhausts it).

171. *See* NTIA U.S. Spectrum Allocation Chart, *available at* <http://www.ntia.doc.gov/osmhome/allochrt.html> (noting that the radio spectrum covers 3 KHz to 300 GHz).

172. Kevin Maney, *‘Megahertz’ Remains a Mega-Mystery to Most*, USA TODAY, Feb. 13, 1997, at 4B. The article describes how airwaves are measured and the different properties that they possess. Low frequency waves can travel far and curve with the Earth but can’t carry much information. High frequency waves can travel only a short distance before breaking up and won’t curve over the horizon, but they can carry much more information.

electromagnetic spectrum cannot be depleted: its roots do not disappear like a forest when it is cleared, nor can its value be exhausted like a coal mine when it is emptied. Further, its exploitation does not have negative externalities on other parts of the ecology, as clear-cutting a forest,¹⁷³ strip mining,¹⁷⁴ and blast fishing near a coral reef do.¹⁷⁵

Nevertheless, even with these new technologies there is perhaps a theoretical level at which spectrum's use can reach an equilibrium of "sustainable consumption."¹⁷⁶ A full discussion of where this equilibrium lies is better saved for electrical engineers, economists, and futurists, although to the extent that regulations continue to allow legacy analog technologies to operate, while simultaneously preventing the public from using large swaths of frequencies (such as the unused broadcasting channels), the public may never know what the electromagnetic equivalent of sustainable consumption is. The public, which could otherwise use all of the spectrum, is still relegated to limited areas of it based on regulatory restrictions, which means that the frequencies not being used by the public are de-facto "consumed" as much as a mine that is emptied of its precious metal, or a tree that has been picked of its fruit. In a given frequency range, if a "dumb" analog device and a "smart" device are operating simultaneously, it is the inefficient "dumb" one that will be the de-facto occupier of that part of the spectrum.¹⁷⁷ Put another way, analog transmissions are a form of consumption, and while this consumption may be sustainable for a time, as more and more digital devices enter the market there will be a point in the future when their consumption of electromagnetic spectrum will become unsustainable.¹⁷⁸ This is because thousands of new wireless devices and uses will require much more efficient use of the spectrum, and the present analog monop-

173. See Federico Cheever, *Four Failed Standards: What We Can Learn from the History of the National Forest Management Act's Substantive Timber Management Provisions*, 77 OR. L. REV. 601, 615–17 (1998) (defining "clearcutting," giving its historical interpretation, and describing its application in the U.S. and the damage that it causes to the environment).

174. See Wendy B. Davis, *Out of the Black Hole: Reclaiming the Crown of King Coal*, 51 AM. U. L. REV. 905, 928 (2002) (detailing the long-term side effects of strip mining, particularly in Appalachia where resulting floods and mudslides still damage homes and crops).

175. See Robin Kundis Craig, *Taking Steps Toward Marine Wilderness Protection? Fishing and Coral Reef Marine Reserves in Florida and Hawaii*, 34 MCGEORGE L. REV. 155, 188–89 (2003) (discussing the many threats to coral reefs, including blast fishing or fish poisoning and removing coral reefs for jewelry).

176. See James Salzman, *Sustainable Consumption and the Law*, 27 ENVTL. LAW 1243, 1246–50 (1997) (analyzing "sustainable consumption" and noting that pollution and waste are caused by the unsustainable consumption of goods and resources).

177. See Benkler, *supra* note 64, at 347 n.239 (describing the economic tradeoffs of "smart" vs. "dumb" devices).

178. See Tony Hallett, *700 Million Wi-Fi Users By 2008*, SILICON.COM, July 25, 2003, at <http://www.silicon.com/news/148-500001/1/5322.html> (noting that Pyramid Consulting has projected Wi-Fi growth to reach 700 Million users within 6 years).

oly will not be acceptable over time. Old technology, old methods of consumption will have to give way to new.

New environmental legislation, influenced by the public-trust doctrine, could theoretically provide some protection here. Environmental law professor William Rodgers has told us that the language of the National Environmental Policy Act (“NEPA”) Subsection 101(b)¹⁷⁹ contains public-trust based language which is “expansive and tantalizingly vague, but it also is strongly prophetic,”¹⁸⁰ because it addresses resources which are non-consumptive and renewable (like the electromagnetic spectrum):

[The public-trust doctrine] has given rise to a number of court-inspired constraints on public-resource decisions, including protecting current public uses, giving preferences to *nonconsumptive* and *renewable* uses, and preventing the subordination of public uses to private development decisions.¹⁸¹

Whatever the angle used, as is the case with all natural resources, a balance must be struck. If we assume that legacy analog technologies unduly consume the electromagnetic spectrum, either today or 20 years from now, a paradox becomes clear. In today’s market, some of the cheapest products available are those that exploit electromagnetic spectrum in the most *inefficient* way. Analog radios and televisions are still much cheaper than digital ones; new businesses that broadcast using digital technologies must subsidize customers’ purchase of their newer, more efficient digital devices in order to jump start the market.¹⁸² In fact, the exact opposite could take place: the producer could, and perhaps should, reflect the total product cost in their devices,¹⁸³ including the consumption cost associated with economic inefficient use and costs of disposal.

Applied to today’s wireless market, analog devices should be the *most* expensive if they are to reflect (a) their truly inefficient

179. 42 U.S.C. § 4331(b) (2000) (“... it is the ... responsibility of the Federal Government ... to improve and coordinate Federal plans, functions, programs, and resources, to the end that the Nation may (1) fulfill the responsibilities ... as trustee of the environment ...”) (emphasis added).

180. RODGERS, *supra* note 164, at 857.

181. *Id.* at 858 (citing *Illinois Cent. R.R. Co. v. Illinois*, 146 U.S. 387 (1892)).

182. See Brian Bergstein, *Satellite Radio Set for Takeoff in U.S.*, AP ONLINE, June 1, 2003, available at <http://www.rednova.com/news/stories/3/2003/06/02/story001.html> (the article notes that both XM and Sirius hope to be able to eliminate the manufacturer equipment subsidy in a few years).

183. See Jon D. Hanson & Douglas A. Kysar, *Taking Behavioralism Seriously: Some Evidence of Market Manipulation*, 112 HARV. L. REV. 1420, 1553–71 (1999). The authors propose “enterprise liability” as a mechanism of incorporating risk into the price of products. This is mostly an argument related to tort liability, however it could be extended to environmental or as a way to price in a device’s inefficient use or resources.

exploitation—their consumption—of electromagnetic spectrum and (b) the fact that they will have to be recalled and destroyed at some time in the future when they are replaced by a digital-generation device. Many analog devices (such as analog cordless phones) have already ended their useful life cycle or they soon will.

Convincing arguments have been advanced that the economic cost of analog broadcast is so great (i.e. the cost of consumption), particularly in broadcast television, that all analog broadcasts should simply be turned off, thereby forcing the market to switch either to digital alternatives or to cable.¹⁸⁴ However, the disposal and switch-over costs from analog to digital are, today, not built into the products' price and it is questionable how the market will sustain them.¹⁸⁵

C. Can Electromagnetic Spectrum Pollute?

If electromagnetic spectrum is exploited at unacceptable levels, its by-product can cause interference with other devices (a “cacophony of competing voices”),¹⁸⁶ and at very high power levels it can cause burning injury to humans.¹⁸⁷ Most studies do not indicate injury,¹⁸⁸ but the Institute of Electrical & Electronics Engineers (“IEEE”) and other

184. See HAZLETT, *supra* note 95, at 15 (suggesting that the analog TV spectrum, if valued based on PCS rates, is far too valuable to keep active and it would probably make more sense to switch as soon as practicable and use the money from auctioning for subsidizing the “public interest,” such as universal service).

185. See Salzman, *supra* note 176, at 1270–75 (suggesting that “extended producer responsibility” should apply to build in the price of the device’s disposal into its manufacturing cost).

186. *Red Lion Broad. Co. v. F.C.C.*, 395 U.S. 367, 376 (1969) (setting forth the 1927 act’s traditional justification: “It quickly became apparent that broadcast frequencies constituted a scarce resource whose use could be regulated and rationalized only by the Government. Without government control, the medium would be of little use because of the cacophony of competing voices, none of which could be clearly and predictably heard.”).

187. See Kenneth R. Foster & John E. Moulder, *Are Mobile Phones Safe?* IEEE SPECTRUM ONLINE, Vol. 37, No. 8 (Aug. 2000), available at <http://www.spectrum.ieee.org/publicfeature/aug00/prad.html> (describing the tissue-heating phenomenon and dispelling spectrum links to cancer); David Black, Health Issues and the Role of Standards and Safety Factors in Respect of Cellphone Technology in the Context of Public Requirements for a Precautionary Approach, IEEE Presentation in Dublin (Sept. 20, 2001), available at <http://grouper.ieee.org/groups/scc28/Summary%20of%20Black%20Presentation.pdf>. Referring to ICNIRP standards, the author states that “[i]t is widely accepted that current standards, such as those published by IEEE and the Guidelines published by ICNIRP are referenced to thresholds of observable and repeatable effects. Tissue heating predominates at high frequencies, and so the onset of detectable disturbances to thermal homeostasis forms the basis of the lowest observable effect threshold used by RF standards above 10MHz.” *Id.*

188. See Howard Frumkin et al., *Cellular Phones and Risk of Brain Tumors*, 51 CANCER J. CLIN. 137–41 (describing numerous epidemiological studies and concluding that there is no definite link to cancerous tumors).

international standards-setting bodies¹⁸⁹ have promulgated guidelines to secure human safety by acknowledging that there are thresholds beyond which electromagnetic exploitation can be a form of dangerous pollution. For this reason, many countries regulate transmission stations by means of national laws,¹⁹⁰ and in the United States, it is regulated by a comprehensive federal-guidelines document,¹⁹¹ although some states have attempted to impose their own standards.¹⁹² So far, court cases for injuries supposedly caused by electromagnetic pollution—particularly at the low levels of pollution to which mobile phones subject users—have failed because their claims have lacked scientific legitimacy under the standard of the *Daubert* decision;¹⁹³ but nonetheless, studies are always being conducted on the effects of broadcast transmissions, and it is possible (although hopefully unlikely) that such an injury may be proved in the future.

Communities across the world have also been very active in this area, and so far the court of public opinion has been far more credulous, through relying on junk science, than courts of law have been.¹⁹⁴ Italian mass hysteria, for instance, incited locals to attempt to shut down the Pope's broadcast facilities due to fear of radiation, an event in which thousands of protesters held up signs proclaiming that "Vatican Radio preaches life but brings us death."¹⁹⁵ In Spain, four alleged school cancer

189. See IEEE International Committee for Electromagnetic Safety Website, at <http://grouper.ieee.org/groups/scc28/>; see also Joint Website of the U.S. Food & Drug Administration and the Federal Communications Commission for Consumer Information on Wireless Phones, at <http://www.fda.gov/cellphones/> (providing exhaustive detail on thresholds and noting numerous additional sources and literature); *In re: Wireless*, 216 F. Supp. 2d 474, 485–87 (D. Md. 2002) (detailing the inter-agency collaboration between the FCC and the FDA in setting RF exposure standards).

190. See WHO, International EMF Project, EMF Worldwide Standards Database, available at <http://www.who.int/docstore/peh-emf/EMFStandards/who-0102/Worldmap5.htm>.

191. See *In The Matter of Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, 11 F.C.C.R. 15123 (August 1, 1996).

192. See New Jersey Radiation Protection Act, N.J. Stat. Ann. § 26:2D-1-88 (setting extensive radiation limits for transmission devices); *New Brunswick Cellular Tel. Co. v. Township of Edison Zoning Bd. of Adjustment*, 693 A.2d 180, 189 (N.J. Super. Ct. Law Div. 1997) (noting that the Federal Emissions Standards will pre-empt New Jersey regulation of emission standards).

193. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993) (assigning trial judges a "gatekeeping" role to determine as a preliminary matter whether the proposed scientific testimony is both reliable and relevant, and in general replacing the test in *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923)).

194. See Joseph Perkins, *Payoffs for Junk Science*, THE WASH. TIMES, Aug. 3, 1999, at A17 (noting that Robert P. Liburdy, a biologist at Lawrence Berkeley National Laboratory who concluded that electromagnetic effects can lead to leukemia, has been exposed as a scientific fraud, and discussing the incentives, based on potential claims, for scientists' coming to incorrect conclusions).

195. Yaroslav Trofimov, *Italians Say Potent Vatican Radio Tower Emits Radiation That Poses Cancer Risk*, WALL ST. J., Mar. 27, 2001, at B7A; Yaroslav Trofimov, 'Electrosmog'

cases created nationwide paranoia, leading to several antennas' being removed, and to the freezing of new broadcasting-site deployment for months.¹⁹⁶ In the United States, hysteria over electromagnetic radiation is localized but strong,¹⁹⁷ sometimes being couched in terms of declining property values due to unsightly tower placement,¹⁹⁸ and other times being based on health concerns.¹⁹⁹ Most United States lawsuits arising out of electromagnetic waves' health hazard have failed,²⁰⁰ but network operators are well aware that the public's fear can affect network deployment.

For example, in spite of political maneuvers undertaken to facilitate network construction,²⁰¹ community hysteria incited companies like Omnipoint to try to build several hundred "stealth-antenna" sites without municipal authorization during the 1990s.²⁰² One can assume that what

Splits Italian Officials, WALL ST. J. EUR., Apr. 10, 2001, at 1 (describing Italy's heated politics regarding electromagnetic emissions and new legislation).

196. Giles Tremlett, *Phone Masts Start Child Cancer Scare*, THE GUARDIAN, Jan. 12, 2002, available at <http://www.guardian.co.uk/international/story/0,3604,631542,00.html>.

197. See David W. Hughes, *When NIMBYs Attack: The Heights to Which Communities Will Climb to Prevent the Sting of Wireless Towers*, 23 J. CORP. L. 469 (1998) (discussing the strategies of activist groups opposing cell-tower placement).

198. *Id.* at 496-98.

199. *Id.* at 492-96.

200. See *Motorola, Inc. v. Ward*, 478 S.E.2d 465 (Ga. Ct. App. 1996) (rejecting a claim against a cell-phone manufacturer for causing or exacerbating cancer, due to lack of causation and inconclusive evidence); see also *In re Wireless Telephone Radio Frequency Emissions Products Liability*, 248 F. Supp. 2d 452 (D. Md. 2003) (preventing claims, brought by five classes of phone purchasers who were not provided with headsets to guard against possible danger, because federal law sets safety standards and preempts such claims); *Newman v. Motorola Inc.*, 218 F. Supp. 2d 769 (D. Md. 2002) (rejecting of claim against cell phone manufacturer for cancer claim for failing the *Daubert* test); *Reynard v. NEC Corp.*, 887 F. Supp. 1500 (M.D. Fla. 1995) (rejecting a plaintiff's wrongful-death action for lack of causation and failing the *Daubert* test); *Chernock v. United States*, 718 F. Supp. 900 (N.D. Fla. 1989) (ruling against several workers' claims against the government for injuries allegedly caused by operating radar devices).

201. See H. R. REP. NO. 104-204, at 95 (1995), reprinted in 1996 U.S.C.C.A.N. 10, 61-62. Congress's intent to achieve national uniformity over RF emissions standards, and the interplay with local zoning laws: "The [Commerce] Committee has received substantial evidence that local zoning decisions, while responsive to local concern about the potential effects of radio frequency emission levels, are at times not supported by scientific and medical evidence. A high quality national wireless telecommunications network cannot exist if each of its component [sic] must meet different RF standards in each community. The Committee believes the [FCC] rulemaking on this issue (ET Docket 93-62) should contain adequate, appropriate and necessary levels of protection to the public, and needs to be completed expeditiously." *Id.*

202. See John Cichowski, *Antenna Critics Demand Answers: Clifton Takes Omnipoint to Task*, THE REC. (NORTHERN N.J.), Sept. 4, 1997, at L3 (discussing an arrangement that Omnipoint made with the State of New Jersey to put up 122 sites without municipal approval, and because of political pressure the New Jersey Governor stepped in to provide the municipalities with a veto right. The article also discusses the "stealth" placement that Omnipoint erected in a commercial zone without obtaining zoning approval); Leslie Haggin, *Complaints Force*

motivated the company was its having concluded that the time and expense required for the antennas' authorization, along with the ensuing public hysteria, would have prevented it from being competitive with existing providers.

The fact that electromagnetic devices can be used in warfare to damage other electric devices and to injure humans²⁰³ shows that electromagnetic spectrum is a natural resource whose exploitation must be prudently monitored. Even though mobile-phone and other low-power uses (such as WiFi) are unlikely to cause injury because FCC standards place their spectrum usage a thousand times below the threshold of human danger,²⁰⁴ as with any other natural resource, there would be zero potential for harm if the resource were left in its natural, unexploited state. Probably no one supports complete abstinence from wireless devices using the spectrum, however, just as no one can realistically suggest completely abstaining from using machinery that consumes petroleum products, even as some cities are close to being rendered "unlivable" from their extensive use of fossil fuels.²⁰⁵

There are safe levels of exploitation in electromagnetic spectrum that, according to our understanding of science, will never harm humans. By way of example: a human can never become sunburned from moonlight, even though moonlight is a reflection of the sun's light. This is because moonlight transmits the sun's energy well below the threshold of damage.²⁰⁶ By way of another example, a 100-watt light bulb will burn someone who touches its surface, but if the same person sits several feet away, the light bulb will not cause a burn. This is known as the

Down Cell Phone Antenna; Wayne Firm Seeks to Restore It, THE REC. (NORTHERN N.J.), May 9, 1997, at L3 (discussing an Omnipoint cellular phone antenna erected on the side of the Newark Pompton Turnpike without any zoning approval and which was forced to come down by municipal authorities).

203. See *Come Fry With Me*, THE ECONOMIST, Feb. 1, 2003 at 68–69 (describing the development of electromagnetic devices for various warfare tactics); Anne Marie Squeo, *U.S. Studies Using 'E-Bomb' in Iraq*, WALL ST. J., Feb. 20, 2003, at A3 (describing the "E-Bomb" electromagnetic weaponry and its possible use in the war against Iraq).

204. See Federal Emissions Guidelines, *supra* note 191, at 15140 (discussing the emissions standards for "low power devices").

205. See Bradley P. Miller, *Obedezco, Pero No Cumplo: Law, Transportation, Politics and Pollution in Mexico City*, 28 STAN. J. INT'L L. 173, 226–28 (1991) (noting the terrible environmental conditions and pollution, and attempts to alleviate them, in the world's most populous city, including a "no-drive day" requiring one fifth of the population to refrain from using their automobiles every day).

206. See Jim Gilbert, *Exploring the Full Moon*, MINNEAPOLIS STAR TRIB., July 18, 1997, at 12C (noting that even at full-moon the moon's brightness is only 1/400,000th of the sun's light).

“threshold” (or “specific absorption rate”),²⁰⁷ and is summarized in simple terms by a World Health Organization online publication:

There is no one level above which exposures [to electromagnetic transmissions] become hazardous to health; instead, the potential risk to human health gradually increases with higher exposure levels. Guidelines indicate that, below a given threshold, electromagnetic field exposure is safe according to scientific knowledge. However, it does not automatically follow that, above the given limit, exposure is harmful. . . . [The International Commission for Non-ionizing Radiation Protection] applies a safety factor of 10 to derive occupational exposure limits, and a factor of 50 to obtain the guideline value for the general public. Therefore, for example, in the radio frequency and microwave frequency ranges, the maximum levels you might experience in the environment or in your home are at least 50 times lower than the threshold level at which first behavioral changes in animals become apparent.²⁰⁸

Just as a burn from a light bulb damages the skin, standing too close to a high-power antenna or other electromagnetic-transmission source can cause burns,²⁰⁹ and for that reason, the risk of burns from electromagnetic pollution should be monitored as a risk element, just like anything else in the environment. Thresholds must be determined, and scientific care must be taken to make sure that they are not crossed.

Even most skeptics agree that a minimum threshold exists, a point below which electromagnetic exposure causes no damage: “[t]here is a big task ahead to define what the lowest level of safe exposure could be,” says Ross Adley, a neurosurgeon who believes that the threshold is very low, and he warns that “[i]ncreasingly, wherever we go, we will be immersed in a sea of low-level, pulsed microwave signals.”²¹⁰ The debate over how much electromagnetic exposure is dangerous will likely con-

207. See WHO Online Publication, EMF Primer: Specific Absorption Rate, at <http://www.wirc.org/primer/sar.shtml>.

208. See WHO Online Publication, About Electromagnetic Fields, at <http://www.who.int/peh-emf/about/WhatisEMF/en/index4.html>.

209. Federal Emissions Guidelines, *supra* note 191, at 15127, 15130–36, 15176 (noting the occurrence of burns); see also Int’l Comm’n on Non-Ionizing Radiation Protection, *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)*, in HEALTH PHYSICS, Apr. 1998, at 496 and 508, available at <http://www.icnirp.de/documents/emfgdl.pdf> (advising that burns, including severe ones, can occur from overexposure to non-ionizing radiation).

210. David Kirkpatrick, *Ross Adey: “Wherever we go, we will be immersed in a sea of low-level, pulsed microwave signals”*, FORTUNE, Oct. 9, 2000, at 266.

tinue for years, and should evolve along with technology.²¹¹ In the words of science writer Robert Pool,

[f]or better or worse, technology has changed. Our days of innocence, when machines were solely a product of larger-than-life inventors and hardworking engineers, are gone. Increasingly, technology will be a joint effort, with its design shaped not only by engineers and executives but also psychologists, political scientists, management theorists, risk specialists, regulators and courts, and the general public. It will not be a neat system. It is probably not the best system. But, given the power and complexity of modern technology, it is likely our only choice.²¹²

Whether or not the system that Robert Pool has described is really our “only choice” would likely be challenged by commentators like Jon Hanson and Douglas Kysar, who have found the existence of manufacturer manipulation of product-risk perceptions in all kinds of industries, from food products’ bogus low-fat claims to the promotional efforts of pharmaceutical-drug manufacturers to obtain FDA approval.²¹³ Hanson and Kysar would suggest that consumers do have choices and that manufacturers should be held accountable in instances where they misrepresent their products and incite consumers to make incorrect choices based on their claims. In the meantime, however, the policy decisions have been made by the FCC, and its discretion in this area has been firmly upheld by the courts.²¹⁴ Happily, numerous independent

211. See Isobel Smith, *Electromagnetic Radiation and Health Risks: Cell Phones and Microwave Radiation in New Zealand*, 59 ENVTL. HEALTH 20 (July–Aug. 1996).

There are a few studies of controlled exposure of human volunteers for brief periods. These studies have established thresholds for feeling warmth and pain due to [radio frequency and microwave] radiation . . . There is clear evidence of a range of biological effects, including effects adverse to the health of exposed animals and humans, resulting from radiation doses at levels high enough to cause tissue heating (the so-called thermal threshold). However, there is disagreement among scientists about whether there is conclusive evidence of adverse effects of doses below this threshold.

Id.

212. ROBERT POOL, *BEYOND ENGINEERING: HOW SOCIETY SHAPES TECHNOLOGY* 305 (1997).

213. Hanson & Kysar, *supra* note 183, at 1451–62.

214. See *Cellular Phone Taskforce v. F.C.C.*, 205 F.3d 82, 91–92 (2d Cir. 2000). This case upholds FCC health guidelines: “[t]he argument that the FCC should create greater safety margins in its guidelines to account for uncertain data is a policy question, not a legal one. As a policy matter, an agency confronted with scientific uncertainty has some leeway to resolve that uncertainty by means of more regulation or less. . . . The FCC concluded that requiring exposure to be kept as low as reasonably achievable in the face of scientific uncertainty would be inconsistent with its mandate to “balance between the need to protect the public and workers from exposure to potentially harmful RF electromagnetic fields and the requirement that

scientific studies also indicate a well-founded basis for our modern understanding of the risks of the various transmission products that use the electromagnetic spectrum.²¹⁵

D. Ecological Imbalances and Harm Caused by Under Exploitation and Overexploitation of Electromagnetic Spectrum

We have seen that FCC regulations constrain users of electromagnetic spectrum to operate within very limited frequency allocations, which can cause overexploitation: AT&T Wireless, for example, must operate *only* within its allocated license area, which may theoretically be oversubscribed in Denver or any market where sales are very strong, while the same frequencies may be under-subscribed in Austin. Thus, there is a possibility of overexploitation (i.e., unsustainable consumption) in Denver that will leave consumers unable to maintain phone calls, and that will incur social costs and resource inefficiencies, while the theoretical corollary of under exploitation in Austin will also be harmful because valuable wireless frequencies will not be able to be used by others.

Underused spectrum does not necessarily reflect a lack of demand: it proves only that there is a lack of demand for a particular part of the spectrum as it is being used by the *company's product* that the FCC has authorized. Under the centrally planned command and control system that has been described above, entrepreneurs cannot use the spectrum for any purpose other than the one that it is authorized. Thus, although only 11 percent of the television spectrum is in use at any given time, this does not mean that there is a lack of demand for the remaining 89 percent. Although it may be true that there is a lack of demand for the remaining 89 percent of television broadcast spectrum, since existing rules only allow television broadcasts over that spectrum, other possible uses of it, such as mobile technologies, wireless Internet, and other services, are prohibited from occupying this valuable resource. And although market mechanisms are beginning to open up and encourage

industry be allowed to provide telecommunications services to the public in the most efficient and practical manner possible." This policy conclusion is neither irrational, arbitrary nor capricious and we decline to disturb it.

215. See, e.g., FED. COMM. COMM'N OFFICE OF ENG'G & TECH., OET BULLETIN No. 56, QUESTIONS AND ANSWERS ABOUT THE BIOLOGICAL EFFECTS AND POTENTIAL HAZARDS OF RADIOFREQUENCY ELECTROMAGNETIC FIELDS (Aug. 1999), available at http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet56/oet56e4.pdf. Also, there are several additional sources on a dedicated website that the FCC has set up regarding electromagnetic safety. See <http://www.fcc.gov/oet/rfsafety/>.

subleasing of excess spectrum,²¹⁶ there is to date no evidence that this system will work.

In addition to harm caused by high-pollution transmission levels that can theoretically cause damage to humans (described in the preceding section), overexploitation can cause electromagnetic pollution in two additional forms: (a) in the form of overcrowding and interference in frequencies that are over subscribed,²¹⁷ and (b) in the form of a (small but growing) number of “pirate” users who are frustrated with regulations and therefore build sites to operate with unconventional antennas for access or transmission of wireless Internet (for example, modified booster antennas crafted from soup cans, called “cantennas”).²¹⁸ Federal regulations do not solve pirate-radio problems that are exacerbated by the systematic underuse of spectrum that is not yet available for access.²¹⁹ Overexploitation in certain frequency bands can be the product of pent-up demand, which is manifested by the *thousands* of applications for low-power FM radio stations that have been made, and the presence of many pirate radio stations.²²⁰

Under exploitation of a natural resource can be as problematic as overconsumption of it, and Hazlett sets this idea up as the opposite of the “tragedy of the commons” by calling it the “tragedy of the *uncommons*,”

216. See Report and Order and Further Notice of Proposed Rulemaking Regarding Spectrum Subleasing Rules (FCC 03-113), May 15, 2003, available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-234562A1.pdf.

217. Alan S. Kay, *WiFi Promise Vs. Reality: The Wireless Technology Gets Put to the Speed Test*, WASH. POST, Apr. 20, 2003, at H9 (explaining that other devices that operate within WiFi's 2.4 GHz frequency band, such as microwave ovens and cordless phones, can “pollute” the WiFi frequencies and impede performance).

218. See John Patrick, *Are You a WiFi Pirate?*, ZDNET.COM, Aug. 21, 2002, at <http://zdnet.com.com/2100-1107-954659.html> (reporting that antennas made from potato-chip cans may increase the reception of WiFi signals from a few feet to several miles); Desa Philadelphia, *Global Briefing*, TIME, Oct. 28, 2002, at A5 (describing home-made “cantennas” made from soup or potato-chip cans); see also The Super Cantenna Product Website, at <http://www.cantenna.com>.

219. A concept called “warchalking” and “wardriving” is a movement of users who drive around urban areas and pinpoint locations for free access to wireless networks. This is a form of piracy. See, e.g., <http://www.warchalking.org>; <http://www.warchalking.us> (many other websites can be found through a Google search).

220. See Jesse Walker, *The FCC's Absurd New Crusade: REBEL RADIO*, THE NEW REPUBLIC, Mar. 9, 1998 (noting that the many pirate radio stations cause little harm against broadcasters, but that the FCC goes after them because of broadcaster power in government); see also *Blacks Protest FCC for 'Pirate' Radio*, NEW PITTSBURGH COURIER, Oct. 14, 1998, at A1 (describing a large group of protesters who operate pirate radio stations and declare themselves to be “organized and broadcasting as . . . several thousand free radio stations . . . as a form of civil disobedience” in protest of the FCC, large corporations, and government control); Pirate Radio Central Website, at <http://www.blackcatsystems.com/radio/pirate.html>; Christian Pirate Radio Website, at <http://www.mycpr.com/>; Seton Hall's Pirate Radio Station Website, at <http://www.wsou.net/>.

in which severe access restrictions leave socially valuable uses untappable.²²¹

Overconsumption and underconsumption of electromagnetic spectrum are not unlike the traditional resource-allocation problems found in other areas of economics, because the government does not allow the consumption of electromagnetic spectrum to be allocated by market forces. Resistance to change in the existing system is great, not unlike the resistance seen in the 1980s when Europe was criticized for poorly planned agricultural production that induced farmers to produce millions of gallons of excess wine and butter, metaphorically known as “wine lakes” and “butter mountains” because of their mammoth proportions.²²² Farmers had become used to comfortable subsidies, and when government set out to change them, for years the farmers blocked plazas and freeways by dumping tons of excess fruit and vegetables and creating social mayhem.²²³ The policymakers’ flawed theory was that it was better to have a cycle of production and destruction of excess wine and butter rather than to let the market figure things out. Ultimately modern economic-allocation theory prevailed over centralized planning. Except, that is, in the area of wireless spectrum allocation.

In the electromagnetic spectrum there are wine lakes and butter mountains: broadcasting frequencies are underused, not because of demand problems, but because government will not allow them to be used for anything but television broadcasting when they could be used for other purposes. Massive growth in Wi-Fi, for example, can be seen by its presence in Starbucks coffee shops²²⁴ and on university campuses,²²⁵ and some cities are offering access for free at airports and other public areas.²²⁶ And Wi-Fi’s growth is just beginning.²²⁷ Interestingly, numerous

221. Hazlett, *supra* note 68, at 382.

222. See Thomas Moore, *Of Wine and Lakes*, FORTUNE, Jan. 7, 1985, at 8 (noting that Europe spent \$800 million in 1984 to get rid of excess wine that was created by subsidies); William R. Doerner, *The European Community’s ‘Butter Mountain’ and ‘Wine Lake’*, TIME INT’L, Oct. 1, 1990, at 24 (describing the wine lakes and butter mountains and excessive overproduction of the 1980’s stemming from subsidies).

223. *Id.* (describing the many protests in the South of France).

224. See *VoiceStream Expands Wireless Web Access in Starbucks Outlets*, WALL ST. J., Aug. 21, 2002 at C9 (noting that as of August, 2002, 500 Starbucks outlets had been installed and more than 2,000 outlets would be outfitted with Wi-Fi wireless access by the end of the year).

225. Michelle Kessler, *Public Wi-Fi Networks Growing Rapidly*, USA TODAY, June 2, 2003, at 11E (noting the rapid expansion of Wi-Fi networks at university campuses and many other public and semi-public locations).

226. Jesse Drucker, *AT&T Wireless to Add Wi-Fi Service*, WALL ST. J., Jan. 28, 2003, at D2 (discussing a plan by AT&T to set up Wi-Fi service at 475 hotels and at many airports and other public places).

227. The White House has specifically denoted Wi-Fi as one of the major growth areas in an annex to the Presidential Memo on Spectrum Policy, *supra* note 32. The Annex states

companies (such as AT&T, T-Mobile and others who *also* hold exclusive licenses for cellular, PCS and other uses)²²⁸ are scrambling to use the limited-but-open 2.4 GHz frequencies. Just as occurred with the centrally-planned production of butter and wine, the centralized plan which (happily) created a new market in 2.4 GHz risks creating overconsumption in the limited open spectrum, while causing underconsumption of other areas of electromagnetic spectrum (such as television channels, which are prohibited from offering Internet). Ultimately, this can create an ecological imbalance and lead to consumer harm. Broadcasters, empowered by government regulations are, like the European farmers of the 1980s, consuming electromagnetic spectrum, creating electromagnetic butter mountains, while their sister telecommunications companies are scrambling to build-out a limited area of open Wi-Fi spectrum. In the case of butter and wine, many of these excesses were destroyed causing unnecessary ecological waste, and it was not until the European countries formed a Common Agricultural Policy that directly attacked inefficient waste created by centralized planning that anything was done about it.²²⁹ If governments do not come up with a solution on their own, a separate mechanism must be found to allay these problems and let consumers set an ecological balance of the electromagnetic spectrum.

III. THE NEW TECHNOLOGIES UWB AND SDR: THE HIGH-TECH NAVIGATORS OF ELECTROMAGNETIC SPECTRUM

One of the main reasons that the way the electromagnetic spectrum is presently regulated is inadequate is that two new technologies work by using much of the spectrum nearly simultaneously, yet they do not compete with other broadcasters. If these technologies become widely used, they will *not* create a cacophony of competing voices, and so it will not be necessary to confine each broadcaster to a narrow band of spectrum.

that there is massive demand for wireless services, noting that there are over 140 million wireless phone customers and that WiFi systems are becoming ubiquitous. *See* Press Release, The White House, Fact Sheet on Spectrum Management (June 5, 2003), *available at* <http://www.whitehouse.gov/news/releases/2003/06/20030605-5.html>. Unfortunately, the government proposes freeing up additional “commons” Wi-Fi-type frequencies in the 5 GHz range. *Id.* While it is good to have more commons-type frequencies available, the characteristics of the 5 GHz frequencies are such that they can not penetrate obstacles and will therefore be of little use indoors or for any mobile services.

228. *See id.*

229. *See* Robert P. Cooper, *The European Community's Prodigal Son—the Common Agricultural Policy Undergoes Reform: Will Multilateral Trading Schemes Fostered by the GATT Blossom or Wither and Die?*, 1 COLUM. J. EUR. L. 233, 282 (1995) (discussing the butter mountains and wine lakes of the 1980s and the effect that the Common Agricultural Policy had on their reduction).

Ultra Wideband (“UWB”) and Software Defined Radio (“SDR”), are two powerful new ways of using wireless spectrum, and both can potentially use the spectrum as a commons, changing the way wireless works and making electromagnetic spectrum like an ocean that is so vast that it does not need to be parceled out into individual properties.²³⁰ The problem is that under existing FCC rules, these new methods of broadcasting are effectively prohibited or highly restricted, because owners of the new technologies would need to obtain large numbers of broadcasting licenses to acquire the right to use the many different frequencies that their technologies require.

Although UWB and SDR technologies are different, they both allow thousands of users to occupy the same bandwidth without interfering with one another.²³¹ UWB devices operate at extremely low power levels, below the noise floor that disturbs the operation of other devices functioning within electromagnetic spectrum, like a soft whisper heard only by the intended listener. SDR, on the other hand, can operate at higher levels through a technique known as “interweaving,”²³² occupying frequencies only when a priority user (such as the owner) is not using them. Also known as “agile radio,” it deploys “smart” navigators that seek only unused spectrum.²³³ As the science writer George Gilder has put it, these two technologies should change our paradigm of the electromagnetic spectrum’s vastness after their use becomes commonplace, for, he writes, “[y]ou can no more lease electromagnetic waves than you can lease ocean waves.”²³⁴

230. See *Freeing the Airwaves*, THE ECONOMIST, May 31, 2003, at 26 (discussing the property vs. commons debate and noting that technologies such as UWB and SDR make powerful arguments that the spectrum should be treated as a commons).

231. See Buck, *supra* note 168, at 6 (discussing the advantages of a commons regime, particularly in light of UWB and technologies that use etiquette standards—such as spread spectrum technologies); see also David Reed, *The Sky’s No Longer the Limit*, CONTEXT MAG., Dec. 2002, available at <http://www.contextmag.com/archives/200212/Insight2TheSkysNoLonger.asp> (presenting an overview of new technologies and arguing that the spectrum is potentially limitless); David Reed’s website, at www.reed.com/OpenSpectrum (containing a full source of academic literature and argumentation for open spectrum).

232. See Benkler, *supra* note 163, at 10.

233. See Dale N. Hatfield, Software Defined Radio: A Regulator’s Perspective, Keynote Address at the SDR Forum 19th Meeting (June 20, 2000), available at <http://www.fcc.gov/oet/speeches/sdrforumsph.html>.

234. GEORGE GILDER, TELECOSM 163 (2000). *But see* Torres, *supra* note 74, at 537–38. Torres notes that there have been conflicts between fishermen and petroleum interests on the outer shelf. The Fishermen’s Contingency Fund was created to address competing interests and to provide compensation for injured fishermen.

A. Ultra Wideband

UWB technology broadcasts at extremely high capacity, at very low power, and across all frequency bands. It broadcasts at the “noise floor” where it does not interfere with concurrent transmitters, and proponents of UWB technology claim that it can eliminate wireless airwave congestion, reduce power consumption requirements to a minimum, and improve the safety applications of wireless in many dramatic ways.²³⁵ Operationally, the technology is said to be useable in wireless Local Area Network applications within buildings,²³⁶ secure military communications, and through-the-wall radar and underground imaging used to rescue people buried in natural disasters (like earthquakes).²³⁷ For years the rights to UWB’s intellectual property were tied up in a battle between private industry and the federal government that private industry eventually won,²³⁸ notwithstanding the fact that the technology has numerous military applications, such as covert communications, radar detection, missile-guidance systems,²³⁹ and usages that employ its unique ability to depict size and distance accurately. UWB is being developed to replace current automobile collision-avoidance systems,²⁴⁰ and many of

235. See *Cutting the Ties That Bind*, THE ECONOMIST, Sept. 19, 2002, at 6 (discussing UWB technology and the chipsets that are under development by various companies).

236. See *Ultra-Wideband Backers Say They’re Next Wave*, TR DAILY, Sept. 28, 1999, available at <http://www.time-domain.com/news/articles/archive.html> (mentioning the application of the devices in wireless LANs).

237. See David G. Leeper, *Wireless Data Buster*, SCI. AM., May 2002, at 64 (providing an excellent overview of the history of radio and development history of UWB); see also Amara D. Angelica, *Powered by Pulse*, TECH WEEK, May 3, 1999, at <http://www.timedomain.com/Files/PDF/news/TechWeek.pdf> (giving a summary of future applications of UWB technology in communications systems).

238. See Peter Eisler, *Did The U.S. ‘Rip Off’ An Invention That Could Change The World?*, USA TODAY, Apr. 9, 1999, at 1A. The article discusses the history of an intellectual-property dispute between Lawrence Livermore National Laboratory and Time Domain. *Id.* The U.S. Government also disclosed security concerns about the technology. Ultimately, the dispute was resolved in most counts in favor of Time Domain. *Id.*

239. See Ira W. Merritt, *Proliferation and Significance of Radio Frequency Weapons Technology*, Testimony before the Joint Economic Committee (Feb. 25, 1992) (document available in the Congressional Testimony by Federal Document Clearing House for Wednesday, Feb. 25, 1998) (furnishing extensive testimony of Dr. Merritt on several applications of UWB in weapons systems); see also Solicitation re: Engineering Services and Development, in the Federal Information & News Dispatch (Solicitation No. N00178-98-Q-0043, Mar. 31, 1998), reprinted in *Commerce Business Daily*, PSA#2063, Mar. 31, 1998, available at [http://www.fbodaily.com/cbd/archive/1998/03\(March\)/31-Mar-1998/59sol035.htm](http://www.fbodaily.com/cbd/archive/1998/03(March)/31-Mar-1998/59sol035.htm) (recounting the government’s awarding a contract to an engineering firm to deploy UWB technology for use in the Hummingbird unmanned aerial vehicle).

240. Dawn Stover, *Radar on a Chip: 101 Uses in Your Life*, POPULAR SCI., Mar. 1995, at 107 (discussing ultra wideband’s potential contribution to collision-avoidance technology).

its other applications appear to be interchangeable with existing wireless technologies, such as wireless telephony.²⁴¹

As early as 1998 and 1999, UWB technology received lots of favorable press.²⁴² In an attempt to expedite the regulatory process, in 1998 a loose coalition of more than fifty companies, scholars, and organizations formed the Ultra Wideband Working Group,²⁴³ and UWB technology quickly gained support because of its potential to revolutionize the way that wireless spectrum is used.²⁴⁴

The technical characteristics of a UWB radio include (a) ultra short-duration pulses yielding ultrawide bandwidth signals, (b) extremely low-power spectral densities, (c) multi-mile ranges with sub-milliwatt average-power levels, and (d) excellent immunity to jamming and interference from other radio systems.²⁴⁵ UWB does not operate within any single band, and because it operates with “pulses” at a very low energy levels, it could open up the capacity for radio communication and conceivably eliminate the need for spectrum allocation altogether. For its pulses do not have a tendency to interfere with each other or with other radio waves, making its widespread application capable of opening up a nearly infinite amount of “new radio real estate.”²⁴⁶ Spectrum is often described as a “pipe,” “a freeway,” or, perhaps most famously, a “tunnel

241. Bruce Schoenfeld, *Welcome to Idea Town*, YOUR COMPANY, May/June 1999, at 56 (giving a detailed history of Time Domain, the pioneer firm that developed UWB technology, and an overview of tested applications and future applications).

242. See Georgie Raik-Allen, *Radical Wireless Technology May Have Its Time*, RED HERRING, May 25, 1999 (discussing UWB's many potential applications and the hurdles that it faced at the FCC).

243. See The Ultra Wideband Industry Website, at <http://www.uwb.org>.

244. See Kevin Maney, *Pulsing with Promise New Digital Technology Likely to Revolutionize How We Live*, USA TODAY, Apr. 9, 1999, at 1B.

Certainly the technology could have a profound—maybe devastating—effect on several existing industries. Companies in TV, radio and telecommunications have spent billions of dollars buying rights to slots on the radio spectrum and billions more developing products to use on those slots. It might take decades, but Time Domain's technology could make those rights far less valuable and the products obsolete. ‘This is really a paradigm buster’ says Bennett Kobb, author of SpectrumGuide, which keeps tabs on radio spectrum.

Id.; see also Heather Forsgren Weaver, *FCC to Start Ultra-wideband Rule Making*, RCR, Oct. 11, 1999, at 14, available at <http://www.timedomain.com/Files/PDF/news/RCR.pdf> (discussing the inventors' statements about the profound effect that the technology could have on the economy).

245. See Timothy J. Shepard, *A Channel Access Scheme for Large Dense Packet Radio Networks*, 26 COMPUTER COMM. REV. 219 (Oct. 1996), available at <http://wireless.oldcolo.com/course/shepard.pdf>. This is an excerpt of Shepard's often quoted thesis demonstrating that millions of radios can co-exist in the same space without interfering with others and is considered to be a seminal study for the FCC Issues of new UWB Rules.

246. Maney, *supra* note 244.

without any edges,”²⁴⁷ and UWB’s operation within spectrum is said to be the same as “background noise,” which already exists in the spectrum through the operation of any number of devices. (For example, a light bulb or a fan emits a certain amount of radio waves, constituting radio “background noise.”) UWB is said to operate within the low thresholds of background noise,²⁴⁸ and a UWB device is therefore capable of entering the commons, and navigating within it (“fishing” and “hunting” for its intended listener) without disturbing the other users. With UWB, there is no need for a pipe, a freeway or a tunnel.

In 2002, UWB received limited FCC approval, but its operation is severely constrained by a “mask,” which is a sort of rev-limiter²⁴⁹ that handicaps its power transmission to the point where it is almost useless exactly where it would be the most valuable: within the wall-penetrating frequencies below 3 GHz.²⁵⁰ Created even though industry provided overwhelming evidence showing that interference is not a concern, the FCC mask places severe limitations on efficiency, effectively forcing UWB to constrain most of its broadcasting to frequencies *above* 3.1 GHz. The Commission has promised to review the interference levels within “the next six to 12 months,”²⁵¹ but as of the date this Article was written, the topic has not been revisited and lobbying efforts by industry, who paid millions for exclusive PCS licenses, and television broadcasters, who see enormous value in the unused frequencies which they possess, will probably continue for some time.²⁵²

247. Coase, *supra* note 79 (discussing the difficulty of finding an appropriate metaphor for spectrum, and noting the irony of calling it a “tunnel” since it is a “tunnel without any edges” and is therefore “something that does not exist”).

248. PUBLIC SAFETY WIRELESS NETWORK, EMERGING WIRELESS TECHNOLOGIES: ULTRA WIDEBAND TECHNOLOGY AND ITS EFFECTS ON GPS 6 (May 2002), *available at* http://www.pswn.gov/admin/librarydocs10/uwb_gps_final.pdf (describing a Johns Hopkins study which concluded that UWB transmissions can operate in the same background noise as other electronic devices without causing interference).

249. A “rev-limiter” is a device which is installed on an engine to prevent the user from operating it at too high of a rate and damaging the motor.

250. Ultra-Wideband Transmission Systems, ET Docket No. 98-153, First Report and Order, FCC 02-48 (Apr. 22, 2002) [hereinafter FCC 02-48], *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-02-48A1.pdf.

251. *Id.* at ¶ 273.

252. See Yuki Noguchi, *3G, or Not to Be?: Wireless Technologies Forge Ahead Despite Uncertainties*, THE WASH. POST, Apr. 5, 2002, at E1 (noting that companies like Verizon and Voice Stream that paid billions for licenses are threatened by new technologies like UWB that do not require licenses); see also *Ultra-Wideband: FCC Stresses Market Needs*, GLOBAL POSITIONING & NAVIGATION NEWS, Apr. 4, 2001, at 1 (noting that GPS users are among the greatest opponents of UWB because GPS operates in such a low power basis).

The justification for the operational-restrictions mask—a temporary measure to be used while the new technology is tried out—was explained in the FCC’s First Report and Order:²⁵³

The limits we are adopting in this proceeding are considerably lower in some frequency ranges than the current Part 15 levels. While these limits may prove to be lower than what is necessary, we believe that such caution is needed in the early stages of UWB implementation. Once additional experience is gained with this equipment and a better understanding develops regarding operating frequency and allowable emissions levels, we may be able to revisit these limits.

The mask has been widely criticized,²⁵⁴ for as Stuart Benjamin has pointed out, it is perhaps even unconstitutional to restrict UWB uses to the extent that (a) the technology offers an alternative medium for First Amendment expression and (b) UWB operation in no way detracts from the existing uses that license holders make of the spectrum.²⁵⁵

The FCC’s decision, however, resulted from struggling to balance the goal of promoting new technologies with the concerns of industry, and it is saddled with rulemaking procedures that make it difficult to please everyone. The resulting “mask” system does allow UWB technology to be introduced, to obtain private funding, and to get products utilizing it out into the marketplace,²⁵⁶ and so some commentators believe that the “mask” was a good compromise.²⁵⁷ UWB pioneer Time Domain, for instance, seems happy with it for the time being,²⁵⁸ and producers are already announcing special chipset radios designed to operate within the

253. FCC 02-48, *supra* note 250, at ¶ 223.

254. See generally *Selected FCC Docket Summaries, Winter 2002*, 11 *COMMLAW CON-SPECTUS* 223, 229 (2003) (summarizing the Report and Order, and noting that the emission limits adopted for UWB devices are significantly more stringent than those imposed on other Part 15 devices).

255. Benjamin, *supra* note 19, at 91.

256. For an overview of UWB and products on the market, see <http://www.ultrawidebandplanet.com>.

257. See The FCC’s UWB Proceeding: An Examination of the Government’s Spectrum Management Process, Subcommittee on Telecommunications and the Internet (June 5, 2002), available at <http://energycommerce.house.gov/107/hearings/06052002Hearing569/print.htm> (The report states that “[w]e are dealing with a new technology and feel the masks are a good compromise between allowing the technology into the spectrum on a nonlicensed basis and the need to protect vital current—and future federal and civil spectrum dependent services that have a good chance to be in the same operating area).

258. See Patrick Mannion, *Ultrawideband Radio Set to Redefine Wireless Signaling*, *EE TIMES*, Sept. 12, 2002, at <http://www.eetimes.com/story/OEG20020911S0072>. For a discussion of the “mask” and noting that industry, on the whole, is agreeable to this compromise so long as the topic is in fact revisited as promised by the FCC.

mask. Amazingly, these sell for as little as \$19.95 per unit,²⁵⁹ which is relatively inexpensive, even if double the price predicted in industry forecasts.²⁶⁰

B. *Software-Defined Radio*

Unlike UWB, which operates to some extent across the entire frequency band at very low levels at all times, Software-Defined Radio operates in specific frequencies, at specific times, at varying levels. As George Gilder writes, “[s]mart radios suggest not a beach but the endless waves of the ocean itself,”²⁶¹ for SDR is a “smart” product made smart by software that controls it and steers it through the spectrum.²⁶² SDR is also “cognitive” in that its software analyzes the spectrum and determines which band to use for transmission. Inputs are programmable and flexible enough to include split-second review based on network loading (the number of speakers and listeners using a given frequency range), interference level (the problems that pre-existing speakers and listeners are having understanding each other), and cost of airtime (some frequencies may cost more to use than others, like frequencies below 3 GHz that penetrate walls and obstructions to reach their receiver). SDR selects the service that it will utilize in terms of both the carrier and the bandwidth occupied.²⁶³

SDR has benefited from great interest in it by the FCC, and a Notice of Inquiry (“NOI”) was initiated in 2000.²⁶⁴ Former FCC Chairman William Kennard has expressed enthusiasm for the technology in his published statement at the opening of the NOI:

[T]his proceeding on Software Defined Radio is another critical step in the development of a more fluid spectrum market. Software defined radios are smart devices that can make good use of underused spectrum. They can operate as a cell phone one

259. See Patrick Mannion, *UWB Chip Set Meets FCC Spectral Mask*, EE TIMES, Aug. 1, 2002, at www.commsdesign.com/story/OEG20020801S0014.

260. See *Ultra-Wideband Market Awaits Regulatory Approval*, WIRELESS TODAY, Sept. 28, 1999, at <http://www.time-domain.com/news/articles/archive.html>. The Chief Technology officer of Time Domain Corporation, founder of the technology, predicts the production costs of the chip to be \$8.00. *Id.* Licensing costs and other costs associated with the patented technology are not included in this figure. *Id.*

261. Gilder, *supra* note 234, at 163.

262. See *Watch This Airspace*, THE ECONOMIST, June 22, 2002, at 14 (discussing “smart antennas” and “smart radios” and noting that it is a result of processing power’s plunging prices that software has become integrated with what used to be considered “dumb” devices).

263. Dan Sweeney, *Shape Changer: Software Defined Radio and the Indefinite Future*, AMERICA’S NETWORK, Dec. 1, 2000, at 75 (discussing the general concept of SDR and its cognitive derivatives).

264. Comm’n Action, Mar. 17, 2000, by Notice of Inquiry (FCC 00-103).

minute, a PCS phone the next, a taxi dispatch radio later on and a two-way pager after that. They can literally bridge the gaps created by differences in frequency and transmission standards. In this way, they can make all spectrum users from average consumers to police, fire, and EMS workers who need to talk to each other more productive and efficient.²⁶⁵

The regulatory problem that SDR would have faced under the previous rules was that a manufacturer would have had to seek new approval and a new identification number for any piece of equipment that broadcast at a new frequency, power, or type of modulation. This framework would have been fundamentally incompatible with SDR, since radios employing it change frequency, power, or modulation type constantly in the field. Fortunately the FCC amended Part 2 to allow SDR devices to operate without the burdensome requirements of legacy regulations,²⁶⁶ but the amendments affect mainly equipment and transmitters. These changes will be useless unless many other regulations are relaxed enough to allow SDR devices to operate within frequency ranges that are presently under the control of commercial broadcasters and others with exclusive rights.

IV. THE PUBLIC TRUST

A. *Why the Public-Trust Doctrine Is Needed to Remedy the Present System of Regulating the Spectrum*

Sweeping reform of the spectrum's regulatory scheme is not likely, but, rather, modernization will proceed piecemeal in response to new technologies, new ideas, academic criticism, political pressure, etc. The public-trust doctrine, which has long been successfully applied to other natural resources, is a legal means that is at hand to remedy some of the immediate problems that have been identified in the previous section. In this section, an overview of the public-trust doctrine will be provided. Since the idea of applying the public-trust doctrine to the electromagnetic spectrum is quite new, this Article will lead the reader through many examples of its application. Some thoughts on procedural mechanisms for application to the electromagnetic spectrum will be explored in Section VI.

265. Statement of FCC Chairman William E. Kennard, Notice of Inquiry on Software Defined Radio, OET Docket No. 00-47 (Dec. 7, 2000), available at <http://www.fcc.gov/Speeches/Kennard/Statements/2000/stwek020.html>.

266. FCC First Report and Order, In the Matter of Authorization and Use of Software Defined Radios, ET Docket No. 00-47 (adopted Sept. 13, 2001, released Sept. 14, 2001), available at http://ftp.fcc.gov/Bureaus/Engineering_Technology/Orders/2001/fcc01264.txt.

The public-trust doctrine relates to the ownership, protection, and use of essential natural and cultural resources, and acts as a sort of common-law check-and-balance against governmental allocation mistakes with regard to public natural resources. The public-trust doctrine has proved useful in the past to correct government misallocations, and it can also do so with the regulation of the electromagnetic spectrum. The public-trust doctrine can—and has—“reached back” and corrected governmental natural-resources-allocation mistakes made long ago (not unlike the spectrum giveaways). For example, the 1983 California Supreme Court decision *Mono Lake*²⁶⁷ reached back to state water allocation decisions made over forty years before and reversed them, holding that California’s government has an “affirmative duty to take the public trust into account” when it makes decisions affecting natural resources, and that it also has a duty of continuing supervision over these resources which allows and may require modification of such decisions whenever they were made.²⁶⁸ In other states, courts have held that the public-trust doctrine has “emerged from the watery depths [of navigable waterways] to embrace the dry sand area of a beach, rural parklands, a historic battlefield, wildlife, archeological remains, and even a downtown area.”²⁶⁹ Courts have done this by relying on academic opinions and recommendations for extension of the public trust to natural resources,²⁷⁰ and this Article hopes to make a first step in a similar extension of the public-trust doctrine to the electromagnetic spectrum.

The public-trust doctrine has been used both to prevent government from conveying public resources to private enterprises,²⁷¹ and to guarantee the public access to natural resources *after* the resources have been conveyed to private interests²⁷² (particularly for purposes of “fishing, fowling and navigation”).²⁷³ This Article asks the reader to take faith that the new technologies that have been described in Section III will allow the public to gain access to electromagnetic spectrum as modern technological fishers, fowlers, and navigators of this natural resource. Indeed,

267. *Nat’l Audobon Soc’y v. Superior Court of Alpine County*, 658 P.2d. 709 (Cal. 1983).

268. *Id.* at 728.

269. *State v. Sorensen*, 436 N.W.2d 358, 362 (Iowa, 1989).

270. The Iowa court cited Richard Lazarus, *Changing Conceptions of Property and Sovereignty in Natural Resources: Questioning the Public Trust Doctrine*, 71 IOWA L. REV. 631, 649 (1986).

271. *See Illinois Cent. R.R. v. Illinois*, 146 U.S. 387 (1892).

272. *Commonwealth v. Alger*, 61 Mass. 53, 67–68 (1851) (holding that intertidal waters are impressed with public rights via the Public-Trust Doctrine—even if the property owner’s title reaches to the low-tide line—preserving the public’s right to “fishing, fowling and navigation”).

273. *Arnold v. Mundy*, 6 N.J.L. 1, 9 (N.J. 1821) (involving oysters, but also applying to fishing, fowling and navigation rights, this was the first United States public-trust-doctrine case).

the electromagnetic spectrum is used to move information from one place to another just as intertidal waters are used to move goods, and so “navigation” within the spectrum should be a protected public right just as navigation within intertidal waters is protected.²⁷⁴

If the doctrine, which already affords people access to certain natural resources, is to be applied to electromagnetic spectrum, then the first question must be whether the spectrum is legally a natural resource. Supporting the conclusion that it is, the United States Supreme Court has stated that electromagnetic spectrum is a “scarce”²⁷⁵ “natural resource.”²⁷⁶ President Bush has also told us that the electromagnetic spectrum is “a vital and limited national resource.”²⁷⁷

Given that the electromagnetic spectrum is a natural resource—the easy part—the next question is whether the public-trust doctrine should be applied to it. Commentators have argued convincingly that the public-trust doctrine should be extended to *all* natural resources,²⁷⁸ and a few wise advocates have suggested that electromagnetic spectrum should be included in the public trust as a subset of “all natural resources.”²⁷⁹ A smaller number of authorities have flirted with the direct possibility of marrying electromagnetic spectrum and the public-trust doctrine.²⁸⁰ The

274. Navigation on the oceans is of course already a protected public right, but since the oceans have not been subject to private law—unlike intertidal waters, which are sometimes transferred to private ownership—the analogy of intertidal waters to the spectrum is a better argument than the analogy of the ocean.

275. See *Red Lion Broad. Co. v. F.C.C.*, 395 U.S. 367, 376 (1969) (calling electromagnetic spectrum a “scarce resource”); *F.C.C. v. League of Women Voters*, 468 U.S. 364, 377 (1984) (“The fundamental distinguishing characteristic of the new medium of broadcasting . . . is that [b]roadcast frequencies are a scarce resource.”).

276. See *Columbia Broad. Sys., Inc. v. Democratic Nat’l. Comm’n.*, 412 U.S. 94, 173–74 (1973) (making a direct link between electromagnetic spectrum and natural resources: “At the outset, it should be noted that both radio and television broadcasting utilize a natural resource—electromagnetic spectrum . . . [a]nd, although broadcasters are granted the temporary use of this valuable resource for terminable three-year periods, ‘ownership’ and ultimate control remain vested in the people of the United States.”).

277. Presidential Memo on Spectrum Policy, *supra* note 32.

278. Sax, *supra* note 2, at 557.

279. See MICHAEL CALABRESE, PRINCIPLES FOR SPECTRUM POLICY REFORM 5–6 (New Am. Found. Working Paper, Oct. 2001), available at http://www.newamericafoundation.org/Download_Docs/pdfs/Pub_File_610_1.pdf.

280. See Torres, *supra* note 74, 528–32, 536–38, 560–62 (discussing separately the public-trust doctrine, public ownership of electromagnetic spectrum, and the Coase theorem); Carol Rose, *The Comedy of the Commons: Custom, Commerce, and Inherently Public Property*, 53 U. CHI. L. REV. 711 (1986). (although Carol Rose’s insightful article was written before Internet and spectrum were hot topics, it is often cited by pundits for its descriptions of “inherently public property.” Even though she does not deal with electromagnetic spectrum her article is quickly gaining momentum as a point of departure for electromagnetic spectrum allocation); LESSIG, *supra* note 42, at 86–88 (describing Carol Rose’s analysis of public roads, navigable waterways, and other commons and acknowledging its utility in “modern” commons, such as the Internet and computer networks); Philip J. Weiser, *The Internet, Innovation,*

New America Foundation,²⁸¹ for example, has argued in a creative *amicus* brief²⁸² (filed in connection with a Federal Communications Commission Notice of Inquiry related to spectrum policies²⁸³) that the public-trust doctrine deprives Congress of the authority to sell off the public airwaves:

The more fundamental underpinning for common ownership and democratic control of the airwaves is that like other natural systems—including the oceans, navigable waterways and the atmosphere—spectrum is inherently a common asset. . . . Throughout history, both law and tradition have recognized that certain assets are inherently public and not subject to ownership—not by private parties, or even by the state. The classic examples from Roman law were roads, harbors, ports and navigable waterways. The Romans called this third category of property, *res publicae*, which has been . . . incorporated into . . . American law as the “public-trust doctrine.” The doctrine holds that, because of their unique characteristics, certain natural resources and systems are held in trust by the sovereign on behalf of all citizens.²⁸⁴

This reasoning is in line with the public-trust doctrine’s history,²⁸⁵ but it addresses only about half the doctrine’s potential. For the public-trust doctrine operates as a superior right guaranteeing qualified access to *all* kinds of property, whether it is owned privately, held by the state, or *unownable*, like the air and the sea. So the New America Foundation has

and Intellectual Property Policy, 103 COLUM. L. REV. 534, 584–87 (2003) (extending Carol Rose’s public property analogy to intellectual property, the Internet and implicitly to wireless communications).

281. The New America Foundation is a public policy institute which lobbies on various topics of public interest. See www.newamericafoundation.org; see also The New America Foundation’s Spectrum Policy Program Homepage, at www.spectrumpolicy.org.

282. See Comments of The New America Foundation, The Consumer Federation of America, Consumers Union, The Association of Independent Video and Filmmakers, The National Alliance for Media Arts and Culture, the Benton Foundation, the Center For Digital Democracy, United Church of Christ, Office of Communication, Inc, and the Media Access Project, , DA 02-1311, ET Docket No. 02-135 (July 8, 2002), at 14, available at http://www.newamerica.net/Download_Docs/pdfs/Pub_File_900_1.pdf (Accessed July 18, 2003).

283. See FCC Spectrum Policy Task Force Website, at www.fcc.gov/sptf; see also Press Release: Spectrum Policy Task Force Seeks Public Comment on Issues Related to Commission’s Spectrum Policies, DA 02-1311, ET Docket No. 02-135 (released June 6, 2002), available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-02-1311A1.pdf.

284. See New America Foundation Amicus Brief, *supra* note 282, at 14.

285. Carol Rose, *Romans, Roads, and Romantic Creators: Traditions of Public Property in the Information Age*, 66 LAW & CONTEMP. PROBS. 89, 97–100 (2003) (describing the history of the public-trust doctrine and its Roman-law *res publicae* roots).

combined a powerful common-law doctrine with a relatively new idea, but it has only considered the doctrine's application to the government's selling of public property to private interests, while ignoring one of the doctrine's most powerful (and often controversial) aspects: its ability to preserve certain rights in a natural resource for the public *even if* the government has conveyed the resource to a private party.²⁸⁶

Thus, applying the public-trust doctrine to the spectrum has been proposed before, but only to remedy one of the spectrum's problems (namely, the problem of much of it being essentially privately owned through exclusive licenses to large broadcasting companies). And it has been proposed to utilize only one characteristic of the public-trust doctrine, namely, its ability to defeat private ownership of natural resources. We will now look at how the doctrine's *other capability* (that is, its ability to place restrictions on the private ownership of a resource) can be used to address the *other problems* that the spectrum has.

1. The "Prohibition on Conveyance" and *Illinois Central*

There is a rich body of literature describing the public-trust doctrine's long history in Roman law,²⁸⁷ but that writing is only of general interest, because to understand the doctrine as it is employed today, one must note the contemporary distinction between the two different characteristics of the public-trust doctrine as it has developed in the past century. One category of doctrine, most often propounded by the "high-tide states,"²⁸⁸ asserts that public-trust property may not be conveyed to private ownership. Another set of doctrines, usually emanating from the "low-tide states,"²⁸⁹ says that the public trust lets the state make certain private conveyances, but the property remains *impressed* with certain reservations that are held for the public trust. I will call the first interpretation of the public-trust doctrine "prohibition on conveyance," and the second "conveyance with impression." These categories can be seen as two different paradigms: states that allow property ownership to the high-tide line, which lean towards prohibition on conveyance; and the minority of coastal states, which extend property ownership all the way

286. This article addresses in detail the various facets of the protection that the public-trust doctrine affords in Section II.

287. Almost every written comment on the public-trust doctrine begins with the following citation of Roman law and The Institutes of Justinian: "all of these things are by natural law common to all: air, flowing water, the sea and, consequently, the shores of the sea." See Patrick Deveney, *Title, Jus Publicum, and the Public Trust: An Historical Analysis*, 1 SEA GRANT L.J. 13, 23 (1976) (quoting The Institutes of Justinian); Rose, *supra* note 285 (discussing various Roman law property traditions).

288. See discussion *infra* at Section V.B.

289. See discussion *infra* at Section V.A.

to the low-tide line and which follow the conveyance-with-impression model.

The most cited United States case for the prohibition-on-conveyance interpretation of the public-trust doctrine is *Illinois Central Railroad v. Illinois*.²⁹⁰ In that decision, the state legislature had transferred ownership of the submerged area of nearly the entire waterfront of Chicago (over 1,000 acres) to the railroad,²⁹¹ and four years later a new legislature sought to revoke the transfer but the railroad challenged the revocation. The United States Supreme Court upheld the revocation and returned the waterfront to the state, famously describing title to the land as:

different in character from that which the state holds in lands intended for sale. It is different from the title which the United States holds in public lands which are open to preemption and sale. *It is a title held in trust for the people of the State* that they may enjoy the navigation of the waters, carry on commerce over them, and have the liberty of fishing therein freed from the obstruction or interference of private parties.²⁹²

Submerged lands, therefore, possess a *different character* than other forms of property, and they carry with them an implied trust for the public's benefit. Here the presence of water altered the character of the land, so the state's use and disposition of that land had to be consistent with a different standard.

The public-trust doctrine does not mean that a state may *never* convey submerged lands to a private party. To the contrary, the Supreme Court in *Illinois Central* noted that conveyance is permissible, so long as it furthers the public trust interest, and so long as

[t]he control of the State for the purposes of the trust can never be lost, except as to such parcels as are used in promoting the interests of the public therein, or can be disposed of without any substantial impairment of the public interest in the lands and waters remaining.²⁹³

The problem in *Illinois Central* was that the state gave away *too much* land with *too little* public purpose. It was a matter of degree: the court weighed the public's interest in the waterfront against the public gain from conveying title to private parties. The outcome is not surprising, because even if the railroad had built certain facilities from which

290. 146 U.S. 387 (1892). Professor Sax calls *Illinois Central* "the Lodestar in American public trust law." Sax, *supra* note 2, at 489.

291. 146 U.S. at 454.

292. *Id.* at 452 (emphasis added).

293. *Id.* at 453.

the public had benefited, it is doubtful that the railroad would have needed the entire waterfront.²⁹⁴

Discussion of *Illinois Central* is helped when framed in the inverse, i.e., from a governmental-takings context, and here it is evident that the Court's questioning whether it makes sense for a railroad to operate a waterfront is well placed.²⁹⁵ Asking such a practical question is precisely what courts do in takings cases, for there is no well-defined rule or fixed formula for determining when government should compensate a private party for a taking.²⁹⁶ Courts consider several factors,²⁹⁷ but they engage in essentially "ad hoc, factual inquiries,"²⁹⁸ just as the Court did in *Illinois Central*.

Nonetheless, the decision is unusual in two respects. One is that although it is a Supreme Court case, state law is at issue. To be fair, there are conflicting views on whether the public-trust doctrine is a matter of state or federal law, though it seems to tend most towards state law. The Supreme Court has said, perhaps most convincingly in *Appelby vs. City of New York*,²⁹⁹ that the *Illinois Central* decision was based on state law but that its general principle has been recognized throughout the country.³⁰⁰ The second way in which the case is unusual is that *Illinois Central* never really addresses how the public-trust doctrine squares with the Constitution.³⁰¹ Some scholars have attempted to read the doctrine

294. *Id.* at 438. The railroad intended to build a railway and to build numerous warehouses, piers, wharves, and other structures along the waterway on the border between the lake and the city.

295. *Id.* at 451 (wondering why "[a] corporation created for one purpose, the construction and operation of a railroad between designated points . . . [could] manage and practically control the harbor of Chicago, not simply . . . as a railroad corporation, but for its own profit generally").

296. *Pennsylvania Cent. Transp. Co. v. New York City*, 438 U.S. 104, 124 (1978) (noting that the court "has been unable to develop any 'set formula' for determining when 'justice and fairness' require that economic injuries caused by public action be compensated by the government, rather than remain disproportionately concentrated on a few persons") (internal citations omitted).

297. See generally Gilbert L. Finnell, Jr., *Public Access to Coastal Public Property: Judicial Theories and the Taking Issue*, 67 N.C. L. REV. 627, 654-56 (1989) (outlining five considerations applied by the court, and citing *Loretto v. Teleprompter Manhattan CATV Corp.*, 458 U.S. 419 (1982), as a leading *per-se* takings case).

298. *Id.*

299. 271 U.S. 364 (1926).

300. 271 U.S. at 395. *Illinois Central* reached the United States Supreme Court because the railroad removed to federal court based on the case's constitutional issues arising out of the Contracts Clause and the Fourteenth Amendment. *Illinois Cent. R.R. v. Illinois*, 146 U.S. 387, 433 (1892).

301. See Richard Epstein, *The Public-Trust Doctrine*, 7 CATO J. 411 (1987). Epstein criticizes the case because it "contains no citations to particular constitutional provision, and the opinion reads like an essay that runs for 20 pages without case citation." *Id.* at 427. Epstein seems to have somewhat of a love/hate relationship with the *Illinois Central*. While he criticizes it for a dearth of constitutional grounding, he appears to praise it for its representing a

into the Constitution through the Commerce Clause,³⁰² but this argument has been met with criticism.³⁰³

At least two more cases involving Lake Michigan and the public-trust doctrine have been heard in the courts, with similar results.³⁰⁴ After *Illinois Central*, however, the public-trust doctrine continued its application at the state level (where it began),³⁰⁵ principally in states affected by tidal waters, although it has “evolved in tandem with the public perception of the values and uses of waterways.”³⁰⁶ But then the doctrine enjoyed an almost wholesale rejuvenation in the late 1960s and early 1970s in the setting of environmental law and civil rights.³⁰⁷

Illinois Central is a good example of a prohibition-on-conveyance case: conveyance was revoked, or prohibited, under the public-trust

theory of limited government in which limitations are placed on public officials that do not apply in private life. *See id.* at 425; *see also* James R. Rasband, *The Disregarded Common Parentage of the Equal Footing and Public-Trust Doctrines*, 32 LAND & WATER L. REV. 1, 65 (1997) (noting that the majority made “no attempt to locate the Constitution” and instead based the decision entirely on common law).

302. *See* Charles F. Wilkinson, *The Headwaters of the Public Trust: Some Thoughts on the Source and Scope of the Traditional Doctrine*, 19 ENVTL. L. 425 (1989). The article discusses the historical relevance of how rivers and lakes facilitated trade and established communication among the states, noting that the need for one central governing body to oversee water traffic was a key impetus for Congress’ primacy under the Constitution’s Commerce Clause. *Id.* at 437. The author advances the argument that it is logical to view the public trust as an implied condition of statehood and as “a key adjunct of Congress’ general purpose of keeping those watercourses ‘forever free.’” and consequently to be read into the Commerce Clause. *Id.* at 458–59; *see also* Michael C. Blumm, *Public Property and the Democratization of Western Water Law: A Modern View of the Public-Trust Doctrine*, 18 ENVTL. L. 573, 587–89 (1989) (stating that with respect to Western water rights, “the public trust seems especially likely to be a complete answer to constitutional challenges, given (1) long-established Supreme Court authority recognizing the inapplicability of rigid private-property concepts to water, and (2) the nearly universal declaration in western states of the public nature of the water resource”).

303. *See* Rasband, *supra* note 301, at n.271 (criticizing Professor Blum’s constitutional application of the public-trust doctrine).

304. *See Milwaukee v. State*, 214 N.W. 820 (Wis. 1927) (applying the public-trust doctrine to void the transfer by the State of Wisconsin of part of Lake Michigan to a steel company); *see also Lake Michigan v. U.S. Army Corps of Engineers*, 742 F. Supp. 441 (N.D. Ill. 1990) (enjoining, based on the public-trust doctrine, the conveyance and filling of 20 acres of Lake Michigan to expand Chicago’s Loyola University).

305. The first reported case in the U.S. is the New Jersey case *Arnold v. Mundy*, 6 N.J.L. 1 (1821), discussed *infra* at Section IV.A.

306. *Nat’l Audubon Soc’y v. Superior Court of Alpine County*, 658 P.2d 709, 719 (Cal. 1983).

307. *See* Marc R. Poirier, *Environmental Justice and the Beach Access Movements of the 1970’s in Connecticut and New Jersey: Stories of Property and Civil Rights*, 28 CONN. L. REV. 719, 723–26 (1996). This article notes several historical factors that tie a 1970s movement to increase public access to the beach with some other social movements, including the emergence of environmental law, the social protest movements’ reaching their peak, and various other challenges to the status quo. The author shows convincingly how these phenomena merged and can be studied in beach-access decisions from the East Coast states.

doctrine. We will now turn to the other interpretation of the doctrine, in which conveyance of natural resources to private parties is permitted but the grantee takes the land subject to certain restrictions.

2. The Conveyance-with-Impression Cases and the Jus Privatum Versus Jus Publicum Dichotomy

The conveyance-with-impression cases are also well known within the jus publicum/jus privatum dichotomy,³⁰⁸ which is simply the clash between private interests and public interests that has been seen not only in public-trust cases but also in more “traditional” property cases (where it is well settled that superior public interests can supersede private-property interests). Public interests’ superiority to private ones can be seen in the deference that has been given to the public’s environmental interests,³⁰⁹ aesthetic tastes,³¹⁰ administrative ease in delivering public services,³¹¹ and zoning.³¹² The phenomenon is apparent in both general property-rights cases and public-trust cases. In the early Massachusetts public-trust decision of *Commonwealth v. Alger*,³¹³ Justice Shaw declared:

[I]t is a settled principle, growing out of the nature of well ordered civil society, that every holder of property, however absolute and unqualified may be his title, holds it under the implied liability that his use of it may be so regulated, that it shall not be injurious to the equal enjoyment of others having an equal

308. See Torres, *supra* note 74, 530 n.43. The article explains that at common law, the jus privatum/jus publicum dichotomy has two components. The first is the jus publicum, which is the dominant estate and encapsulates the public’s trust rights, ranging from fishing, fowling, and navigation to other broader rights like recreation. The second component is the jus privatum, which encompasses the proprietary rights for use and possession of property. Naturally, the owners of the jus privatum may not use the property of the jus publicum to the exclusion of the public’s rights.

309. See, e.g., *Aspen Wilderness Workshop, Inc. v. Colo. Water Conserv. Bd.*, 901 P.2d 1251, 1257 (Colo. 1995) (restricting a ski resort’s use of its private property so that the court could protect instream flows); *Selkirk-Priest Basin Ass’n v. Idaho ex rel. Andrus*, 899 P.2d 949, 953 (Idaho 1995) (granting standing to an environmental group to challenge the sale of timber on state forest lands, which, allegedly, harmed fish in an adjacent creek).

310. For example, signs on private property are a protected form of free speech, but the state may regulate signs’ physical characteristics because they take up space and may sometimes obstruct views, distract motorists, displace alternative uses of land, and pose other problems that justify state regulation under municipal police powers. See *City of Ladue v. Gilleo*, 512 U.S. 43 (1994).

311. See *Chicago B. & Q. Ry. Co. v. Illinois*, 200 U.S. 561, 587 (1906) (noting that public utilities are “quasi-public” organizations that may take property (with compensation) under eminent domain for the greater public interest).

312. *Miller v. Bd. of Public Works*, 234 P. 381 (1925), *appeal dismissed*, 273 U.S. 781 (1926).

313. 61 Mass. 53 (1851).

right to the enjoyment of their property, nor injurious to the rights of the community.³¹⁴

While Shaw's opinion imposed restrictions upon private-property rights through the public-trust doctrine, he also embraced private property in general by calling upon the common law for an established principle, the *sic utere* doctrine, and then distinguishing it.³¹⁵ The *jus publicum/jus privatum* principle underlies many traditional property-law (i.e. non-public trust) cases, particularly in zoning matters.

Compare Justice Shaw's declaration in the public-trust case *Alger* with that of Justice Owen in the Wisconsin zoning case, *Carter v. Harper*.³¹⁶ Justice Owen used language inspired by the United States Supreme Court in *Chicago, B. & Q. v. People of State of Illinois*,³¹⁷ which has since become a cornerstone of California law through its integration into *Miller v. Board of Public Works*³¹⁸ and at least a half dozen subsequent cases.³¹⁹ Justice Owen observed:

It is thoroughly established in this country that the rights preserved to the individual by these constitutional protections are held in subordination to the rights of society. Although one owns property, he may not do with it as he pleases, any more that he may act in accordance with his personal desires. As the interest of society justifies restraints upon individual conduct, so also does it justify restraints upon the uses to which property may be devoted. It was not intended by these constitutional provisions to so far protect the individual in the use of his property as to enable him to use it to the detriment of society. By thus protecting individual rights, society did not part with the power to protect itself or to promote its general well-being. Where the interest of the individual conflicts with the interest of society, such individual interest is subordinated to the general welfare.³²⁰

314. *Id.* at 84–85.

315. *Id.* at 63. The full phrase is: “sic utere tuo ut alenum non ladas.” See 16A AM. JUR. 2D. *Constitutional Law* § 321 (2003) (discussing the *sic utere* maxim in relation to nuisance law, and stating that it stands for the proposition that “every person has the right to the free use of his or her property so long as the rights of another are not injured”).

316. 196 N.W. 451 (Wis. 1923).

317. *Id.* at 453 (citing *Chicago B. & Q. Ry. Co. v. Illinois*, 200 U.S. 561 (1906)).

318. 234 P. 381, 385 (Cal. 1925), *appeal dismissed*, 273 U.S. 781 (1926).

319. See *Kelly v. Mahoney*, 8 Cal. Rptr. 521, 523 (Cal. Ct. App. 1960); *HFH, Ltd. v. Superior Court*, 542 P.2d 237, 242 (Cal. 1975); *Agric. Labor Relations Bd. v. Superior Court*, 546 P.2d 687, 694 (Cal. 1976); *Robins v. Pruneyard Shopping Ctr.*, 592 P.2d 341, 344–45 (Cal. 1979); *Viso v. California*, 154 Cal. Rptr. 580, 583 (Cal. Ct. App. 1979); *Judlo, Inc. v. Vons Cos.*, 259 Cal. Rptr. 624, 626 (Cal. Ct. App. 1989).

320. *Carter*, 196 N.W. at 453.

In a sense, the public-trust doctrine does the same thing as the principle outlined in *Miller*: it affirms that private ownership and rights reserved for the general public are compatible with each other, but it holds that private rights are subordinate to public rights. This has tremendous upside potential for spectrum advocates, even if it may repulse absolutist property-rights proponents, because it could mean that regulators do not have to decide today whether privatization or the commons is the better model, i.e. whether spectrum should be allowed to be owned and traded like property,³²¹ or whether (as this Article advocates) it should instead be open to all, like other natural resources.³²² If the *jus privatum/jus publicum* dichotomy is applied to electromagnetic spectrum, the conveyance-with-impression interpretation of the public-trust doctrine will make it possible to reserve certain rights for the public and apply them to both the privatization and the commons models. Specifically, this could manifest itself in the right of UWB and SDR users to navigate within the spectrum of others, as long as they do not interfere with the principal use of the spectrum.

Some commentators, perhaps most famously Richard Epstein, support the prohibition-on-conveyance construction of the public-trust doctrine. Epstein's property-law theory allows for a mix of public and private rights, and the public-trust doctrine is most useful when allocative mistakes occur between public rights and private rights.³²³ While he supports the public trust in the form of prohibition on conveyance, Epstein rejects conveyance-with-impression, labeling it a development from "more recent times" that is "another unfortunate effort to create instability in private rights."³²⁴ Professor Epstein has argued that the Fifth Amendment protections should act to require government to pay for the value that they see in private property before government takes it from private hands,³²⁵ and he believes, unsurprisingly, that governments should provide compensation for many partial takings, (as well as, of course, for full takings), including cases where value is diminished in small increments.³²⁶ Epstein emphasizes that the distinction between total and partial takings is absent in other areas of the law, such as restrictive covenants, and asks "[w]hy then should the understanding or reasonable

321. See Hazlett, *supra* note 68.

322. LESSIG, *supra* note 42, at 77–79.

323. Epstein, *supra* note 301.

324. *Id.* at 412 n.1.

325. See Richard A. Epstein, *Lucas v. South Carolina Coastal Council: A Tangled Web of Expectations*, 45 STAN. L. REV. 1369 (1993).

326. See *id.* at 1377, 1387–88, 1392.

expectations shift so dramatically when we move into the public sphere?"³²⁷

Others have echoed Epstein's frustration with the "impression" cases. Professor Huffman (who has also been called the "Darth Vader of Public Trust")³²⁸ has said:

Historically the doctrine was reasonably clearly defined as to geographic scope and as to uses. It was a very narrow doctrine compared to the ambitions that people have had for it since Sax wrote his piece. I have problems with that, thinking in resource allocation terms, because of the uncertainties that the rapid, modern evolution of the doctrine have introduced into the lives of public and private resource managers.³²⁹

It is unclear why public-trust critics believe that the conveyance-with-impression cases are "recent" (Epstein) and part of a "modern evolution" (Huffman), for in fact they are among the oldest public-trust cases in the United States. As far back as 1842, the United States Supreme Court held, in *Martin v. Waddell*,³³⁰ that title transfers and grants may not divorce themselves from the public trust: "[g]rants . . . are, therefore, construed strictly; and it will not be presumed, that [the grantor] intended to part from any portion of the public domain."³³¹ This principle, often referred to as the "impression" principle,³³² is fundamental in "low-tide states" such as Massachusetts, where private owners hold *limited* property rights under common-law principles that have existed since the Magna Carta.³³³

It could be argued that for Epstein (and for Huffman to a lesser extent), the public-trust doctrine acts as a corollary to the Constitutional takings clause, and that any other form of taking besides complete taking, such as the partial-taking form, should not exist unless it is compensated. The low-tide-state examples apparently are ignored in favor of a theoretical property-ownership paradigm. This theoretical proposition is that "[a]ll regulations, all taxes, and all modifications of

327. *Id.* at 1388.

328. Blumm, *supra* note 302, at 716 n.108.

329. JIM BURLING ET AL., CENTER FOR PRIVATE CONSERVATION, CONSERVATION AND THE PUBLIC-TRUST DOCTRINE (Mar. 1999), *available at* <http://www.privateconservation.org/pubs/roundtables/625conservationpublic.pdf>.

330. 41 U.S. 367 (1842).

331. *Id.* at 411.

332. *See, e.g.,* Hope M. Babcock, *Has the United States Supreme Court Finally Drained the Swamp of Takings Jurisprudence*, 19 HARV. ENVTL. L. REV. 1, 42 (1995) (discussing *Phillips Petroleum Co. v. Mississippi*, 484 U.S. 469 (1988), in which the Court *impressed* upon tidelands a trust obligation to be exercised on behalf of the public).

333. *See* discussion *infra* Section V.

liability rules are takings of private property prima-facie compensable by the state,³³⁴ and if the state wants to allow the public trust to transfer property from public to private ownership but reserve certain rights under the conveyance-with-impression theory, then according to Epstein the state should pay compensation for a partial taking.

The public-trust doctrine is a common-law doctrine, so it evolves with the common law.³³⁵ As Justice Hall stated in the New Jersey case *Neptune City*, the public-trust doctrine “should not be considered fixed or static, but should be molded and extended to meet changing conditions and needs of the public it was created to benefit.”³³⁶ Both categories, the prohibition-on-conveyance and the conveyance-with-impression aspects, are important to electromagnetic spectrum. The first can be used to make an argument that both the first and second spectrum giveaways (described above) should be revoked, while the second can be used to assert public-trust interests in spectrum grants in which broadcasters or others maintain a monopoly, but to which new technologies like UWB and SDR need to gain access without disturbing the primary user.

B. *The Sax Principles*

Advocates of expanding the public-trust doctrine point to Joseph Sax’s 1970 article, *The Public-Trust Doctrine in Natural Resource Law: Effective Judicial Intervention*, in which he convincingly argued that the public trust is an important citizens’ tool to protect public rights in all natural resources, not just tidal waters.³³⁷ The Sax article has been said to be “every law professor’s dream: a law review that not only revived a dormant area of the law but continues to be relied upon by courts some two decades later,³³⁸ and his article has survived as one of the most cited law-review articles of all time.³³⁹

Professor Sax advances three principles as bases for expanding the doctrine. First, that “certain interests are so intrinsically important to every citizen that their free availability tends to mark the society as one of citizens rather than of serfs.”³⁴⁰ These interests have traditionally em-

334. RICHARD A. EPSTEIN, *TAKINGS: PRIVATE PROPERTY AND THE POWER OF EMINENT DOMAIN* 95 (1985).

335. Sax, *supra* note 2, at 528.

336. *Borough of Neptune City v. Borough of Avon-By-The-Sea*, 294 A.2d 47, 54 (N.J. 1972).

337. Sax, *supra* note 2.

338. Blumm, *supra* note 302, at 574.

339. Fred R. Shapiro, *The Most Cited Law Review Articles*, CAL. L. REV. 1540, 1551–53 (1985) (cataloguing the top law-review articles from the previous 40 years, Sax’s 1970 public-trust article was ranked 31st).

340. *Id.* at 484.

phasized the public right to fish in water and navigate upon it. Sax cites *U.S. v. Chandler-Dunbar Co.*³⁴¹ for the proposition that it is “‘inconceivable’ that any person should claim a private property interest in the navigable waters of the United States.”³⁴² Second, that these protected public interests (again, principally fishing, fowling, and navigation)³⁴³ “are so particularly the gifts of Nature’s bounty, that they ought to be reserved for the whole of the populace.”³⁴⁴ Third, Sax underlines the special character of certain natural resources—the shores, great ponds, national parks, and national museums—and declares that these “interests are so peculiarly public [in] nature that . . . their adaptation to private use [is] inappropriate.”³⁴⁵ These three principles have had the result of empowering citizens, particularly environmentalists and, in some cases, civil-rights advocates,³⁴⁶ to expand the application of the public-trust doctrine beyond fishing, fowling, and navigation.

The public-trust argument has found its way into many different areas of law and policy, including the preservation of culture,³⁴⁷ where the American Association of Museums has declared that the country’s museums “are organized as public trusts, holding their collections and information as a benefit for those they were established to serve.”³⁴⁸ And in New York, courts have held that state parks are “impressed with a public trust.”³⁴⁹ Although an effort to extend public-trust thinking to copyright was not successful,³⁵⁰ the attempt was indicative of the applicability of the concept to additional areas.

C. *Eldred v. Reno*

Whether the public-trust doctrine should apply to copyright law was recently fought over in a district-court decision involving a challenge to the Sonny Bono Copyright Term Extension Act,³⁵¹ a law extending

341. 229 U.S. 53, 69 (1913).

342. Sax, *supra* note 2, at 484.

343. Although “fowling” was not mentioned earlier, he presumably considers it to be a basic right since he supports the others that accompany it (i.e. fishing and navigation).

344. Sax, *supra* note 2, at 484.

345. *Id.* at 485.

346. See Poirier, *supra* note 307.

347. See, Patty Gerstenblith, *Identity and Cultural Property: The Protection of Cultural Property in the United States*, 73 B.U. L. REV. 559, 646–55 (1995) (arguing for an extension of the public-trust doctrine to include national cultural identity and archaeology).

348. American Association of Museums Code of Ethics, 2000, *available at* <http://www.aam-us.org/aamcoe.cfm>.

349. *Grayson v. Town of Huntington*, 160 A.D.2d 835, 837 (N.Y. App. Div. 1990).

350. See discussion *infra* Section IV.C.

351. Pub. L. No. 105-298, 11 Stat. 2827 (1998).

existing and future copyrights by 20 years. In the case, *Eldred v. Reno*,³⁵² the plaintiffs argued:

While copyright creates a present interest in the copyright holder, it simultaneously creates a future interest in the public. The Public Trust Doctrine holds that government may not transfer the public property of a commons into private hands in the absence of any public benefit in exchange. While this doctrine has traditionally been applied in the context of public lands, the same principle should apply to the reallocation of public rights in intangible property, such as copyright.³⁵³

Citing *Illinois Central* for the public-trust doctrine's basic premise³⁵⁴ and *United States v. 1.58 Acres of Land*³⁵⁵ for the proposition that the doctrine restricts the federal government's conveying of public-trust property,³⁵⁶ the plaintiffs said that copyrighted works should be considered public-trust property as a matter of logic: "every grant of a copyright necessarily guarantees the public right to use the copyrighted work after the term's expiration . . . [and] the public has a vested remainder interest in copyrighted works."³⁵⁷ The plaintiffs called on the court to consider the flexible aspects of the public-trust doctrine, noting that it has addressed "diverse modern needs" including recreational areas and environmental resources.³⁵⁸ While acknowledging that much of the doctrine's history is connected with navigable waters, the *Eldred* plaintiffs nevertheless emphasized that this should be an "illustrative, and not an exclusive application."³⁵⁹

Citing two cases and summarily dismissing the argument, the district court's memorandum opinion showed no willingness to extend the public-trust doctrine to copyright, declaring that "the public-trust doctrine

352. *Eldred v. Reno*, 74 F. Supp. 2d 1 (D.D.C. 1999), *aff'd*, *Eldred v. Reno*, 239 F.3d 372 (D.C. Cir. 2001), *aff'd sub nom. Eldred v. Ashcroft*, 537 U.S. 186 (2003). Note that all briefs cited herein are available on the *Eldred v. Ashcroft* Legal Archive at www.eldred.cc.

353. Pl.'s First Am. Compl. at 69a, *Eldred v. Reno*, 74 F. Supp. 2d 1 (D.D.C. 1999)(No. 1:99CV00065).

354. Memorandum in Support of Plaintiff's Motion for Judgment on the Pleadings or, in the Alternative, for Summary Judgment and in Opposition to Defendant's Motion for Judgment on the Pleadings at 55–58, *Eldred v. Reno*, 74 F. Supp. 2d 1 (D.C.C. 1999)(No. 1:99CV00065).

355. 523 F. Supp. 120, 124–25 (D. Mass. 1981).

356. Pl.'s Resp. I, at 59, *Eldred v. Reno*, 74 F. Supp. 2d 1 (D.D.C. 1999)(No. 1:99CV00065).

357. Plaintiffs' Reply Memorandum In Support of Motion for Judgment on the Pleadings or in the Alternative for Summary Judgment, at 24, *Eldred v. Reno* 74 F. Supp. 2d 1 (D.D.C. 1999) (No. 1:99CV00065).

358. See Pl.'s Resp. I, at 58.

359. See Pl.'s Resp. I, at 57.

applies to navigable waters and not copyrights.”³⁶⁰ It is apparent, however, that the court was result-oriented and chose the easiest ground for refusing to apply the public-trust doctrine to copyright, rather than discussing the possibility of so applying it. Upon appeal to the Supreme Court, the plaintiffs apparently abandoned the public-trust argument.³⁶¹

The arguments advanced in the *Eldred* plaintiffs’ district-court briefs are useful, for they not only argue persuasively for extending the public-trust doctrine to another realm, but also make a conceptual distinction that can be usefully applied to the electromagnetic spectrum. The reason that intellectual property is unique is because it does not “technically compete,” and that “[o]ne person’s use of intangible work does not preclude the use by another.”³⁶² The plaintiffs could have been writing about the spectrum for, as has been shown, with two new technologies users will not need to compete with one another to speak or listen.

V. SOME EXAMPLES OF PUBLIC-TRUST JURISPRUDENCE

The United States coastal region is only about 11% of the total land area, yet 110 million people occupy it. It is expected to grow in population by 60 percent by 2010,³⁶³ and it is the most densely populated and rapidly growing part of the country.³⁶⁴ Much of the coast is privately owned—87 percent of the coastal area from Virginia to Maine, for example, is private³⁶⁵—and not surprisingly, this corridor includes many of the nation’s low-tide states:³⁶⁶ Massachusetts, Maine, Delaware, Pennsylvania and Virginia. In spite of private ownership to the low-tide line, three states’ courts (those of Massachusetts, Maine and Delaware) have guaranteed a minimum right of fishing, fowling, and navigation in the zone between high and low tide (the “intertidal zone”), while the high-tide states (like New Jersey and California) have been much more

360. 74 F. Supp. 2d at 3–4 (citing *Phillips Petroleum Co., v. Miss.*, 484 U.S. 469 (1988) and *District of Columbia v. Air Florida, Inc.* 750 F.2d 1077 (D.C. Cir. 1984)).

361. *Eldred v. Ashcroft*, 537 U.S. 186 (2003).

362. Pl.’s Resp. I, at 58.

363. Pamela Pogue & Virginia Lee, *Providing Public Access to the Shore: The Role of Coastal Zone Management Programs* 27 COASTAL MANAGEMENT 219, 220 (1999). The calculation excludes Alaska and the U.S. Territories.

364. *Id.* (citing T.J. Culliton et al., *50 Years of Population Change Along the Nation’s Coasts: 1960–2010*, in NATIONAL OCEANIC AND ATMOSPHERIC COMMISSION, COASTAL TRENDS SERIES, REPORT 2 (1988)).

365. *Id.* at 223.

366. SURFRIDER FOUNDATION, *STATE OF THE BEACH* (2003) (noting that Massachusetts, Delaware, Maine, Pennsylvania, Virginia are low-tide states, as well as the non-coastal state Wisconsin).

expansive with beach-access rights, finding in some instances a public trust right up to dry sand, in order to let people use the beach.

*A. Examples of Low-Tide Jurisprudence:
Massachusetts and Maine*

Many low-tide states have attempted through legislation to change beach-ownership rules to increase public access, with these attempts including proposals to change private beaches' boundaries from the low to the high-tide line. But these movements have often been struck down as unconstitutional takings in courts' advisory opinions.³⁶⁷ Some legislatures have, in response, attempted to purchase private areas in order to increase the public's beach-access rights, but because of the high cost of coastal property, only very limited public purchases have in fact taken place.³⁶⁸ In spite of the low-tide states' guarantee of access to the intertidal zone, events there illustrate the problems that can arise when private-property rights are extended to a natural resource's outer limits.

With about 75 percent of its beaches privately owned,³⁶⁹ Massachusetts is *the original* low-tide state, having conveyed private-property rights to intertidal waters in land grants during 1641–1647 (the “1641 Grants”).³⁷⁰ Maine, as a former component of the Massachusetts Commonwealth, was also subject to these grants.³⁷¹ Massachusetts's and Maine's private interests in intertidal waters are perhaps the most extensive of the low-tide states, though public rights in fishing, fowling, and navigation are still protected there.³⁷² Both the Massachusetts and Maine legislatures have attempted to change the rule and expand the public trust through legislation, but with only limited success: they have not

367. See, e.g., *In re Opinion of the Justices*, 313 N.E.2d 561 (Mass. 1974) (responding to legislation passed to increase beach access in Massachusetts).

368. Andrew Blake, *Beach Rights: A Question of Access*, BOSTON GLOBE, June 11, 1995, at 1 (noting that the legislature passed a bill authorizing the taking of beaches by eminent domain and then allowing the courts to determine what the compensatory amount would be, hoping that it would be low, but that the government has since decided to work cooperatively with the private beach owners, which has resulted in a long and expensive process).

369. See John H. Boit, *Beach Access Under Scrutiny*, THE PATRIOT LEDGER, Dec. 3, 1998, at 1.

370. Matthew J. Kiefer, *The Public Trust Doctrine: State Limitations on Private Waterfront Development*, 16 REAL EST. L.J. 146, 148 (1987) (noting that the first enactment was the Massachusetts Bay Colony in 1641–1647); see also *In Re Opinion of the Justices*, 313 N.E.2d 561, 565 (Mass. 1974) (observing that the grants are also found in a 1649 Massachusetts codification entitled “The Book of the General Lawes and Libertyes”).

371. See *Storer v. Freeman*, 6 Mass. (1 Tyng) 435, 438 (1810) (involving land in Cape Elizabeth in the District of Maine, and noting that the rule of law governing titles to the intertidal zone had its origin in the Colonial Ordinance of 1641–47 of the Massachusetts Bay Colony, long before the separation of Maine was received into the common law of Massachusetts by long usage and practice throughout the jurisdiction of the Commonwealth).

372. See *Crocker v. Champlin*, 202 Mass. 437, 441 (1909).

been able to change the permanently engraved “impression” aspect of the low-tide policy.³⁷³ Though Massachusetts and Maine stem from a common land grant, in recent years Maine has shown more sympathy for expanding the public-trust doctrine into the intertidal zone, much as its high-tide counterpart New Jersey has done.³⁷⁴

1. The “Massachusetts Rule”

One of the first and most famous cases in this regard is the 1851 decision of *Commonwealth v. Alger*,³⁷⁵ which arose after Massachusetts legislation passed between 1837 and 1847 prevented construction beyond a certain point so as to protect harbors.³⁷⁶ The Supreme Judicial Court upheld the legislation’s constitutionality, with Chief Justice Shaw explaining that the Court was “deeply impressed with the importance of the principles which [the case] involves, and the magnitude and extent of the great public interests, and the importance and value of the private rights” involved in the intertidal zone.³⁷⁷ *Alger* stands firmly for the two principles that (a) the 1641 grant created private-property rights down to the low-tide line,³⁷⁸ and (b) the property right between the high-tide and low-tide lines is subject to the public-trust doctrine, which reserves to the public rights to fishing, fowling and navigation.³⁷⁹

Residents of Cape Cod would undoubtedly note few actual “fowl” in the intertidal zone, since the only fowl available in this area are seagulls. Likewise, there is probably very little navigation, except in harbors, since water is too shallow to safely sail, and fishing in the intertidal zone is confined to the rare beach caster or pier fisherperson. Nevertheless,

373. See Kiefer, *supra* note 370 (describing Massachusetts’s unusual jurisprudence and distinguishing it as the “Massachusetts Theory”).

374. See discussion *infra* Section V.

375. 61 Mass. (1 Cush.) 53 (1851).

376. *Id.* at 83–84. The case discusses five related acts of legislation: (1) “an act to preserve the harbor of Boston, and to prevent encroachments therein,” passed on April 19, 1837; (2) another similar act passed on March 17th, 1840; (3) another similar act passed on March 6, 1841; (4) another similar act passed on April 26, 1847; and (5) another similar act passed on May 10, 1848. All were part of the same series of legislation—divided into separate sections—but intended to set limits and lines for the construction of wharves and piers so as to preserve the waters for navigation. *Id.* at 54.

377. *Id.* at 64.

378. *Id.* at 71 (carefully describing the purpose and intent of the 1641 Grant, and finding that it created “a legal right and vested interest in the soil, and not a mere permissive indulgence, or gratuitous license, given without consideration, and to be revoked and annulled at the pleasure of those who gave it”).

379. *Id.* at 67–68. The court cites Section 2 of the 1641 Grant, which provides that the public “shall have free fishing and fowling in any great ponds, bays, coves and rivers, so far as the sea ebbs and flows within the precincts of the town where they dwell.” *Id.* The Court later goes on to explain that “the great purpose . . . was to declare a great principle of public right . . . and to make them all free.” *Id.*

though few persons may exercise their public-trust rights in Massachusetts (and elsewhere), they are still an important part of the law, and they have moved Massachusetts citizens to highlight them in a brochure entitled “Public Rights/Private Property.”³⁸⁰

2. The 1974 and 1991 Massachusetts Legislation

In 1974, Massachusetts attempted to pass a bill expanding the principles found in *Commonwealth v. Alger* to give the public a walking right on beaches. In the “interest of the public,” the proposed bill³⁸¹ attempted to create an “on-foot free right of passage along the shore . . . between the mean high water line and the extreme low water line”³⁸² In an advisory opinion³⁸³ on the proposed 1974 legislation entitled *Opinion of the Justices*,³⁸⁴ however, the Massachusetts Supreme Judicial Court rejected the proposal as against the Massachusetts and United States Constitution’s Takings Clauses. The Court reviewed the Massachusetts case law and found the “on-foot” right of passage (which allowed passage over *dry land*) to be inconsistent with the “traditional” rights that were reserved for the public.³⁸⁵ Declaring that they were “unable to find any authority that the rights of the public include a right to walk on the beach,”³⁸⁶ the court invalidated the bill as an improper taking under both the Massachusetts Constitution and the United States Constitution’s 14th Amendment.³⁸⁷

But despite the 1974 opinion, a determined legislator kept the matter alive for decades and in 1991 finally amended the original 1974 bill³⁸⁸ to authorize³⁸⁹ the state to seize a privately-owned beach by eminent do-

380. Brochure available on the Massachusetts State Website at <http://www.ago.state.ma.us/pubs/beachacc.pdf>.

381. 313 N.E.2d 561, 563 (Mass. 1974) (citing H.R. 481 (Mass. 1974)).

382. *Id.* at 563 n.1.

383. See Mel A. Topf, *The Jurisprudence of the Advisory Opinion Process in Rhode Island*, 2 ROGER WILLIAMS U. L. REV. 207 (Spring 1997) (noting that many states have repealed the advisory opinion procedure as a violation of the separation-of-powers doctrine but that it is particularly active in Massachusetts).

384. 313 N.E.2d at 561.

385. *Id.* at 566 (noting that the “traditional” rights that were reserved include “fishing, fowling, and navigation”).

386. *Id.* at 567.

387. *Id.* at 568.

388. See Andrew Blake, *Beach Rights: a Question of Access*, BOSTON GLOBE, June 11, 1995, at 1 (“The [1991] Beach Access Law was sponsored by Senate President William Bulger . . . who had been proposing that legislation since 1974 when he and several of his children were walking across a Cape Cod beach and were told to remove themselves—that the beach was private.”).

389. 1991 Mass. Acts. Ch. 176, Section 4; see also Sharon M.P. Nicholls, *Public Right Of Passage Along the Massachusetts Coast: An Argument For Implementation Without Com-*

main. The intent of the bill was to force a lawsuit so that the state could determine “just compensation” and set a precedent on the merits,³⁹⁰ with the amount of compensation being set by the courts.³⁹¹ After considering the matter for several years, however, the state never acted on the plan, fearing the negative precedent that could result.³⁹² Instead, it decided to educate people about their rights under the public-trust doctrine,³⁹³ and the attorney general has published a brochure entitled “Public Rights/Private Property,”³⁹⁴ explaining the fishing, fowling, and navigation rights still reserved for the public,³⁹⁵ while the Massachusetts Office of Coastal Zone Management maintains a website explaining the public-trust doctrine’s application to the Massachusetts coast.³⁹⁶

Massachusetts’s decision to educate the public about the scope of the public-trust doctrine shows that valuable rights are retained for the public, which should be enjoyed by them. Cases now make clear, for example, that “bathing” is not a derivative of “navigation” but that there is indeed a right to “swim or float,”³⁹⁷ and that collecting shellfish is a derivative right of the public-trust right to fishing,³⁹⁸ (though one may not take the dirt surrounding the shellfish, just the shellfish themselves).³⁹⁹ The public right to “fishing” does not include the right to “aquaculture,” however, which is placing boxes or other apparatus to catch fish.⁴⁰⁰

persation, 4 B.U. PUB. INT. L.J. 113, 125 n.73 (1994), (noting that the amendment “was passed as a section of the 1991 appropriations bill and not as an independent resolution”).

390. See Teresa M. Hanafin, *Budget Vote Funds General Relief, Broadens Test for Beach Access*, BOSTON GLOBE, Aug. 13, 1991, at 19.

391. Nicholls, *supra* note 389, at 126 (advocating that the matter should be pursued and that compensation would be *de minimis*).

392. See Alexander Reid, *Access to Beach Hinges on Old Path*, THE BOSTON GLOBE, July 18, 1999, at 1.

393. *Id.*

394. Brochure available on the Massachusetts State Website at <http://www.ago.state.ma.us/pubs/beachacc.pdf>.

395. *Id.* (noting that “fishing, fowling and navigation” and its “natural derivatives” are protected uses). The brochure says that the Attorney General takes the (untested) position that birdwatching is a derivative of “fowling,” and that “swimming” is a derivative of “navigation” so long as the swimmer’s feet do not touch the bottom.

396. Massachusetts Office of Coastal Zone Management Website, at <http://www.state.ma.us/czm/shorelinepublicaccess.htm>.

397. *Butler v. Attorney Gen.*, 195 Mass. 79, 83 (1907) (“We think that there is a right to swim or float in [the intertidal zone] . . . [b]ut we do not think that this includes a right to use for bathing purposes, as these words are commonly understood . . .”).

398. *Weston v. Sampson*, 62 Mass. 347, 355 (1851) (stating that a derivative right to “fishing” includes the right to take clams from intertidal waters).

399. *Porter v. Shehan*, 73 Mass. 435, 436 (1856) (defendant, who entered plaintiff’s intertidal waters and took five cords of muscles, dead fish, and soil for fertilizer, was guilty of trespass).

400. *Wellfleet v. Glaze*, 525 N.E.2d. 1298, 1304 (Mass. 1988) (O’Connor, J., concurring) (“Aquaculture is not fishing, nor can it legitimately be considered a ‘natural derivative’ of the right to fish.”).

Future lawsuits should further clarify what rights are derived from the public's entitlement to fishing, fowling, and navigation.

3. Maine—Breaking with Tradition?

Only 27 miles of Maine's beautiful 3,500-mile coastline are publicly-owned sandy beaches,⁴⁰¹ and this has created a long-standing battle between residents and nonresidents for access to beach space.⁴⁰² In 1984, therefore, several private homeowners in the Town of Wells brought a quiet-title action against the township to quell the public use of the beaches near their property. Their first lawsuit, known as *Bell I*,⁴⁰³ was initially dismissed by the lower court, but the Supreme Court reversed and remanded after citing the longstanding common-law traditions of both Maine⁴⁰⁴ and Massachusetts.⁴⁰⁵ After the remand, however, the action was affected by political turbulence from the state legislature, which had in the meantime (in 1986) passed expansionist, public trust-influenced legislation similar to that proposed in Massachusetts in 1974.⁴⁰⁶ Maine's Public Trust in the Intertidal Land Act⁴⁰⁷ declared that intertidal lands were impressed with a "public trust," and that the public had a "right to use intertidal land for recreation."⁴⁰⁸

A Maine court heard the matter in 1987 and concluded that the Public Trust Intertidal Land Act was an unconstitutional taking,⁴⁰⁹ with the court at the same time refusing to expand the public-trust doctrine beyond its traditional scope of "fishing, fowling, and navigation."⁴¹⁰ The same case went back to the Supreme Court (commonly known as *Bell II*),⁴¹¹ who upheld the superior court's decision in language echoing Massachusetts's *Opinion of the Justices*. The court said, in fact, that their

401. See *Public Shoreline Access and the Moody Beach Case*, Marine Law Institute, Sea Grant Communications Office, available at www.mli.usm.maine.edu/onemoody.pdf.

402. See Jeff Strout, *Access to Islands Not Guaranteed*, BANGOR DAILY NEWS, Oct. 5, 2002, at D6 (discussing Maine beach-access disputes' history and concluding that they are still dealt with on a case-by-case basis).

403. *Bell v. Town of Wells (Bell I)*, 510 A.2d. 509 (Me. 1986).

404. *Id.* at 511 (citing *Moulton v. Libbey*, 37 Me. 472, 485-88 (1854), and a Maine advisory opinion, *Opinion of the Justices*, 437 A.2d. 597 (Me. 1981)).

405. *Id.* at 513 (citing *Storer v. Freeman*, 6 Mass. 435, 438 (1810), and *Barker v. Bates*, 30 Mass. 255 (1832)).

406. 12 Me. Rev. Stat. Ann. §§ 571-573 (Supp. 1988) (enacted during the pendency of *Bell I* by P.L. 1985, ch. 782 (eff. July 16, 1986)).

407. *Id.*

408. *Id.* § 573(1)(B).

409. *Bell v. Town of Wall (Bell II)*, 557 A.2d. 168, 177 (Me. 1989).

410. *Id.* at 169; see also *id.* at 174 (noting that rights derived from the right to "fishing," such as taking shellfish, are already allowed, but that taking "sea manure" or leaving "scrapings of snow and ice" in the intertidal zone are not allowed, citing *Marshall v. Walker*, 45 A. 497, 536 (Me. 1900)).

411. *Id.* 168.

“answer is the same as the unanimous opinion of the Massachusetts justices,” noting that “[n]o decision of either the Maine or the Massachusetts court supports any such open-ended interpretation of the public uses to which privately owned intertidal land may be subjected.”⁴¹²

Private rights to the intertidal zone were revisited by the Supreme Court in 2000 in *Eaton v. Wells*,⁴¹³ but this time they were addressed differently: at stake was a small strip of beach (2,200 linear feet) for which the township (Wells) put up ample testimony of prescriptive use under a prescriptive-easement theory for public recreation. Before the trial began, the township offered to purchase an easement from the property owners for \$3,000, but when they countered with \$1.2 million, the officials took the case to court.⁴¹⁴ The claim was successful and ultimately accomplished the same thing, on a smaller scale, that the township had attempted in the *Bell* cases by way of the public-trust doctrine. The majority limited its decision to the prescription question and did not discuss the public-trust doctrine,⁴¹⁵ but the press and some academics have interpreted *Eaton* as an opportunity for expanding the public-trust doctrine in subsequent cases.⁴¹⁶

Much excitement about *Eaton v. Wells* has been aroused by its concurring and dissenting opinions, in which two justices stated that they did not agree with the prescription approach. Justice Saufley, concurring, stated that she would have used *Eaton v. Wells* as an opportunity to overrule *Bell II*, thereby expanding the public-trust doctrine’s scope:

By our unduly narrow judicial construction of the time-honored public-trust doctrine, our holding in [*Bell II*] restricted the public’s right to peaceful enjoyment of one of this state’s major resources, the intertidal zones. Pursuant to our holding in [*Bell II*], a citizen of the state may walk along a beach carrying a fishing rod [for “fishing”] or a gun [for “fowling”], but may not walk along that same beach empty-handed or carrying a surfboard. This interpretation of the public-trust doctrine is clearly flawed.⁴¹⁷

412. *Id.* at 174.

413. 760 A.2d 232 (Me. 2000).

414. See Ted Cohen, *Who Owns Wells Beach?*, PORTLAND PRESS HERALD (MAINE), Jan. 6, 1997, at 1C.

415. 760 A.2d at 248 (“Because we affirm the trial court’s decision that the public and the Town have an easement by prescription to use both the dry sand portion of the beach and the accompanying intertidal zone, we need not reach the State’s contention that we expand the public-trust doctrine established in *Bell*.”).

416. See John Duff, *Who Owns the Beaches?*, at <http://www.mli.usm.maine.edu/Beachlaw101/sld001.htm>.

417. *Eaton*, 760 A.2d at 248–49 (Saufley, J., concurring).

The *Eaton* decision has been criticized by other commentators, too, who believe that expanding the public-trust doctrine with easements by prescription may spur massive litigation over little pieces of the Maine coast.⁴¹⁸

The Maine Supreme Court, however, has shown restraint since *Eaton*, distinguishing at least one case from it because the evidence of prescription was insufficient;⁴¹⁹ but this has not stopped calls to test *Eaton's* limits, and litigation will likely continue.⁴²⁰

B. High-Tide Examples: New Jersey and California

The states of New Jersey and California provide some examples of high-tide jurisprudence, because the cases that have arisen there are among the oldest and most influential in this category.

1. New Jersey

New Jersey's case of *Arnold v. Mundy*⁴²¹ is the first reported decision involving the public-trust doctrine in the United States, and it was heavily relied upon as persuasive authority in *Illinois Central*.⁴²² *Arnold v. Mundy* is also one of the more expansive applications of the public-trust doctrine. Arnold claimed that Mundy had trespassed onto his oyster bed, which was located in intertidal waters, and stolen oysters that Arnold had "planted" there.⁴²³ Arnold believed that he had title to the oyster bed on the basis of conveyances⁴²⁴ from a 17th century royal charter from Charles II, King of England, who had granted them to the Duke of York (his brother).⁴²⁵ The court ruled in favor of Mundy and said that Arnold's title was invalid because the public-trust doctrine forbade the conveyance

418. See Orlando E. Delogu, *Eaton v. Town of Wells: A Critical Comment*, 6 OCEAN & COASTAL L.J. 225, 230 (2001).

419. *Lyons v. Baptist Sch. of Christian Training*, 804 A.2d 364, 373 (Me. 2002) (finding overwhelming evidence in *Eaton* that owners had notice of a public easement and their property rights being in jeopardy, but that in *Lyons* such evidence was lacking).

420. See Editorial, *Maine's Private Beaches*, BANGOR DAILY NEWS, Sept. 19, 2002, at A10 ("Justice Saufley's words may be taken as an invitation to bring suit to overthrow the outmoded colonial law . . . [t]he opportunity to free Maine's beaches is here, and the time seems right.").

421. 6 N.J.L. 1 (N.J. 1821).

422. *Illinois Cent. R.R. v. Illinois*, 146 U.S. 387, 456 (1892) (per Fields, J.) (noting that *Mundy* should be "entitled to great weight, and in which the decision was made 'with great deliberation and research'").

423. *Mundy*, 6 N.J.L. at 8 (observing that oysters may be referred to as "planted"—i.e., "planted" for nurturing—when they are taken from one location to another); see BONNIE J. MCCAY, OYSTER WARS AND THE PUBLIC TRUST (1998).

424. *Mundy*, 6 N.J.L. at 32 (referring to "mesne" conveyances, which are intermediate conveyances in the chain of title between two grantees).

425. *Id.* at 14.

of submerged land.⁴²⁶ The court reviewed the public-trust doctrine in English law and said that New Jersey was under the same obligation to honor the doctrine, because holding otherwise would be tantamount to ruling that the “Magna Carta was a farce.”⁴²⁷

The *Mundy* court went to great lengths to tie the public-trust doctrine to New Jersey common law, speaking of “the law of nature, which is the only true foundation of all the social rights,”⁴²⁸ and saying that the Magna Carta was a restoration of these social rights. The court then ruled that the state “cannot make a direct and absolute grant of the waters of the state, divesting all the citizens of their common right,”⁴²⁹ for doing so “never could be long borne by a free people.”⁴³⁰ Most important, *Mundy* expanded the original right of fishing, fowling, and navigation to include “purposes of passing and repassing, navigation, fishing, fowling, sustenance and *all other uses of the water and its products*.”⁴³¹

Many of the court’s utterances rang of citizenship empowerment, citing from the “law of nature” and grievances “which could never be long borne by a free people,” the court explained:

[I]t is the public property; [no one, not even the King may] intrude upon the common property . . . and appropriate it to himself, or to the fiscal purposes of the nation, the enjoyment of it is a natural right which cannot be infringed or taken away, unless by arbitrary power; and that, in theory at least, could not exist in a free government The sovereign power itself, therefore, cannot, consistently with the principles of the law of nature and the constitution of a well ordered society, make a direct and absolute grant of the waters of the state, divesting all the citizens of their common right. It would be a grievance which never could be long borne by a free people.⁴³²

Mundy’s expansion of the public-trust doctrine was upheld in the modern case of *Borough of Neptune City v. Borough of Avon-by-the-Sea*,⁴³³ in which beach access was not limited to the “ancient” right to fish and navigate, but was held to include recreational uses such as “bathing, swimming and other shore activities.”⁴³⁴ Using equal-protection

426. *Id.* at 50 (noting that no grant is valid that fences in or shuts fisheries against the common use).

427. *Id.* at 62.

428. *Id.* at 52.

429. *Id.* at 53.

430. *Id.*

431. *Id.* at 9 (emphasis added).

432. *Id.* at 50, 53.

433. 294 A.2d 47 (N.J. 1972).

434. *Id.* at 54.

phraseology but holding on the basis of property law rather than constitutional law,⁴³⁵ the court said that “a modern court must take the view that the public-trust doctrine dictates that the beach and the ocean waters must be open to all on *equal terms* and *without preference* and that any contrary state or municipal action is impermissible.”⁴³⁶

One of the most recent New Jersey public-trust cases, *Matthews v. Bay Head Improvement Association*⁴³⁷ is, like *Mundy*, one of the most expansive beach-access cases to come from an East Coast state. In *Matthews*, the plaintiff brought suit against an organization that owned six parcels of land adjacent to a beach, but that refused to allow beach access over its property. The New Jersey Supreme Court found that the public-trust doctrine, which allows swimming and bathing below the high-tide line, depends on access to the beach, because the public would be unable to take advantage of its benefits unless access over private property were guaranteed.⁴³⁸ “To say that the public-trust doctrine entitles the public to swim in the ocean and to use the foreshore . . . without assuring the public of a feasible access route would seriously impinge upon, if not effectively eliminate, the rights of the public-trust doctrine.”⁴³⁹ To a certain extent, the *Matthews* ruling effectively read a new right into the public-trust doctrine by using it to draw property lines beyond the high-tide line and include dry sand for access. The court declared that “[a]rchaic judicial responses are not an answer to a modern social problem. Rather, we perceive the public-trust doctrine not to be ‘fixed or static,’ but [as] one to ‘be molded and extended to meet changing conditions and needs of the public it was created to benefit.’”⁴⁴⁰

2. California

The most important public-trust-doctrine case in California is *Mono Lake*,⁴⁴¹ which held that the state has “an affirmative duty to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible.”⁴⁴² The case allows for an earlier administrative decision to be reconsidered at any time, even if the deadline for challenging a permit has passed, and in *Mono Lake* the

435. See Poirier, *supra* note 307, at 776–77. The case was strongly pursued by the New Jersey Civil Liberties Union. While the lower court’s decision in *Neptune City* was based on the Equal Protection Clause, the Supreme Court found enough basis in the common-law public-trust doctrine that it did not decide the case on constitutional grounds.

436. 294 A.2d. at 54 (emphasis added).

437. 471 A.2d. 355 (N.J. 1984).

438. *Id.* at 364.

439. *Id.*

440. *Id.* at 365.

441. *Nat’l Audubon Soc’y v. Superior Court*, 658 P.2d. 709 (Cal. 1983).

442. *Id.* at 728.

public-trust suit occurred over forty years after the state had begun diverting water from a lake.⁴⁴³ After determining that the lake had lost one third of its surface area, and would lose much more over the coming years due to water diversion,⁴⁴⁴ the court held that the state had a duty to reexamine old water rights that were initially granted without considering the public trust and to modify those rights if necessary to protect trust values. The court noted the impression of the public trust as follows:

[T]he grantee holds subject to the trust, and while he may assert a vested right to the servient estate (the right of use subject to the trust) and to any improvements he erects, he can claim no vested right to bar recognition of the trust or state action to carry out its purposes.

The court held that state or municipal agencies (here, the City of Los Angeles) have no “vested right to harm the public trust.”⁴⁴⁵ The *Mono Lake* decision means that the state must manage water resources by weighing yesterday’s traditions against today’s values found in the public trust,⁴⁴⁶ and the case has influenced water-rights decisions in Idaho, North Dakota, Washington, and elsewhere.⁴⁴⁷

With regard to beaches, public access is guaranteed by the California State Constitution, which states that no one “[s]hall be permitted to exclude the right of way to such water whenever it is required for any public purpose . . . and the Legislature shall enact such laws as will give the most liberal construction to this provision so that access to the navigable water of this State shall always be attainable for the people thereof.”⁴⁴⁸ The 1976 California Coastal Act further clarifies that “[t]he basic goals of the State for the coastal zone are to . . . (c) Maximize public access to and along the coast”⁴⁴⁹ Private owners’ right to access below the high-water mark has been protected in *San Francisco Sav. Union v. R.G.R. Petroleum & Mining Co.*,⁴⁵⁰ where a private owner of land abutting a beach was blocked as a private nuisance, prevented the construction of platforms that would have barred his access to the ocean.⁴⁵¹

443. *Id.* at 711.

444. *Id.*

445. *Id.* at 732.

446. See Michael C. Blumm & Thea Schwartz, *Mono Lake and the Evolving Public Trust in Western Water*, 37 ARIZ. L. REV. 701, 703 (1995).

447. *Id.* at 720.

448. Constitution of the State of California 1879, Cal. Const. Art. 10, § 4 (1996).

449. California Coastal Act, Cal. Pub. Res. Code § 30001.5 (2004).

450. 77 P. 823 (Cal. 1904).

451. *Id.*

The rights of private owners up to 1976 had generally been weak as against the public, although a deal struck with homeowners in 1976 as part of the California Coastal Act expanded private owners' rights with a quid-pro-quo: private owners must grant new access routes to beaches in areas where no public access exists, in exchange for the right of planning approval of any new developments on their property. This practice was in place for about ten years, but was ruled an unconstitutional taking by the United States Supreme Court in *Nollan v. California Coastal Commission*.⁴⁵² A heated debate between private and public interests continues to this day,⁴⁵³ an example of which is the controversy caused by the *Nollan* case's failure to clarify the status of past offers, i.e. those made before 1987.⁴⁵⁴ That has been contested in a highly-publicized lawsuit launched by David Geffen based on an easement that was pledged in 1983 but that Geffen later refused to honor.⁴⁵⁵ The United States Supreme Court denied certiorari to two similar cases regarding pledges made prior to 1987, which was held to be a victory by some,⁴⁵⁶ and the discussion is likely to continue for some time into the future.⁴⁵⁷

VI. SOME PRACTICAL THOUGHTS ON APPLYING THE PUBLIC-TRUST DOCTRINE TO THE ELECTROMAGNETIC SPECTRUM

In order for the public-trust doctrine to be applied to the electromagnetic spectrum, a conceptual bridge is needed between the natural resources that the doctrine already protects and the spectrum. The basis for this bridge has been explained in this Article. We have seen that the electromagnetic spectrum *is* a natural resource (at least the United States Supreme Court has said so), and like any other one—a lake, a mountain, a forest—it is finite, geographically bound, and subject to exploitation and enjoyment by a mixture of public, private, and governmental uses.

452. 483 U.S. 825 (1987).

453. Timothy Egan, *Owners of Malibu Mansions Cry, 'This Sand Is My Sand'*, N.Y. TIMES, Aug. 25, 2002, at A1 (reporting the existence of a heated political debate between wealthy Malibu homeowners and the public).

454. See David G. Savage & Kenneth R. Weiss, *Justices Bolster Beach Access*, L.A. TIMES, Oct. 22, 2002, at A1.

455. *Id.*

456. *Ann Daniel and Leonard Hill v. County of Santa Barbara*, 288 F.3d 375 (9th Cir. 2002), *cert. denied*, 537 U.S. 973 (2002); *Cole v. County of Santa Barbara*, No. B147339, 2001 WL 1613856 (Cal. Ct. App. Dec. 17, 2001), *cert. denied*, 537 U.S. 973 (2002) (both cases dealing with easement pledges in exchange for planning approvals made prior to 1987); see also Community Rights Council Website, Cert. Petitions Denied in Significant Regulatory Takings Cases, at <http://www.communityrights.org/legalresources/PetitionsForCertiorari/SCtCertDenied.asp>.

457. See California Coastal Coalition, at www.californiacoastline.org; see also California State's Website for Local Coastal Programs, at <http://www.coastal.ca.gov/recap/rctop.html>.

And like many of the world's largest natural resources, the electromagnetic spectrum provides its greatest value to the public not by being improved, but by being left alone: developing the Grand Canyon, for example, would destroy its value, as would developing the San Francisco Bay (which almost happened but was stopped by public-trust lawmaking).⁴⁵⁸ Therefore, instead of trying to assert regulatory control over the spectrum, government should, in a sense, leave the spectrum alone, and regulate only the manner in which devices *access* it, including creating liability for manufacturers and distributors of devices that offend the public's access rights.

Yet history has shown that government will not do this alone, that the present system of overarching regulation of the electromagnetic spectrum must be curtailed by some other means; and this Article has shown that the public-trust doctrine is such a means. Detailing *how* to apply the doctrine is a tall order, but some guidelines can be provided here.

A. The Federal Courts Have Held That Ownership of the Electromagnetic Spectrum Is Vested in the Citizens

The public-trust doctrine can only be applied to the electromagnetic spectrum if the spectrum is owned by the public. Yet this hurdle is a fairly easy one to surmount, for, as previously stated, the United States Supreme Court has found that the electromagnetic spectrum is a natural resource that is owned by the people of the United States:

"At the outset, it should be noted that both radio and television broadcasting utilize a natural resource—electromagnetic spectrum . . . [a]nd, although broadcasters are granted the temporary use of this valuable resource for terminable three-year periods, 'ownership' and ultimate control remain vested in the people of the United States."⁴⁵⁹ Since it is owned by the people, the spectrum passes a threshold test for public-trust-doctrine treatment.

B. The Public Trust Has Evolved Into Federal Law

In order for electromagnetic spectrum to receive the benefits of the public-trust doctrine, the doctrine must be able to be applied by the federal courts. And though most of the cases discussed in the preceding

458. See Alison Reiser, *Ecological Preservation as a Public Property Right: An Emerging Doctrine in Search of a Theory*, 15 HARV. ENVTL. L.R. 393, 396–97 (1991) (recounting the San Francisco Bay being filled in and the legislation and citizens' movements that stopped it, an outcome that might not have happened had the public-trust doctrine not been adopted in California legislation and case law).

459. *Columbia Broad. Sys., Inc. v. Democratic Nat'l. Comm.*, 412 U.S. 94, 173–74 (1973).

sections have been state-law applications, the doctrine has also found its way into at least two federal decisions.

1. U.S. v. 1.58 Acres of Land and In re
Steuart Transportation Company

In *U.S. v. 1.58 Acres of Land*, the Federal District Court of Massachusetts applied the public-trust doctrine to the federal condemnation of property owned by the Commonwealth of Massachusetts that the Commonwealth declared to be “public.”⁴⁶⁰ The district court agreed, and stated emphatically that it accepted the policy that “no developed western civilization has recognized absolute rights of private ownership in . . . land as a means of allocating [a] scarce and precious resource among competing public demands.”⁴⁶¹ The court turned to the public-trust doctrine and said that the “trust devolving upon the State (or federal government) for the public . . . cannot be relinquished by a transfer of the property,”⁴⁶² and the court went on to discuss the nature of publicly owned property: “[s]ince the trust *impressed* upon this property is governmental and administered jointly by the state and federal governments by virtue of their sovereignty, neither sovereign may alienate this land free and clear of the public trust.”⁴⁶³

Similarly, the federal court in *In re Steuart Transportation Company*⁴⁶⁴ applied the public-trust doctrine, ruling that “[u]nder the public trust doctrine, the State of Virginia *and the United States* have the right and the duty to preserve the public’s interest in natural wildlife resources. Such right does not derive from ownership of the resources but from a duty owing to the people.”⁴⁶⁵

Such court decisions underline the importance of protecting a public resource, even if it is not beachfront property. The electromagnetic spectrum, as a public and natural resource, should be protected under the public-trust doctrine just as the public property in *1.58 Acres of Land* was. Furthermore, the electromagnetic spectrum is nominally owned by the people like the federal property that was the subject of *In re Steuart Transportation Company*.

As a matter of persuasive authority, federal courts should also be influenced by other cases discussed or footnoted in this Article, including: (a) *Illinois Central*,⁴⁶⁶ a United States Supreme Court case that (applying

460. 523 F. Supp. 120 (D.C. Mass. 1981).

461. *Id.* at 123.

462. *Id.* at 124.

463. *Id.* (emphasis added).

464. 495 F. Supp. 38 (E.D. Va. 1980).

465. *Id.* at 40 (emphasis added).

466. 146 U.S. 387 (1892).

state law) prevented a state from granting public-trust property to a privately owned railroad (recall here that the Supreme Court said in *Appelby v. City of New York*,⁴⁶⁷ that the *Illinois Central* decision was based on state law but that its general principle has been recognized throughout the country);⁴⁶⁸ (b) *Phillips Petroleum Co. v. Mississippi*,⁴⁶⁹ a United States Supreme Court case that also applied state law in expanding the public-trust doctrine to include all waters, not just navigable water; (c) *Save Ourselves Inc., v. Louisiana*,⁴⁷⁰ a state-law case which recognized that potentially all natural resources are protected by the public-trust doctrine, including the air; and (d) *Mono Lake*,⁴⁷¹ a case that made California authorities go back and apply the public trust to resource-allocation decisions that had been made over forty years earlier.

2. Reaching Through the Property Clause

The public-trust doctrine can also be seen through the window of federal cases that have applied the United States Constitution's Property Clause.⁴⁷² In *Kleppe v. New Mexico*,⁴⁷³ for example, the United States Supreme Court stated that the United States Constitution's Property Clause permits federal law to "exercise . . . complete power over particular public property *entrusted to it*,"⁴⁷⁴ and held that the Property Clause gives Congress the power to protect wildlife on public lands, notwithstanding state authority.⁴⁷⁵ If we assume, as this Article has argued, that the electromagnetic spectrum is held by the government on behalf of the people, it is reasonable to assume that the Property Clause allows federal courts to extend the public-trust doctrine to the electromagnetic spectrum. Indeed, in *United States v. Ruby Co.*,⁴⁷⁶ which involved a patent dispute between the United States and a patentee's successors, the Ninth Circuit Court of Appeals embraced the Property Clause and said that it is "the constitutional precept that public lands are *held in trust* by the federal government for all of the people."⁴⁷⁷ Therefore, if one believes that the electromagnetic spectrum is held in trust like federal lands, the Property clause is another mechanism for extending the public-trust doctrine's reach to the electromagnetic spectrum.

467. 271 U.S. 364 (1926).
468. *Id.* at 395.
469. 484 U.S. 469 (1988).
470. 452 So. 2d. 1152 (La. 1984).
471. *Nat'l Audubon Soc'y v. Superior Court*, 658 P.2d 709 (Cal. 1983).
472. U.S. Const. Art. IV, § 3.
473. 426 U.S. 529 (1976).
474. *Id.* at 540 (emphasis added) (citations omitted).
475. *Id.* at 546 (citations omitted).
476. 588 F.2d 697 (9th Cir. 1978).
477. *Id.* at 704 (citations omitted).

C. Is the Timing Right for a Public-Trust Lawsuit, and If So, Who Would Be the Plaintiff and What Relief Would She Seek?

The FCC has indicated some interest in changing the electromagnetic-spectrum management process, and attempting to influence the FCC is certainly one way to try to bring about regulatory reform in this area. The mechanics of the FCC rulemaking process may make it possible to integrate the public-trust doctrine into the Code of Federal Regulations by submitting comments to the FCC in an open rulemaking procedure.⁴⁷⁸ It may also be possible to make changes in electromagnetic-spectrum regulation through President Bush's initiative on spectrum policy.⁴⁷⁹ Yet both of these approaches are unlikely to succeed, since the history of spectrum regulation detailed in this Article shows that the federal government is reluctant to make large-scale revisions in the regulatory process. This Article argues, therefore, that instead of lobbying the executive branch to reform spectrum regulation, citizens and entrepreneurs should take an activist role and effect change through the courts by applying the public-trust doctrine, just as they did after Joseph Sax's article was published in 1970, when they used the public-trust doctrine to defend the environment.

The influence of Sax's public-trust article shows that paradigm shifts in science can happen quickly. Certainly, the changes in environmental law that the public-trust doctrine accomplished took place in a context in which many other developments were occurring to cause a paradigm shift. For example, while it may now be axiomatic that we can cause serious damage to the environment and to humans by using Polychlorinated Biphenyls ("PCBs"), this was not obvious in the mid 1900s. At that time PCBs were a new technology that seemed to bring great benefits to the public, and they were enthusiastically built into all facets of our developing industrial infrastructure.⁴⁸⁰ This was particularly true in the utility industry, where the technology's nonconductive and fire-resistant qualities made it ideal for transformers and capacitors. The discovery that PCBs caused liver toxicity, poisoning, and other carcinogenic effects (particularly in animals)⁴⁸¹ changed that perception, and although it was perhaps impossible to fully repair all the damage that

478. Comments are filed for all spectrum initiatives in accordance with the Administrative Procedure Act through the FCC's website at www.fcc.gov.

479. Presidential Memo on Spectrum Policy, *supra* note 32.

480. Lauren MacLanahan, *Polychlorinated Biphenyls and the "Mega Rule"—Will It Have the Mega-Impact the EPA Desired?*, 24 WM. & MARY ENVTL. L. REV. 345, 347 (2000) (describing PCBs' history—how they were viewed as a great technology in the thirties but have now become an environmental nightmare).

481. Shu-Feng Hsieh et al., *A Cohort Study on Mortality and Exposure to Polychlorinated Biphenyls*, 51 ARCHIVES OF ENVTL. HEALTH 417 (1996).

PCBs had caused, the federal government responded by passing laws (specifically the TSCA⁴⁸²) that imposed a ban on the manufacture, use, and introduction of these harmful products into the environment.⁴⁸³

In the case of PCBs, the discovery of toxicity and tumors in animals was the event that incited legislative action.⁴⁸⁴ In the case of our waterways, many believe that we waited until the Cuyahoga, an otherwise free-flowing river, caught fire before taking notice of the problem of water contamination and passing legislation like the Clean Water Act.⁴⁸⁵ The burning Cuyahoga became a pop-culture *cause célèbre* at the time, as songs were written and the story became something of an urban legend.⁴⁸⁶ To solve the problem, the government did not take over the administration of the factories that spewed flammable substance into the river, but instead (admittedly, this is a somewhat brutal simplification) passed science-intensive laws requiring filtering⁴⁸⁷ and imposing criminal⁴⁸⁸ and civil liability (often strict liability)⁴⁸⁹ upon those who violate emissions standards. This approach is what this Article advocates—regulating the industry and mechanisms that use the natural resource rather than the resource itself.

Just as the hazard of PCBs and the Cuyahoga River fire created public awareness of the need to defend our environment, a number of recent developments have created awareness of the need for change in spectrum

482. In 1976 Congress enacted the Toxic Substances Control Act, 15 U.S.C. § 2605(e) (1998). The TSCA is probably best known for its burden of proof, which places responsibility for safety on manufacturers. See RODGERS, *supra* note 164, at 493.

483. See MacLanahan, *supra* note 480, at 346.

484. See *Envil. Def. Fund, Inc., v. Envil. Prot. Agency*, 636 F.2d 1267, 1270 (C.A.D.C. 1980).

485. See Jonathan H. Adler, *Fables of the Cuyahoga: Reconstructing a History of Environmental Protection*, 14 FORDHAM ENVTL. L.J. 89, 93–97 (2002) (describing in detail the history of the 1969 Cuyahoga River burning and the ensuing legislation that was created in its wake).

486. *Id.* at 89 (citing Randy Newman, “Burn On, on Sail Away” (Warner Bros. Records 1972), and also averring that the Cuyahoga River burning inspired R.E.M.’s “Cuyahoga, on Life’s Rich Pageant” (EMD/Capitol 1986) (“Underneath the river bed we burned the river down. . . . Cuyahoga; Cuyahoga gone.”)).

487. The Clean Water Act limits the amounts of various pollutants that can be discharged into the water by, among other sources, wastewater treatment plants. See 33 U.S.C. § 1311 (1988). In order to meet those discharge limits, wastewater treatment plants use a variety of chemical and biological technologies to remove pollutants from the water to be discharged. 56 Fed. Reg. 7849, 7853 (1991).

488. See *United States v. Law*, 979 F.2d 977, 978 (4th Cir. 1992). Defendants were found guilty on sixteen counts for violating the Clean Water Act. One defendant was sentenced to twenty-four months in prison, and the corporation was fined.

489. Section 309 of the Clean Water Act addresses federal enforcement. 33 U.S.C. § 1319 (2000). The civil section of the Act imposes strict liability, stating that “any person” who violates specific provisions of the Act may be subject to an enforcement action. *Id.* § 1319(a).

policy: a presidential memorandum has been issued, a new spectrum-policy task force has been created, UWB and SDR technologies are swiftly passing from development to deployment, and the bankruptcies of companies that overpaid in spectrum auctions have altered the telecommunications industry. Since waiting for governmental evolution is not the best means of effecting change in spectrum regulation, some alternatives should be considered:

A communications company that is being prevented by spectrum licensing from deploying a cost-saving, spectrum-efficient service—such as one using UWB or SDR technology—could sue under the public-trust doctrine to be permitted to use unavailable frequencies that are controlled by large broadcasters. The plaintiff could rely upon the age-old principles set forth in New Jersey's *Arnold v. Mundy* and demand “fishing, fowling, and navigation” rights within the electromagnetic spectrum, having first established that (a) the spectrum is owned by the public, (b) it is a natural resource, and (c) the new technology would not interfere with licensed broadcasters as it “navigates” for its users. This argument is, of course, premised on a showing that UWB and SDR are ready for commercial usage. The companies should be able to make these arguments fairly easily with support from filings that they have submitted in connection with the many FCC rulemaking procedures related to the deployment of these technologies.

A more ambitious way of revising the way the spectrum is regulated would be for a citizens' group to attempt to reverse one or both of the spectrum “giveaways” (described previously), based on the prohibition-on-conveyance concept set forth in *Illinois Central*. The first giveaways might be difficult to undo, since they have taken place over the past 75 years (although as stated, *Mono Lake* required a state government to reconsider allocation decisions made 40 years earlier). But an attempt to reverse the second giveaway—which consisted of providing additional channels for digital use to numerous broadcasting companies—might be more likely to succeed if citizens could show that the broadcasters will not use the channels that they received for free, or that those broadcasters will never use the spectrum in accordance with the public trust with which the spectrum is impressed.

People whose free-speech rights have been abridged by being prevented from broadcasting their views may be able to use the public-trust doctrine as an alternative argument to bolster their First Amendment rights. The low-power FM radio stations that have essentially been prohibited from broadcasting in urban areas, for example, could be plaintiffs in such an action.

CONCLUSION

Nineteenth-century French economist Frédéric Bastiat sarcastically suggested that one way of parceling out the limited number of jobs to the most people would be to handicap them, either by requiring that they work with one hand or by having a hand chopped off.⁴⁹⁰ This is, in a sense, what is happening today with the allocation of electromagnetic spectrum: the public is prevented from navigating within most of the spectrum due to a legacy policy dating back to the 1920s, not because the spectrum is inaccessible, but because of the FCC's unique brand of command and control. However, this handicapping could be removed by introducing aspects of environmental law into electromagnetic spectrum policy. Specifically, the public-trust doctrine, invoked in combination with environmental law's alternative notion of command and control—which relies more heavily on science and technology deployed at the *device* level rather than at the *resource* level—could serve as a useful model for improving public access and enjoyment of the spectrum.

The role of the FCC is evolving, just as government's role has evolved in the management of other natural resources, and this evolution is likely to take time. As Justice Broussard explained when the California Supreme Court made the (then very controversial) decision to apply the public-trust doctrine retroactively to government's water-allocation actions in *Mono Lake*:

[T]he function of the Water Board has steadily evolved from the narrow role of deciding priorities between competing appropriators to the charge of comprehensive planning and allocation of waters. This change necessarily affects the board's responsibility with respect to the public trust. The board of limited powers of 1913 had neither the power nor duty to consider interests protected by the public trust; the present board, in undertaking planning and allocation of water resources, is required by statute to take those interests into account.⁴⁹¹

In a similar vein, the FCC is already required by statute to take the “public interest” into account,⁴⁹² and it is not an unreasonable leap to ask legislatures and courts to apply the public-trust doctrine to their

490. Frédéric Bastiat, *Bastiat*, THE ECONOMIST, July 19, 2001, at 64.

491. 658 P.2d 709, 726 (Cal. 1983).

492. The standard for practically all decision making in the FCC is “public interest, convenience and necessity.” *See, e.g.*, 47 U.S.C. § 309 (2000) (relying on “public interest, convenience and necessity” for the initial granting of licenses); 47 U.S.C. § 310 (2000) (relying on “public interest, convenience and necessity” when reviewing assignment and transfer of licenses); 47 U.S.C. § 307 (2000) (relying on “public interest, convenience and necessity” for the renewal and extension of licenses).

interpretation of the public interest. New technologies like UWB and SDR, which will allow the public to access and use electromagnetic spectrum in ways never before possible, should provide an additional impetus for the FCC to invoke the public-trust doctrine, in this case to authorize purveyors of UWB and SDR technologies to use frequencies at the same time that broadcasters use them.

At present, thousands of pages of rules regulate use of the electromagnetic spectrum, and most of them are the product of an outdated understanding of science and economics. These rules assume analog transmissions to be the norm, regulate transmitters rather than receivers, and they are based on (in nearly every case) the disfavored notion that interference is the unavoidable result of a “cacophony of competing voices.” Happily, change is slowly under way: a rulemaking procedure has recently authorized some market propretization mechanisms,⁴⁹³ and a recent presidential memorandum has been issued on spectrum policy.⁴⁹⁴ The FCC, however, continues to retain its monopoly power to determine which frequencies go to whom.⁴⁹⁵ Indeed, much of the intellectual energy expended on the spectrum over the past few years has focused on how best to *allocate* spectrum, rather than on how best to provide the public *access* to it. Better spectrum-allocation mechanisms, such as auctions instead of hearings, will theoretically improve public access, but a better centralized-allocation system will still entail centralized allocation with government retaining full control. Indeed, almost all methods of revising spectrum regulation that are under consideration would preserve the government’s right to determine who should speak when. Although there has recently been a general consensus that giving spectrum away for free no longer makes sense, since auctioning brings in revenue while hearings do not, it does not necessarily follow that auctioning or propretizing the spectrum will improve the public’s access to it. Billions of dollars may change hands, but if areas of the spectrum remain idle, government will have failed in its main purpose of letting the public use the spectrum.

That creating public access is the most important goal of regulating the spectrum is implied by propretization advocate Thomas Hazlett’s observation that “[t]he license ‘giveaway’ has been studied by economists for decades. Repeatedly the conclusion has been reached that the system was not merely inefficient but illogical, error-prone, a mere acci-

493. See Report and Order and Further Notice of Proposed Rulemaking, FCC 03-113, *supra* note 216.

494. Presidential Memo on Spectrum Policy, *supra* note 32. The memo describes the president’s intention to make electromagnetic spectrum, a “vital and limited national resource” more available for use.

495. *Id.* (discussing multiple notice and administrative requirements retained by the FCC).

dent of history.”⁴⁹⁶ In the same sense (i.e., considering access to be regulation’s primary goal), the massive amounts of money generated by the PCS and 3G auctions may in 20 years also be viewed as an accident. If new technologies like UWB and SDR function better in an *undivided* spectrum, then auctioning off parts of spectrum separately may prevent UWB and SDR from being deployed. Auctioning slices of spectrum with clearly defined electromagnetic “borders” assumes that technology works better if participants are, like cars, relegated to operating within specific lanes; it assumes that spectrum is like a piece of property that is best harnessed when in private hands, rather than its being subject to the “tragedy” of the commons. It is far too early in our technological development to come to this conclusion, and indeed, if the proponents of UWB and SDR are right, the exact opposite is true. If so, there is a great danger in granting property rights—which are difficult to revoke—before we know how best to exploit electromagnetic spectrum, one of our largest and most valuable natural resources.

The *Next Wave* case provides another example of regulations diminishing access, for it shows that allocating electromagnetic spectrum through auctions can make frequencies unavailable for years. There an auction turned out to be just as inefficient as the giveaways, comparative hearings, and lotteries that had preceded it, since it led to frequencies being left unused for a long time, and idle spectrum is always a problem for the public regardless of how the party who keeps the frequencies idle acquired them. The relative benefit of creating auction-generated government revenue is in many cases offset by the public harm caused by unused spectrum, and by the financial instability and bankruptcies of the “winning” licensees.

It must be acknowledged that applying the public-trust doctrine to electromagnetic spectrum could be complicated in the short term because it could upset many quasi-private property arrangements that exist today: cellular, PCS, and television and radio broadcasters (along with their investors) have all made long-term business plans based on the assumption that they will have enduring monopolistic control over the slices of spectrum to which they hold licenses. Even though FCC regulations do not allow private ownership,⁴⁹⁷ the tradition of automatically renewing

496. Hazlett, *supra* note 163, at 569.

497. See 47 U.S.C. § 301 (2000).

It is the purpose of this Act to maintain the *control* of the United States over *all the channels of radio transmission*; and to provide for the *use of such channels, but not the ownership thereof*, by persons for limited periods of time, under licenses granted by Federal authority, and no such license shall be construed to create any right, beyond the terms, conditions and period of the license.

Id. (emphasis added).

broadcasting licenses has created *de facto* property interests in numerous frequencies. Upsetting those “property rights” is understandably a concern to incumbents, as well as to free-market proponents who believe that predictability in property rights is necessary for a stable economy. And it has implications for spectrum deregulation, too, that commentators have counseled restraint in extending the public-trust doctrine to certain other resources, such as the sky, suggesting that government should avoid changing too much too fast, because “to do so would risk unsettling a variety of arrangements upon which people have organized their lives and their enterprises.”⁴⁹⁸

While extending the public-trust doctrine to electromagnetic spectrum could unsettle a variety of arrangements—such as the existing monopolies over the spectrum that FCC licenses confer—it is not clear that freeing up access to the spectrum would cause a problem for anyone other than those incumbents and their investors. The “public interest” is, after all, the *public’s* interest. As Justice Scalia said when he strictly construed § 525 of the Bankruptcy code in *Next Wave*, “a debt is a debt, even when the obligation to pay is also a regulatory condition;”⁴⁹⁹ it could just as easily be said that “a public resource is still a *public* resource, even when the right to its temporary use is given to a private company.” To be clear, the proposition here is not that the public should have *unbridled* access to the spectrum at all times, but that the public, armed with new technologies (such as UWB and SDR), should have *access rights to navigate* within the natural resource as long as its navigation does not harm others. This does little more than restate many other long-accepted principles of property law in which private interests are subordinated to public ones. And new technologies can now—or will soon—allow policymakers to import the public trust into the electromagnetic spectrum and allow public interests such as free speech to have priority over private-property interests.

This Article has demonstrated that there is an emerging consensus that the present system of electromagnetic spectrum command and control must be changed.⁵⁰⁰ In keeping with that trend, recent reports indicate that there is not much of a philosophical gap between academic theorists at all (though a more basic debate about categorizing terms may

498. Torres, *supra* note 74, at 522.

499. F.C.C. v. NextWave Pers. Comm., 123 S. Ct. 836, at 839 (2003).

500. See LESSIG, *supra* note 45; see also FAULHABER & FARBER, SPECTRUM MANAGEMENT: PROPERTY RIGHTS, MARKETS, AND THE COMMONS 6, available at http://rider.wharton.upenn.edu/~Faulhabe/SPECTRUM_MANAGEMENTv51.pdf (analogizing the FCC allocation method to the Soviet “Gosplan”); *Freeing the airwaves*, THE ECONOMIST, May 31, 2003, at 76 (evaluating the privatization vs. commons approaches to spectrum, noting that both sides believe that there is not enough data available today to bet everything on a single regime, and also discussing the Faulhaber/Farber “big-bang” theory).

still be underway).⁵⁰¹ Promising new technologies have been partially proven. Most experts now agree that the electromagnetic spectrum is owned by the public and that new technologies will help the public use and enjoy it. And while citizens may not be *individually* interested in how their spectrum property is managed,⁵⁰² this Article argues that they are indeed individually interested in maintaining *access* to their property. The public-trust doctrine, as well as other principles like environmental law's version of command and control, can help the public fully realize the potential of this vital natural resource.

Ironically, in environmental law, one of the underlying policy theories is also called command and control. Here, however, it acts more as a mechanism for attaching liability to devices, manufacturers, and pollutants than it does to impose control upon a resource itself. For example, the Clean Air Act⁵⁰³ has been described as a comprehensive "command and control regime of strict technology and health based standards."⁵⁰⁴ Could command and control, as defined by environmental law principles, become the new method of management of electromagnetic spectrum by replacing the antiquated command and control of the entire resource as currently practiced by the FCC? This shift from one type of command and control regime to another makes sense. As professor James Huffman explains:

The dominant approach to environmental protection over the past thirty years has been command and control regulation. The basic idea has been that private decision makers, particularly those acting pursuant to market incentives, will fail to take account of the environmental consequences of their actions. It is therefore necessary that government establish acceptable levels of environmental impact and command that these levels not be exceeded.⁵⁰⁵

501. See Lawrence Lessig, Lessig Blog Archives for May, 2003, at http://www.lessig.org/blog/archives/2003_05.shtml (citing the *Economist* article, Lessig says that "[a]s Yochai Benkler is increasingly pushing the point, the problem with the "commons" metaphor is that it itself is a 'property' metaphor—just a form of 'property' where everyone has a right to access").

502. See Hazlett, *supra* note 68, at 400 ("Members of the general public are the nominal spectrum owners, but they are individually uninterested in the management of 'their' property.>").

503. See Clean Air Act Amendments of 1990, Pub.L. 101-549. 101st Cong., 2d Sess., 104 Stat. 2399 (Nov. 15, 1990).

504. Richard J. Lazarus, *The Greening of America and the Graying of United States Environmental Law: Reflections on Environmental Law's First Three Decades in the United States*, 20 VA. ENVTL. L.J. 75, 87 (2001).

505. James L. Huffman, *The Past and Future of Environmental Law*, 30 ENVTL. L. 23, 25 (2000).

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The management paradigm of electromagnetic spectrum is evolving, and a natural progression would be to move from the present brute force, centrally planned command and control system⁵⁰⁶ to a more specific, targeted form of command and control.

506. LESSIG, *supra* note 45, at 182 (comparing the history of broadcasting regulation in the U.S. to centralized planning in the former Soviet Union).