
UNLEASHING THE OPEN MOBILE INTERNET

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I. Introduction

Today's society increasingly relies on mobile technology while remaining limited to a handful of Internet service providers (ISPs). Policymakers continue to struggle with how to provide nondiscriminatory Internet access without undermining the financial incentives needed to encourage continued infrastructure development. Applications like streaming media or peer-to-peer (P2P) file sharing consume significantly more Internet resources than a traditional voice over Internet protocol (VoIP) telephone call. In response, Internet providers frequently degrade these bandwidth intensive applications to maximize profit. Many consider this practice discriminatory, believing that each user should be free to run the application of his choice on an equal basis with other users. With few exceptions, Internet users pay the same price to access the Internet regardless of which application they run. Without a mechanism to fairly price each application based on its consumption of Internet resources and value to the consumer, ISPs are incentivized to continue discriminating.

Two developments are unfolding that may provide for nondiscriminatory access while retaining the incentive for Internet infrastructure development. First, the Federal Communica-

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tions Commission (FCC) has made available a significant amount of bandwidth previously reserved for analog television transmission. Second, multi-mode and cognitive radio technology have advanced to the point where it is now feasible to develop mobile devices that can work with virtually any ISP regardless of the transmission mode or frequency that the ISP supports. These devices may enable consumers to have ad-hoc open mobile Internet access to the ISP of their choosing. The resulting free market competition will provide non-discriminatory access without unduly depriving ISPs of the economic incentive required to continue providing Internet services.

This Note proposes a new FCC regulation that would require ISPs to offer ad-hoc open mobile access. Section II describes the evolution of the Telecommunications Act of 1996, which regulates most aspects of mobile Internet communications. Section III describes the conflicting goals of providing nondiscriminatory access and maintaining price tiers that incentivize Internet infrastructure development. These disparate goals are irreconcilable without a new paradigm. Sections IV and V describe recent developments that enable a new paradigm and convey the missing link as a new minimally obtrusive FCC regulation. Specifically, Section IV discusses the recent availability of radio spectrum previously reserved for analog television.

Section V describes developments in software-defined radio technology and general industry trends supporting its use in unlicensed spectrum. This technology can effectively exploit newly available spectrum in a way that could alleviate the concerns of nondiscriminatory Internet access. Recent examples of this technology will be highlighted to show that the proposed regulation is pragmatic. Section VI is an analysis of the proposed regulation with anticipated issues and defenses. Section VII concludes this note by showing that the proposed regulation is the only remaining obstacle to enabling a free market solution to mobile Internet access. This regulation will unleash the power of the open mobile Internet so that it will continue to develop with financial incentives for ISPs, nondiscriminatory access for users, and minimum regulatory burden.

II. Historical Context of the Telecommunications Act

In 1934, President Franklin Roosevelt passed the Communications Act of 1934.¹ This act established the FCC, which consolidated authority over radio, telephone, and telegraph operations.² The mandate of the FCC was to regulate wire and radio transmissions in a nondiscriminatory manner.³

The scope of communications changed significantly when IBM introduced the first electronic computer in 1943.⁴ Building on the introduction of computers, the military developed the ARPANET in 1969 to permit computers to communicate with each other – the genesis for the present day Internet.⁵ In response to the data-processing services that the computer and Internet enabled, the FCC promulgated rules and regulations (Computer II) to distinguish “basic” common carriers of voice from “enhanced” information-service providers.⁶ Computer II provided a safe harbor exemption from the requirement to provide nondiscriminatory access for enhanced services because the FCC believed such services were not public necessities in contrast to basic voice transmission.⁷ A recent case affirmed the distinction between “basic” and “enhanced” services, holding that a cable company was exempt from mandatory regulation under Title II of the Communications Act when transmitting broadband Internet services, even though the company utilized a transmission

¹48 Stat. 1064 (1934) (amended 1937), *amended by* Telecomms. Act of 1996, 47 U.S.C. § 151 (2006).

² *See id.*

³ *See id.*

⁴ Susan W. Brenner, *Law in an Era of Pervasive Technology*, 15 WIDENER L.J. 667, 729 (2006) (describing first computer mainframe as “five-ton Harvard Mark I”).

⁵ *Reno v. ACLU*, 521 U.S. 844, 849-50 (1997) (describing ARPANET as “an international network of interconnected computers”).

⁶ *Second Computer Inquiry*, 77 F.C.C.2d 384, 387 (1980) (final decision). *See also* 47 U.S.C. § 153(43) (2006) (defining “telecommunications” as “transmission . . . without change in the form or content of the information . . .”); 47 U.S.C. § 153(20) (2006) (defining “information service” as “generating, acquiring, storing, transforming, processing . . .”).

⁷ *Second Computer Inquiry*, 77 F.C.C.2d at 387.

medium that could also transmit voice.⁸ The court affirmed the FCC's position "that it was unwise to subject enhanced service to [basic] common-carrier regulation given the 'fast-moving, competitive market' in which they were offered."⁹

The Telecommunications Act of 1996 (1996 Act) amended the Communications Act of 1934 in response to regional monopolies, which were created following the break-up of AT&T into smaller entities under an antitrust consent decree.¹⁰ These regional monopolies were referred to as "incumbent local exchange carriers" (ILECs), while their competitors were "competing local exchange carriers" (CLECs).¹¹ The 1996 Act attempted to foster competitive market development by imposing several new ILEC duties.¹² ILECs must provide interconnection agreements with CLECs so that CLECs can access the large physical network established by the ILECs.¹³ The ILECs receive reciprocal compensation for the mandated access to their physical networks because it is arguably a constitutional taking of a property right.¹⁴ ILECs must also provide unbundled access to their network, so CLECs can offer service without having to duplicate all of the network elements.¹⁵ The 1996 Act also facilitated competition by requiring

⁸ See generally *Nat'l Cable & Telecomms. Assn. v. Brand X Internet Servs.*, 545 U.S. 967, 1017 (2005).

⁹ *Id.* at 977 (quoting *Second Computer Inquiry*, 77 F.C.C.2d at 434).

¹⁰ See *MCI WorldCom Commc'ns., Inc. v. Dept. of Telecomm. & Energy*, 810 N.E.2d 802, 805-06 (Mass. 2004); *Earthlink, Inc. v. F.C.C.*, 462 F.3d 1, 3-4 (D.C. Cir. 2006).

¹¹ See *MCI WorldCom*, 810 N.E.2d at 805-06.

¹² 47 U.S.C. § 251(b)-(c) (2006).

¹³ *Id.*; see also 47 U.S.C. § 251(c)(2) (2006).

¹⁴ Adam Candeub, *Network Interconnection and Takings*, 54 SYRACUSE L. REV. 369, 396-98 (2004) (discussing mandated interconnect agreement as constitutional taking). See also 47 U.S.C. § 251(b)(5) (2006) (describing reciprocal compensation).

¹⁵ 47 U.S.C. § 251(c)(3) (2006). The statute requires the following:

The duty to provide, to any requesting telecommunications carrier for the provision of a telecommunications service, nondiscriminatory access to network elements on an unbundled basis at any technically feasible point on rates, terms, and conditions that are just, reasonable, and nondiscriminatory in accordance with the terms and conditions of the agreement and the requirements of this section and section

number portability and by permitting CLECs to access “telephone numbers, operator services, directory assistance, and directory listing”¹⁶

III. Internet Access – A Balancing Act

A. Network Neutrality

“Americans today spend almost as much on bandwidth—the capacity to move information—as [they] do on energy.”¹⁷ Americans are in the midst of an information revolution, which a bandwidth cartel, similar to the oil cartel created during the industrial revolution, may constrain.¹⁸ Advocates of network neutrality argue that the Internet is fundamental to the nation’s economic health, and a handful of network providers are unfairly controlling the terms of access.¹⁹ Such proponents have called on the next administration to implement a “Digital New Deal” fashioned after the New Deal that was implemented when President Franklin Roosevelt reinvigorated the economy by “putting millions of Americans to work.”²⁰ Estimates of the economic significance of a digital new deal are in the trillions of dollars.²¹

Only one part of the Internet factors into the network neutrality debate.²² The Internet is generally thought of as a mesh of

252 of this title. An incumbent local exchange carrier shall provide such unbundled network elements in a manner that allows requesting carriers to combine such elements in order to provide such telecommunications service.

Id.

¹⁶ 47 U.S.C. § 251(b)(3) (2006).

¹⁷ Tim Wu, *Opec 2.0*, N.Y. TIMES, July 30, 2008, at A17, archived at <http://www.webcitation.org/5eMzmLARb>. Tim Wu is a professor at Columbia Law School and an advocate for network neutrality. *Id.*

¹⁸ *Id.*

¹⁹ Wu, *supra* note 17.

²⁰ Helen De Michiel, *Next President Should Launch the Digital New Deal*, SAN FRANCISCO CHRONICLE, Apr. 11, 2008, at B-11, archived at <http://www.webcitation.org/5eMovDYw4>.

²¹ Michiel, *supra* note 20.

²² Wu, *supra* note 17.

interconnected computers.²³ This mesh is further defined as a “cloud” where most routing occurs and the “last mile” of the transmission medium where consumers send and receive information.²⁴ The last mile is where network neutrality proponents contend the greatest amount of network provider discrimination occurs.²⁵ The 1996 Act mandated nondiscriminatory Internet access by defining the duties of common carriers.²⁶ In 2005, the Supreme Court upheld the FCC’s statutory interpretation of 47 U.S.C. § 153(20), which classified cable modem service as an information service.²⁷ Consequently, cable companies could offer discriminatory access to their networks.²⁸ In 2005, the FCC further adopted an order classifying digital subscriber line (DSL) and other wire-line services as information services.²⁹ The combined discriminatory effect of classifying cable modem and DSL providers as information services affected ninety-eight percent of the broadband market in 2006.³⁰ Unlike telephone companies, whose voice services are still subject to common carrier regulation, Internet providers face the new challenge of how to provide cost effective services to customers whose applications consume

²³ See *Reno v. ACLU*, 521 U.S. 844, 849-50 (1997).

²⁴ Rob Frieden, *Internet 3.0: Identifying problems and solutions to the Network Neutrality Debate*, 1 INT’L J. COMM. 461, 474 (2007), archived at <http://www.webcitation.org/5eMpCXoah>. The “last mile” is a figurative term based on historical distance of the final physical connection between the user and the Internet “mesh.” Glenn Gabe, *The Critical last Mile for SEO: Your Copywriters, Designers and Developers*, GSQI, Dec. 1, 2008, archived at <http://www.webcitation.org/5eQLDCGUT>.

²⁵ Frieden, *supra* note 24, at 479.

²⁶ See 47 U.S.C. § 251(c)(3) (2006).

²⁷ See generally *Nat’l Cable & Telecomms. Assn. v. Brand X Internet Servs.*, 545 U.S. 967, 986 (2005) (holding as reasonable the FCC decision classifying cable as an information providing service).

²⁸ See *id.* at 973.

²⁹ *Appropriate Framework for Broadband Access to the Internet over Wire-line Facilities*, 20 F.C.C.R. 14853, 14858 (2005). DSL provides broadband Internet using standard telephone lines.

³⁰ See Ben Scott, *Why Consumers Demand Internet Freedom, Network Neutrality: Fact vs. Fiction*, FREE PRESS, May 2006, at 4, archived at <http://www.webcitation.org/5eMpl9lfK> (arguing that allowing the duopoly allowed discrimination injured the rights of the service providers, content providers and ultimately customer).

varying amounts of bandwidth.³¹ In contrast, common carriers charge users based on connection time on the assumption that all users consume similar bandwidth for telephone calls.³² Each user consumes the same bandwidth for the same price without discrimination.³³

There are several principle arguments that advocates of network neutrality have put forth.³⁴ First, cable and DSL providers operate as an oligopoly.³⁵ This results in an incentive to leverage their investments in transmission medium infrastructure in order to restrict competition—a “natural monopoly.”³⁶ For example, one ISP described heavy bandwidth users, such as Google, as “free riders” stating “[n]ow what they would like to do is use my pipes free, but I ain’t going to let them do that because we have spent this capital and we have to have a return on it.”³⁷ In addition, when home networking first emerged in 2002, AT&T likened it to “‘theft of services’ and threatened subscribers with civil and criminal penalties.”³⁸ Second, the Internet’s rapid development is due in part to its open architecture, which allows any type of device to be connected to it or any type of content to be provided.³⁹ Discriminatory access would stifle Internet development by limiting “content, applications, services, and technologies delivered over [the] Internet”⁴⁰ Restricting the use of

³¹ See Frieden, *supra* note 24, at 469-71 (describing difficulty in monetizing amounts of consumer use).

³² See Frieden, *supra* note 24, at 470-71.

³³ See Frieden, *supra* note 24, at 470-71.

³⁴ See Michele C. Farquhar, *Telecommunications Future*, 887 PLI/Pat 113, 128-29 (2006) (describing four distinct avenues for arguing for net neutrality).

³⁵ See Farquhar, *supra* note 34, at 128 (discussing argument wherein network operators exist in a duopoly environment to leverage market power to discriminate access).

³⁶ See Tim Wu & Christopher S. Yoo, *Keeping the Internet Neutral?: Tim Wu and Christopher Yoo Debate*, 59 FED. COMM. L.J. 575, 585 (2007) (arguing current standards create economic incentive to control bandwidth).

³⁷ Frieden, *supra* note 24, at 472.

³⁸ Tim Wu, *Network Neutrality, Broadband Discrimination*, 2 J. TELECOMM. & HIGH TECH. L. 141, 157 (2005).

³⁹ See Farquhar, *supra* note 34, at 129 (recounting open architecture argument in favor of net neutrality).

⁴⁰ See Farquhar, *supra* note 34, at 129.

new technologies would conflict with the FCC mandate to encourage “advanced telecommunications.”⁴¹ Third, network neutrality is necessary to protect the first amendment right to free speech.⁴² Finally, network operators should not be compensated both by consumers and content providers for use of the same infrastructure.⁴³ By bundling Internet access and allowable content, ISPs create the equivalent of a “walled garden.”⁴⁴ In this walled garden, “vendors collaborate to direct consumers’ Internet navigation to each other’s Web sites.”⁴⁵ For example in 2004, a spokesperson for Disney stated that eighty-five percent of AOL users never left AOL territory.⁴⁶

In 2005, the FCC adopted a policy in support of preserving Internet freedom.⁴⁷ This policy articulated four guiding principles to be used in future policy-making activities, but the principles are not rules per se.⁴⁸ These principles “encourage broadband deployment and preserve and promote the open and interconnected nature of the public Internet. . . .”⁴⁹ The four principles are directed toward freedom to access lawful content, run applications, connect legal devices that do not harm the network, and toward the promotion of competition amongst “network providers, application and service providers, and content providers.”⁵⁰

⁴¹ 47 U.S.C.A § 1302 (2001) (“The Commission . . . shall encourage the deployment on a reasonable and timely basis of advanced telecommunications capability to all Americans . . .”).

⁴² See Farquhar, *supra* note 34, at 129; see also U.S. CONST. amend. I.

⁴³ See Farquhar, *supra* note 34, at 129 (arguing against double recovery of payments from consumers and content providers accessing the same bandwidth but in different contexts).

⁴⁴ SEARCHSECURITY.COM, Definitions: walled garden, *archived at* <http://www.webcitation.org/5eMq9ZbGt>.

⁴⁵ See SEARCHSECURITY.COM, *supra* note 44.

⁴⁶ See SEARCHSECURITY.COM, *supra* note 44.

⁴⁷ See Frieden, *supra* note 24, at 489 (describing how time limit agreements adopted by the FCC to support code of conduct for providers); see also Marlene H. Dortch, F.C.C. Policy Statement FCC 05-151 (Sept. 23 2005), *archived at* <http://www.webcitation.org/5eMqNB0yl> at 3 (issuing a policy statement articulating base line of acceptable conduct for ISP’s).

⁴⁸ See Dortch, *supra* note 47, at 3 n.15.

⁴⁹ See Dortch, *supra* note 47, at 3.

⁵⁰ See Dortch, *supra* note 47, at 3.

B. Network Diversity

“[N]ew mandates on Internet access could reduce incentives to build new high-speed broadband networks or invest capital in innovative new technologies.”⁵¹ Those who have invested in the deployment of Internet infrastructure tend to argue against network neutrality, in favor of price tiers, prioritization of data delivery, and diversity regarding how services are delivered to the consumer.⁵² Proponents of network diversity put forth the following main arguments.⁵³ First, investment in broadband infrastructure should be encouraged by permitting network owners to profit from high-value services enabled by such facilities.⁵⁴ Second, existing market competition is sufficient without the need for intrusive regulation.⁵⁵ Finally, where there is no evidence of “anti-competitive Internet restrictions” a net neutrality mandate could “thwart the deployment of beneficial technologies, services, and business models.”⁵⁶

Network diversity proponents are concerned primarily with minimizing regulation of information services, which are exempt from common carrier regulations under Computer II’s safe harbor rules.⁵⁷ However, there also is support for regulatory forbearance for common carrier services.⁵⁸ The 1996 Act imposes a general duty on common telecommunications carriers to provide “nondiscriminatory access to network elements on an unbundled basis at any technically feasible point on rates, terms, and conditions that are just, [and] reasonable . . .” thus allowing CLECs’ to combine elements of ILECs’ networks to provide com-

⁵¹ Rob Jordan, *Internet Neutrality: A Solution in Search of a Problem*, FREEDOM WORKS, Feb. 7, 2006, archived at <http://www.webcitation.org/5eMr5ywB4>. (describing how four principals promote freedom of access and provides space for competition).

⁵² See Farquhar, *supra* note 34, at 128.

⁵³ See Farquhar, *supra* note 34, at 129.

⁵⁴ See Farquhar, *supra* note 34, at 129.

⁵⁵ See Farquhar, *supra* note 34, at 129.

⁵⁶ Farquhar, *supra* note 34, at 129.

⁵⁷ Second Computer Inquiry, 77 F.C.C.2d 384, 387 (1980).

⁵⁸ 47 U.S.C. § 160 (2006) (providing “competition in provision of telecommunications service”).

peting services.⁵⁹ ILECs may petition the FCC to forbear application of the unbundling regulation, arguing satisfaction of the following three-prong balancing test.⁶⁰ First, enforcement of the regulation is not necessary to ensure services are just, reasonable, and non-discriminatory.⁶¹ Second, enforcement is not necessary to protect the consumer.⁶² Finally, forbearance is consistent with public policy.⁶³ In determining the reasonableness of regulatory forbearance, the FCC is not required to perform an analysis of market conditions but can rely on likely future market developments.⁶⁴

IV. Television White Spaces

The limited capacity of the Internet provides the impetus for the debate between network neutrality and network diversity.⁶⁵ Conversely, unlimited capacity would remove the incentive for price tiers while devaluing the cost of accessing the Internet so that it would be available to anyone.⁶⁶ Advocates of network neutrality have suggested that increasing bandwidth may be an alternate solution to ensuring non-discriminatory Internet access, rather than imposing additional regulation on network providers.⁶⁷ Unused wireless bandwidth is substantial.⁶⁸ "At any given moment, more than [ninety] percent of the nation's airwaves are empty."⁶⁹ Licensees tie up a significant portion of this bandwidth in a wasteful manner.⁷⁰ One such area of waste includes the extra bandwidth and guard bands required by analog

⁵⁹ 47 U.S.C. § 251(c)(3) (2006).

⁶⁰ 47 U.S.C. § 160(a) (2006).

⁶¹ *Id.*

⁶² *Id.*

⁶³ *Id.*

⁶⁴ *See Earthlink, Inc. v. FCC*, 462 F.3d 1 (D.C. Cir. 2006) (balancing short term impact of unbundling against long term gains).

⁶⁵ *See Wu, supra* note 17 (describing lag in FCC reform affecting consumer rights).

⁶⁶ *See Wu, supra* note 17 (describing economic effect of bandwidth).

⁶⁷ *See Wu, supra* note 17.

⁶⁸ *Wu, supra* note 17.

⁶⁹ *Wu, supra* note 17.

⁷⁰ *Wu, supra* note 17.

television transmission.⁷¹ The unused spectral range previously dedicated to analog television spans 54-698 MHz and is commonly referred to as “white space.”⁷² With the transition to digital television (DTV), this white space may now be reallocated to more efficient uses.⁷³ Portions of this spectrum are particularly valuable because of their “range and the ability of the signals to travel through walls” (as opposed to requiring line-of-sight communication).⁷⁴ The value of this spectrum was demonstrated when a small portion known as the 700Mhz band was auctioned for nineteen billion dollars.⁷⁵

The FCC derives its right to regulate radio device apparatuses from the interstate commerce clause.⁷⁶ Although the reallocation of spectrum occurs by means of an FCC auction, what is being sold is a term license to use FCC-approved radio devices.⁷⁷ No property rights are bestowed.⁷⁸ An applicant for an FCC license must specifically grant a waiver of any property rights or claims against the United States as a condition of receiving such

⁷¹ Maury Wright, *White space clash looks like a long battle: Licensing may be the only avenue to deployment*, DIGITAL HOME DESIGNLINE, Sept. 23, 2008, archived at <http://www.webcitation.org/5eMriP73m>. Guard bands refer to the unallocated spectrum to prevent interference between used portions of the spectrum. *Id.* Analog television requires wider guard bands than digital television. *Id.*

⁷² See Nicolas Mokhoff, *Analysis: Of elections and “white spaces,”* DIGITAL HOME DESIGNLINE, Nov. 5, 2008, archived at <http://www.webcitation.org/5eMrurIE> (describing “white spaces”).

⁷³ See Wright, *supra* note 71.

⁷⁴ Wright, *supra* note 71. Certain frequencies will permit transmission of information through walls without acceptable levels of signal loss whereas other frequencies require the transmitter and receiver to have no obstructions other than the earth’s atmosphere. *Id.* Barry McLarnon, *VHF/UHF/Microwave Radio Propagation: A Primer for Digital Experimenters*, TAPR, 1997, archived at <http://www.webcitation.org/5eQOEHcKc>.

⁷⁵ F.C.C., *Summary for Auction 73* (Oct. 1, 2008), archived at <http://www.webcitation.org/5eMsSP5Yr>.

⁷⁶ 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, 453, 460 (Spring 2001). See also U.S. CONST. art. I, § 8, cl. 3.

⁷⁷ See Hazlett, *supra* note 76, at 453 (reasoning that auction is an inappropriate term since no title to property actually changes hands).

⁷⁸ See Hazlett, *supra* note 76, at 453.

license.⁷⁹ This is a fundamental concept of communications law that the 69th Congress in 1926 introduced in order to counter fears that property rights in the airwaves would undermine the regulatory authority of the FCC.⁸⁰ A grant of a spectrum license is limited to specific uses determined by public interest, not market access.⁸¹

In a dramatic step, the FCC opened the substantive remainder of television white spaces for unlicensed use.⁸² Additional unlicensed spectrum has been provided in other spectral ranges (bands) not associated with analog television.⁸³ The FCC has instituted numerous safeguards on the type of radio devices that may be used in the unlicensed spectrum to prevent harmful interference.⁸⁴ A connecting radio device must have geo-location capability coupled with a provision for accessing data over the Internet to identify incumbent services.⁸⁵ In addition, the device must have spectrum-sensing technology.⁸⁶ Although white space proponents initially argued that spectrum-sensing technology alone would suffice, the FCC struck a compromise by requiring geo-location technology until spectrum-sensing technology matures.⁸⁷ In addition to these technological protections, there are

⁷⁹ Hazlett, *supra* note 76, at 454 n.380. *See also*, 47 U.S.C. § 304 (2006). “No station license shall be granted by the Commission until the applicant therefor shall have waived any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States” 47 U.S.C. § 304.

⁸⁰ Hazlett, *supra* note 76, at 454, 454 n.380.

⁸¹ *See* Hazlett, *supra* note 76, at 456-57.

⁸² Alan Stillwell, *FCC Adopts Rules for Unlicensed Use of Television White Spaces*, FCC, Nov. 4, 2008, archived at <http://www.webcitation.org/5eMst05In>.

⁸³ Kevin J. Martin, Statement Re: *Unlicensed Operation in the TV Broadcast Bands; Additional Spectrum for Unlicensed Devices Below 900 Mhz and in the 3 Ghz Band*, Fcc.gov, Nov. 4, 2008, archived at <http://www.webcitation.org/5eMtFt2JM> (commenting on unlicensed operations). In addition to the TV broadcast bands, unlicensed operation is permitted below 900 MHz and in the 3GHz band. *Id.*

⁸⁴ Stillwell, *supra* note 82, at 1; *see also* 47 C.F.R. § 15 (2008) (covering general unlicensed radio device requirements).

⁸⁵ Stillwell, *supra* note 82, at 1.

⁸⁶ Stillwell, *supra* note 82, at 1.

⁸⁷ Michael J. Copps, Statement Re: *Unlicensed Operation in the TV Broadcast Bands*, FCC, Nov. 4, 2008, archived at <http://www.webcitation.org/5IUZdq0jZ>.

procedural protections as well.⁸⁸ First, the FCC must certify all devices.⁸⁹ Second, the devices must conform to rules for unlicensed radio operation, which require deactivation of the device if it creates harmful interference.⁹⁰ Third, incorporating geo-location technology facilitates deactivation of devices later found to have manufacturing flaws.⁹¹ Finally, all interested parties will have an opportunity to be present during the testing of devices that rely solely on spectrum-sensing technology.⁹²

Despite the technological and procedural protective measures that have been put into place, there are still many unresolved issues.⁹³ The order authorizing unlicensed use of the TV white-space lacks clear language addressing the complaint process in cases of interference.⁹⁴ The main concern is interference with incumbent broadcasters, cable providers, and wireless microphones (in venues such as sports stadiums and theatres).⁹⁵ When interference is found, the order does not specify the “legal responsibilities of those who provide these new unlicensed devices.”⁹⁶ Industry analysts express concern that TV receivers are ill-equipped to reject interference from adjacent unli-

(discussing need to utilize “junk space” to continue to develop new products to utilize wireless networks). Spectrum-sensing technology detects the presence of other local transmitters rather than relying on a predefined database listing their location. *Id.* at 1. Nate Anderson, *White spaces, angry faces: Inside the battle over “interference”*, ARSTECHNICA, Sept. 23, 2008, archived at <http://www.webcitation.org/5eQPOYY5z>.

⁸⁸ See Copps, *supra* note 87, at 2.

⁸⁹ Copps, *supra* note 87, at 2.

⁹⁰ Copps, *supra* note 87, at 2. See also 47 C.F.R. § 15 (2008) (covering general unlicensed radio device requirements).

⁹¹ Copps, *supra* note 87, at 2.

⁹² Copps, *supra* note 87, at 2.

⁹³ See Deborah Taylor Tate, Statement Re: *Unlicensed Operation in the TV Broadcast Bands*, FCC, Nov. 4, 2008, archived at <http://www.webcitation.org/5eMu07rzk> (discussing issues that may arise from the opinion including the likelihood for infringement and the cost of physical implementation of the policies).

⁹⁴ Tate, *supra* note 93, at 1.

⁹⁵ Tate, *supra* note 93, at 2.

⁹⁶ Tate, *supra* note 93, at 4.

censed transmitters.⁹⁷ They also echo the concern that interfering, unlicensed operators may not be held accountable for product liability issues (assuming the operators can be identified in the first place).⁹⁸

History has witnessed the rapid evolution of cellular technology.⁹⁹ This evolution marks a fundamental shift in the network neutrality debate.¹⁰⁰ In the beginning, a few brick sized telephones would consume an entire channel.¹⁰¹ Today, a single channel can support millions of full-featured multimedia handsets, which are computers in their own right.¹⁰² Similarly, the unlicensed bands that were “once derided as ‘junk spectrum’ suitable only for garage door openers” can now support “hundreds of millions of users.”¹⁰³ Expansion of wireless services provides a needed “third pipe” into the home, or wherever the consumer may roam.¹⁰⁴ Competition at the consumer level may break down the “barriers created by walled gardens” and eliminate the quest for additional governmental regulation to ensure nondiscrimina-

⁹⁷ Andrew M. Seybold, *White Spaces Decision will Haunt the FCC*, FIERCE WIRELESS, Nov. 6, 2008, archived at <http://www.webcitation.org/5eMueDPcD>.

⁹⁸ See Seybold, *supra* note 97, at 1.

⁹⁹ Copps, *supra* note 87, at 1.

¹⁰⁰ See Robert M. McDowell, Statement Re: *Unlicensed Operation in the TV Broadcast Bands, ET Docket No. 04-186; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band, ET Docket No. 02-380*, FCC, Nov. 4, 2008, archived at <http://www.webcitation.org/5eMvCdA4Q> (describing how policy that allows for greater advances in wireless technology creates greater access for the consumer).

¹⁰¹ Copps, *supra* note 87, at 1.

¹⁰² Copps, *supra* note 87, at 1. A “handset” means a cell phone or other communicator that is small enough to hold with a hand.

¹⁰³ Copps, *supra* note 87, at 1. Unlicensed white-space has been likened to “Wi-Fi on steroids.” Copps, *supra* note 87, at 2.

¹⁰⁴ Jonathan S. Adelstein, F.C.C. Comm’r, Statement Re: *Unlicensed Operation in the TV Broadcast Bands, ET Docket No. 04-186; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band, ET Docket No. 02-380*, FCC, Nov. 4, 2008, archived at <http://www.webcitation.org/5eMv0VkmN> (describing necessity of wireless internet to preserve future use for consumers in unused television white spaces). The other two pipes are Cable and DSL. See Scott, *supra* note 30, at 4. Broadband over Power Line (BPL) is also emerging as an additional pipe. See Farquhar, *supra* note 34, at 125.

tory Internet access.¹⁰⁵ Consequently, there are also benefits for rural consumers who have the most unused spectrum and the least amount of existing competition.¹⁰⁶

V. Technology Developments and Trends

A. Software-Defined Radio

The effective utilization of unlicensed white space requires a radio that can opportunistically find and exploit idle spectrum without creating harmful interference to other users.¹⁰⁷ Such a radio would be required to sense key parameters such as geographic position coupled with a permissions database, or alternatively would determine frequency, power and transmission modes that would not interfere with current users of that spectrum.¹⁰⁸ Software-defined radio technology has the potential to meet these requirements.¹⁰⁹ The FCC defines a software-defined radio as follows:

A radio that includes a transmitter in which the operating parameters of frequency range, modulation type or maximum output power (either radiated or conducted), or the circumstances under which the transmitter operates in accordance with Commission rules, can be altered by making a change in software without making any changes to hardware

¹⁰⁵ McDowell, *supra* note 100, at 1-2. (describing possibilities for increased competition).

¹⁰⁶ McDowell, *supra* note 100, at 2.

¹⁰⁷ Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies, 20 F.C.C.R. 5486, 5486-87 (2005) (ET Docket No. 03-108) (discussing "Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies"). The term "radio" is a generic descriptor of any device that emits radio waves. Radios in the context of this note refer to cell phones but may also include laptop computers or even electronic games.

¹⁰⁸ Press Release, Federal Communications Commission, FCC Adopts Rule Changes for Smart Radios (Mar. 10, 2005) *archived at* <http://www.webcitation.org/5eMvhurS9> (describing technical capabilities of smart radio capabilities in products such as WLANS).

¹⁰⁹ *Id.* at 1.

components that affect the radio frequency emissions.¹¹⁰

Similar to the Internet, software-defined radio was a product of the Department of Defense and originated as a Joint Tactical Radio System.¹¹¹

Cognitive radios are software-defined radios that adapt to their environment, rather than requiring explicit software changes.¹¹² A simple, albeit understated, example of a cognitive radio is a cordless telephone that selects the best channel based on signal clarity.¹¹³ Cognitive radios typically employ a combination of the following six features.¹¹⁴ “Frequency Agility” is the ability to change transmitter and receiver operating frequencies.¹¹⁵ “Dynamic Frequency Selection” (DFS) is the ability to sense existing transmissions in an effort to avoid transmitting on the same frequency.¹¹⁶ “Adaptive Modulation” permits adaptive use of transmission modes such as GSM, TDMA, or CDMA.¹¹⁷ “Transmit Power Control” (TPC) facilitates reduction in interference by reducing power in congested areas.¹¹⁸ “Location Awareness” is the ability to physically locate its position and the location of other transmitters.¹¹⁹ “Negotiated Use” either shares spectrum under a prearranged agreement or negotiates on an ad-hoc basis.¹²⁰ A cognitive radio may also employ heuristics to

¹¹⁰ *Facilitating Opportunities*, 20 F.C.C.R. at 5499-5500.

¹¹¹ *Id.* at 5494 (describing military origins of software-defined radio). *See also* *Reno v. ACLU*, 521 U.S. 844, 849-50 (1997) (describing military origins of the Internet).

¹¹² *Facilitating Opportunities*, 20 F.C.C.R. at 5489. A software-defined radio modifies a hardware design to serve multiple markets thereby achieving cost reduction. *Id.* In contrast, cognitive radios can sense and adapt to their environment without human intervention. *Id.*

¹¹³ *Id.* at 5489 n.6.

¹¹⁴ *Id.* at 5489-90.

¹¹⁵ *Id.* at 5490.

¹¹⁶ *Id.* at 5490. Dynamic frequency selection is also called “spectrum sensing.” *See, e.g.,* Stillwell, *supra* note 82, at 1.

¹¹⁷ *See Facilitating Opportunities*, 20 F.C.C.R. at 5490.

¹¹⁸ *Id.* at 5490.

¹¹⁹ *Id.* at 5490. Location awareness is also called “geo-location.” *See, e.g.,* Stillwell, *supra* note 82, at 1.

¹²⁰ *Id.* at 5490.

adapt to previous events.¹²¹ The FCC approved the first cognitive radio in 2003.¹²²

Cognitive radios may also be used in secondary markets where licensed spectrum is leased.¹²³ In cases where priority services would otherwise require reserved spectrum, “interruptible spectrum leasing” is used.¹²⁴ Interruptible spectrum leasing, using one of two methods, accomplishes access and reversion back to the lessor.¹²⁵ The first method uses spectrum sensing similar to unlicensed white space access.¹²⁶ The second method relies on overt permission of the licensee by transmitting a control signal “beacon” that can be “interrupted quickly with a high degree of reliability.”¹²⁷ The beacon approach requires adequate reception of the transmitted control signal, in contrast to the spectrum sensing approach, which relies on the absence of existing transmissions.¹²⁸ The third method involves a “handshaking” approach where each transmission requires a request and acknowledgment between the radio operator and the network provider.¹²⁹

¹²¹ *Id.* at 5497.

¹²² *Id.* at 5492 n.17. See also Press Release, Federal Communications Commission, FCC Approves First Software Defined Radio (Nov. 19, 2004), archived at <http://www.webcitation.org/5eMw73U2i>. Approval was granted to Vanu, Inc. for a mobile base station that could support multiple transmission formats. *Id.*

¹²³ *Facilitating Opportunities*, 20 F.C.C.R. at 5514-5515 (describing adaptability of cognitive radios to adapt to provide or deny access based on the lessor licensee rights in the spectrum). Leasing spectrum under the terms of the FCC license should not be confused with a property right. Hazlett, *supra* note 76, at 453.

¹²⁴ *Facilitating Opportunities*, 20 F.C.C.R. at 5492. For example, emergency 9-1-1 services could lease spectrum while retaining ability to drop existing calls and use the spectrum. *Id.* at 5514.

¹²⁵ See *id.* at 5514.

¹²⁶ See *id.* at 5514.

¹²⁷ *Id.* at 5514.

¹²⁸ *Id.* at 5514.

¹²⁹ *Facilitating Opportunities*, 20 F.C.C.R. at 5514-15 (arguing handshaking approach provides more security but possibly at the cost of increasing complexity and overhead).

Commercial mobile radio service (CMRS) providers are concerned that the Commissioner would permit “involuntary sharing of licensed CMRS spectrum with unlicensed devices.”¹³⁰ The Commissioner replied that there is no intent for the FCC to enable this capability in licensed spectrum.¹³¹ CMRS providers share similar technical concerns about unlicensed operation.¹³² Technical concerns with spectrum sensing relate primarily to the variability in propagation, antenna and receiver characteristics that would result in an unlicensed radio transmitting further than it could reliably sense.¹³³ Additional concerns relate to the “hidden node” problem caused by topological features and the incompatible transmission modes used by various CMRS networks.¹³⁴ The extra measure of using geolocation coupled with a permissions database does not satisfy the concerns of CMRS providers.¹³⁵ Although CMRS providers generally oppose cognitive

¹³⁰ *Id.* at 5494. The CMRS providers included V-Comm L.L.C., Verizon Wireless, AT&T Wireless, Cingular/Bellsouth, CTIA, Nokia, Nextel Partners, and the Wireless Communication Association. *Id.* at n.26.

¹³¹ *Id.* at 5494.

¹³² *Id.* at 5494.

¹³³ Reply Comments Of V-Comm, L.L.C., Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies, ET Doc. No. 03-108, at 3-4 (June 1, 2004) [hereinafter V-Comm Comments] *archived at* <http://www.webcitation.org/5eTLJ64k5>. *See also* Comments Of Verizon Wireless, Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies, ET Doc. No. 03-108, at 4-5 (May 4, 2004) [hereinafter Verizon Comments] *archived at* <http://www.webcitation.org/5lSm02pJK> (expressing similar technical concerns as V-COMM, L.L.C.); Reply Comments Of AT&T Wireless Services, Inc., Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies, ET Doc. No. 03-108, at 3-4 (June 1, 2004) [hereinafter AT&T Comments] *archived at* <http://www.webcitation.org/5eTLdyc1M>.

¹³⁴ V-Comm Comments, *supra* note 133, at 11 .

¹³⁵ Comments of Cingular Wireless, LLC & BellSouth Corporation, Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies, No. 02-108, at 31-32 (May 3, 2004) [hereinafter Cingular Comments] *archived at* <http://www.webcitation.org/5eTLpMFrF> (discussing problems with geolocation indoors and maintenance of permission database). *See also* Comments Of The Wireless Communications Association International, Inc., Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies, No. 03-108, at 6-7 (May 3, 2004) [hereinafter WCAI Comments] *archived at*

radio use in the licensed spectrum, they do support its use in the unlicensed spectrum and secondary markets.¹³⁶

Configurable radios must incorporate security features to prevent unauthorized software modifications.¹³⁷ The level of security is currently defined by industry standards.¹³⁸ There are diverging opinions on the efficacy of this approach.¹³⁹ Dell believes that manufacturers should not be held liable for unauthorized software modifications if their radios meet or exceed industry standards.¹⁴⁰ Intel, on the other hand, believes that rigid security standards would encourage manufacturers to create a design “that may not address the actual threat of modifications to a specific device.”¹⁴¹ The FCC has declined to establish liability criteria; instead it will evaluate each non-compliant device on a case-by-case basis.¹⁴² Non-conforming devices will be subject to monetary forfeiture taking into account the “nature, circumstances, extent and gravity of the violations and, with respect to the violator, the degree of culpability, and history of prior offenses, ability to pay, and such other matters as may be relevant and appropriate.”¹⁴³

<http://www.webcitation.org/5eUVKNVIt> (discussing problems with permissions database security).

¹³⁶ See Comments of Verizon, *supra* note 133, at 10 (requesting testing and traceability of cognitive radios); AT&T Comments, *supra* note 133, at 9-11 (quoting another commenter’s description of unlicensed spectrum as “the ‘holy grail’ for intelligent [cognitive radio] devices . . .”); Cingular Comments, *supra* note 135, at 16-17 (stating use of “cognitive radios [in] the unlicensed bands would tend to diminish interference within those bands and improve the efficiency of unlicensed spectrum usage.”).

¹³⁷ *Facilitating Opportunities*, 20 F.C.C.R. at 5493 (describing need in order to regulate unlicensed access and prevent interference while increasing access).

¹³⁸ See *id.* at 5505.

¹³⁹ See *id.* at 5505. See also AT&T Comments, *supra* note 133, at 16-17; WCAI Comments, *supra* note 135, at 6-7 (discussing problems with permissions database security).

¹⁴⁰ See *Facilitating Opportunities*, 20 F.C.C.R. at 5505 (recalling Dell argument against third party liability).

¹⁴¹ *Id.* at 5505 (recalling Intel argument in favor of protecting strict standards to avoid interference).

¹⁴² *Id.* at 5506 (describing FCC position).

¹⁴³ *Id.* at 5506 (citing 47 C.F.R. § 1.80(b)(4) (2008)). See also 47 U.S.C. § 503(b)(2)(E) (2006).

For every technical argument that incumbents put forth against the use of cognitive radios, there are equally compelling technical counter arguments.¹⁴⁴ Skeptics opine that the issue is one of competition, not interference.¹⁴⁵ For example, wireless microphones have been used for years as unlicensed devices without reports of interference.¹⁴⁶ Indeed, even if “white space devices work flawlessly,” broadcasters will lose market share.¹⁴⁷ CMRS providers who have opposed unlicensed cognitive radio usage are developing their own unlicensed mobile handsets to “seamlessly handoff calls between the [CMRS] carrier’s network and WiFi networks.”¹⁴⁸

B. Industry Trends

1. The Digital Divide

“Broadband’s potential to unleash innovation, promote free speech and encourage learning makes this technology the key to the future success of the U.S. economy and American democracy.”¹⁴⁹ “There is a growing digital divide in America” based

¹⁴⁴ See, e.g., Nate Anderson, *White spaces, angry faces: Inside the battle over “interference”*, ARSTECHNICA, Sept. 23, 2008, archived at <http://www.webcitation.org/5eQPOYY5z>.

¹⁴⁵ *Id.* at 4 (stating “despite the huge mound of technical documentation filed in the docket so far – the basic issue isn’t about interference at all. It’s about competition.”).

¹⁴⁶ See *id.* at 3 (describing the wireless microphone industry as one of the opponents to cognitive radio usage in licensed spectrum).

¹⁴⁷ *Id.* at 4 (describing possibility that insensitive yet licensed devices still may interfere with broadcasts and moreover possibility that even a sensitive scan may still interfere with broadcast spectrums due to the possibility that that spectrum is within a “hidden node”).

¹⁴⁸ Farquhar, *supra* note 34, at 123 (describing T-Mobile and Cingular’s plans to offer “[u]nlicensed Mobile Access”). This offering would enable subscribers to “use their handsets on their home networks and in hotspots without using cellular minutes, then switch to their carrier’s licensed networks when venturing beyond the range of the WiFi.” Farquhar, *supra* note 34, at 123.

¹⁴⁹ INTERNET FOR EVERYONE, *One Nation Online*, June 20, 2008, archived at <http://www.webcitation.org/5eUVhpvXG>. (Setting forth the group’s mission and policy statements regarding free and open access to the internet).

on income, geography and ethnic differences.¹⁵⁰ Only thirty-five percent of homes earning fifty thousand dollars or less annually have broadband access.¹⁵¹ Despite rural access to both telephones and TV, nearly twenty million Americans live in areas not served by broadband, while tens of millions can choose from only a single provider.¹⁵² High-speed Internet access is an essential conduit for education, yet only forty percent of minorities have broadband access, while fifty-five percent of non-Hispanic white households and sixty-nine percent of Asian households are connected.¹⁵³ Since 2001, the United States has dropped from fourth place for broadband adoption to fifteenth.¹⁵⁴ Despite the Internet being developed in the United States, the average broadband offering is ten times slower and nearly twice the cost of service in Japan.¹⁵⁵

Bandwidth intensive applications further exacerbate the disparity within economic, geographic, and ethnic groups.¹⁵⁶ P2P applications represent sixty percent of Internet traffic, primarily due to illegitimate video transfers.¹⁵⁷ Content owners view P2P as a revenue drain, while ISPs see their networks congested by users who do not pay their fair share.¹⁵⁸ More users are also “getting used to being kicked off the Net as computers competing for bandwidth interfere with one another.”¹⁵⁹ This occurs, even

¹⁵⁰ *Id.* Broadband data are based on a 2007 U.S. Census, while data for general Internet access are based on 2001 statistics. *Id.*

¹⁵¹ *Id.* See also Wu, *supra* note 17 (quoting “Americans today spend almost as much on bandwidth – the capacity to move information – as [they] do on energy”).

¹⁵² InternetforEveryone.org, *supra* note 149.

¹⁵³ See InternetforEveryone.org, *supra* note 149.

¹⁵⁴ InternetforEveryone.org, *supra* note 149.

¹⁵⁵ InternetforEveryone.org, *supra* note 149; see also *Reno v. ACLU*, 521 U.S. 844, 849-50 (1997).

¹⁵⁶ See Jennifer Pigg, *P2P: Damn This Traffic Jam*, YANKEE GROUP, July 18, 2008 (describing excerpt from full report).

¹⁵⁷ *Id.* (Indicating preference of illicit activity in peer to peer networks).

¹⁵⁸ *Id.* (describing both the strain on bandwidth resources and markets for illicit distribution of materials owned and created by content owners created by P2P networks).

¹⁵⁹ Neal Savage, *Cognitive Radio*, TECHNOLOGY REVIEW, Mar./Apr. 2006 at 1, archived at <http://www.webcitation.org/5eUVwiaeT> (describing phenomenon) [hereinafter Savage].

within thirty meters of a transceiver, due to spectrum congestion.¹⁶⁰ Bandwidth congestion will increase further as more devices adopt wireless technology.¹⁶¹ For example, wireless sensor networks now monitor office building temperatures, moisture in cornfields, store merchandise and nursing-home patients.¹⁶² The real culprit is not the lack of spectrum, but the way it is used.¹⁶³ One solution may be to “teach cognitive radios to negotiate with other devices in their vicinity.”¹⁶⁴ Intel is building reconfigurable chips that will “analyze their environments and select the best protocols and frequencies for data transmission.”¹⁶⁵ Intel is also attempting to reduce network traffic by turning personal computers into Personal Area Networks.¹⁶⁶ This will allow home entertainment devices to communicate directly without competing with other network traffic.¹⁶⁷

2. Network Discrimination

Three ISPs were accused of discriminatory practices and anti-competitive behavior with regard to how they blocked certain Internet content.¹⁶⁸ Although it ultimately reversed its decision, Verizon Wireless showed its power as a “content gatekeeper” by blocking text messages with controversial content.¹⁶⁹

¹⁶⁰ *See id.*

¹⁶¹ *See id.*

¹⁶² *Id.* (arguing that wireless devices currently are inefficiently attempting to all work on the same spectrum instead of scanning the variety of blank spectrums, creating virtual “traffic jams”).

¹⁶³ *Id.* at 1.

¹⁶⁴ *Id.*, at 1.

¹⁶⁵ Savage, *Cognitive Radio*, TECHNOLOGY REVIEW, Mar./Apr. 2006 at 2, archived at <http://www.webcitation.org/5eUVwiaeT>

¹⁶⁶ R. Colin Johnson, *Intel's "My Wi-Fi" seeks to mobilize personal-area nets*, EE TIMES, Feb. 2, 2009, archived at <http://www.webcitation.org/5eUW6xDtF>.

¹⁶⁷ *See id.*

¹⁶⁸ Letter from Bryon L. Dorgan, U.S. Senator, & Olympia J. Snowe, U.S. Senate, to Daniel K. Inouye, Chairman, Committee on Commerce, Science and Transportation, United States Senate (Oct. 26, 2007), archived at <http://www.webcitation.org/5eUWGWq18> (requesting hearing to discuss pattern of discriminatory practices by phone and cable companies) [hereinafter Dorgan].

¹⁶⁹ *See id.* (intimating that blocking such content showed technological ability to fully control access).

AT&T was accused of reserving the right in its Terms of Service to discontinue service if customers were critical of the company.¹⁷⁰ Comcast was accused of blocking a P2P file-sharing service called BitTorrent.¹⁷¹ Free Press and Public Knowledge filed a formal complaint against Comcast alleging discriminatory content blocking with respect to BitTorrent.¹⁷² The FCC found Comcast had blocked application specific Internet traffic even when little bandwidth was used.¹⁷³ This violated users' rights to access content and use applications of their choice.¹⁷⁴

The FCC also found that Comcast had engaged in anticompetitive behavior by failing to disclose its practices to consumers.¹⁷⁵ Consumers had blamed the applications for poor performance rather than Comcast, which consequently had placed the applications at a competitive disadvantage.¹⁷⁶ Despite the Comcast decision, another large cable company, Cox Communications, announced plans to test prioritization of time sensitive applications, giving priority to streaming video over P2P applications.¹⁷⁷ Recently, Google has responded to these issues by putting forth a

¹⁷⁰ See *id.* (listing charges).

¹⁷¹ See *id.* (listing charges).

¹⁷² Formal Complaint from Marvin Ammori, General Counsel, Free Press, to Ms. Marlene H. Dortch, Secretary, FCC (Nov. 1, 2007) *archived at* <http://www.webcitation.org/5eUWP59dI>, at 5-9.

¹⁷³ Press Release, Federal Communications Commission, Commission Orders Comcast To End Discriminatory Network Management Practices (Aug. 1, 2008) [hereinafter FCC Press Release Aug. 1, 2008] *archived at* <http://www.webcitation.org/5eUWeymSE>. See also Dortch, *supra* note 47 (discussing four open-Internet freedoms).

¹⁷⁴ FCC Press Release Aug. 1, 2008, *supra* note 173 (describing expert opinions and surveys taken concerning Comcast's discriminatory monitoring of content in peer to peer sharing systems, as limiting access and preventing fair competition).

¹⁷⁵ FCC Press Release Aug. 1, 2008, *supra* note 173 (listing FCC order and findings).

¹⁷⁶ FCC Press Release Aug. 1, 2008, *supra* note 173 (describing FCC's decision regarding the anti-competitive nature of Comcast .in limiting access which negatively affected certain applications).

¹⁷⁷ Kim Dixon, *Google begins effort to find Internet blockers*, REUTERS, Jan. 28, 2009, at 1, *archived at* <http://www.webcitation.org/5eUWpO6Ir> (Describing Cox Communications initial plans to provide priority to video transfer and other applications that they deemed were time sensitive traffic).

plan to help users determine the source of slow Internet performance and to guard against inappropriate application and content blocking.¹⁷⁸

3. Moving Towards Mobile Interoperability

The convergence of Internet telephony, packetized video and data minimizes application-based distinctions in transmission media.¹⁷⁹ With fewer distinctions among transmission media, there should be less discrimination.¹⁸⁰ This should shift the focus of the FCC “away from the second-best policy goal of promoting competition among complementary services and return to the first-best policy goal of promoting competition in the last mile.”¹⁸¹

The Fixed-Mobile Convergence Alliance (FMCA) is a global non-profit organization dedicated to making convergence products and services that are both easy to use and technologically agnostic.¹⁸² Their membership represents over 850 million customers, or a third of the world’s telecom users.¹⁸³ The International Telecommunications Union (ITU) is defining the Next Generation Network (NGN) in a way that complements the FMCA goals.¹⁸⁴ The goal of NGN is to offer a shared packet-based core network for all services, which allows “[u]nrestricted access by users to different service providers” and “[i]nterworking with legacy networks via open interfaces.”¹⁸⁵ Network providers are beginning to embrace the move towards open mobile net-

¹⁷⁸ *Id.*

¹⁷⁹ See Wu & Yoo, *supra* note 36, at 588-89 (describing convergence of media and the cable companies ability to capitalize on this convergence).

¹⁸⁰ See Wu & Yoo, *supra* note 36, at 588-89.

¹⁸¹ See Wu & Yoo, *supra* note 36, at 589 (Describing ability of convergence to support the breaking of the current existing oligopoly in the last mile of internet service).

¹⁸² FMCA, About Us, *archived at* <http://www.webcitation.org/5eUX0dZUG>.

¹⁸³ *Id.*

¹⁸⁴ See ITU, Definition of Next Generation Network, *archived at* <http://www.webcitation.org/5eUXBF4RK>.

¹⁸⁵ *Id.*

works.¹⁸⁶ Verizon has opened its network to any device that meets their minimum technical standards.¹⁸⁷ New mobile products that adapt to different transmission frequencies and modes have removed technical barriers to exploiting the open mobile Internet.¹⁸⁸ Google has taken the prospect of a truly open mobile Internet one step further by suggesting an open bidding process where network providers would compete for each mobile connection.¹⁸⁹ Mobile phones, by linking to services such as PayPal, can also be used independently of a particular ISP for purchases such as a movie ticket or fast food.¹⁹⁰

¹⁸⁶ See Posting of Marguerite Reardon to CNET News Blog, *Verizon Wireless opens up its network*, Mar. 19, 2008, archived at <http://www.webcitation.org/5eUXIsquv>. Despite this promising trend, Verizon Wireless believes it will take a long time before consumers are willing to give up the handset subsidy and pay "\$200 or \$300 for a device." *Id.* Consumers can elect to buy unlocked phones without the subsidy. See Dylan McGrath, *Apple offers unlocked iPhone in Hong Kong*, *EE TIMES*, Sept. 29, 2008, archived at <http://www.webcitation.org/5ee50Wxo3>. The main advantage to purchasing an unlocked phone is the ability to choose a phone independent of the service provider. *Id.* Consumers also may purchase prepaid phones as an alternative to long-term contracts. Hiawatha Bray, *Prepaid cellphones offer inexpensive alternative to contracts*, *BOSTON GLOBE*, Dec. 11, 2008, at B9, B13, archived at <http://www.webcitation.org/5ee6ILRjy>.

¹⁸⁷ Reardon, *supra* note 186 ("As part of the open development program, Verizon has released specifications and best practices for new devices and applications that can be used on its network. The new specifications only allow customers to bring any CDMA (code division multiple access) or EV-DO (evolution data optimized) phone to its network if it's been pre-certified by Verizon.").

¹⁸⁸ Vanu Home Page, archived at <http://www.webcitation.org/5eUXSVunk>. Vanu was the first company to receive FCC certification for a software-defined radio that enables simultaneous operation of GSM and CDMA. *Id.* See also BitWave Semiconductor Inc., *BitWave Semiconductor secures \$10.2M in Series B*, Aug. 18, 2008, archived at <http://www.webcitation.org/5eUXr6YjW> (claiming their technology will "work at any frequency, any bandwidth and for any wireless protocol").

¹⁸⁹ See Eliot Weinman, *Google's "instant bid" patent puts new weight behind an old idea*, *MobilenetTrends.com*, Oct. 2, 2008, archived at <http://www.webcitation.org/5eUY1y2IX>.

¹⁹⁰ Katie Hafner, *Will That Be Cash or Cell Phone?; Wireless Payment Systems Might Mean Dialing Inot [sic] Your Own Wallet*, *N.Y. TIMES*, Mar. 2, 2000, at G1, archived at <http://www.webcitation.org/5ecHnxzJ8> (describing possible future applications for mobile networks).

VI. Towards a New Paradigm

A. Proposed Change to Telecommunication Rules

Telecommunication policy frequently adapts to keep pace with technological developments; however, the current policy has fallen behind.¹⁹¹ The FCC regulates common carriers because they provide voice services that are considered an essential public service.¹⁹² The telephone is now so ingrained in society that its use is no longer a luxury.¹⁹³ However, information service providers remain free to discriminate under the Computer II safe harbor rules, which considered such services to be nonessential.¹⁹⁴ In addition, the FCC considers regulation of information services unwise because it involves a “fast-moving, competitive market”¹⁹⁵ Information services now affect nearly every facet of our lives, including the right to civic participation and equality of education.¹⁹⁶ The Internet is essential both for distance learning and as a conduit to allow constituents to make informed choices.¹⁹⁷ In the same manner that the telephone transformed from a luxury item to a necessity, so too have many information services.¹⁹⁸ Computer II established a bright line between essential and non-essential services by distinguishing be-

¹⁹¹ See Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies, 20 F.C.C.R. 5486, 5523 (2005) (ET Docket No. 03-108) (stating “the Commission continues the process of modifying the rules to reflect these ongoing technical developments in radio technologies.”); InternetforEveryone.org, *supra* note 149 (cautioning that America is falling behind in broadband leadership); Wu, *supra* note 17, (noting that the FCC “continues to drag its heels” regarding reformation of DTV whitespaces).

¹⁹² See Second Computer Inquiry, 77 F.C.C.2d 384, 395 (1980).

¹⁹³ See *id.* at 419.

¹⁹⁴ See *id.* at 395-96.

¹⁹⁵ Nat’l Cable & Telecomms. Assn. v. Brand X Internet Servs., 545 U.S. 967, 977 (2005).

¹⁹⁶ See InternetforEveryone.org, *supra* note 149 (stating “[b]roadband can serve as a conduit for education, information and civic participation.”).

¹⁹⁷ See INTERNET FOR EVERYONE, *supra* note 149 (describing the four principals that underlie the InternetforEveryone platform for increasing internet access and availability).

¹⁹⁸ See INTERNET FOR EVERYONE, *supra* note 149.

tween common carriers and information services.¹⁹⁹ Continued advancements in technology may require a change to this bright line test. Indeed, this line is likely to continue to change over time.²⁰⁰

In light of the essential nature of many information services, network neutrality advocates have called for Internet regulation to prevent discrimination.²⁰¹ Although ISPs often bundle applications with access to their networks in a “walled garden,” ISPs have been accused of blocking competing applications.²⁰² In other cases, ISPs have prioritized certain applications to maximize their revenue.²⁰³ This discriminatory behavior may also give rise to an antitrust tying argument.²⁰⁴ For example, if two users have paid for similar Internet bandwidth services, the ISP will make more revenue from a lower bandwidth VoIP telephone call than from a user downloading a large data file.²⁰⁵ Where the ISP has limited bandwidth, giving priority to the VoIP call is discriminatory.²⁰⁶ This example provides further justification for changing the bright line division between common carriers and information services.²⁰⁷ Common carrier telephone calls are regulated; however, VoIP telephone calls remain an information service subject to the Computer II safe harbor provisions.²⁰⁸ Additionally, two users may require the same bandwidth but a dif-

¹⁹⁹ See *Second Computer Inquiry*, 77 F.C.C.2d 384, 499-500 (1980) (finding distinction is appropriate tool for resolving access disputes).

²⁰⁰ See generally *InternetforEveryone.org*, *supra* note 149.

²⁰¹ See Wu, *supra* note 38, at 165 (proposing language for network neutrality law).

²⁰² See McDowell, *supra* note 100, at 2. Commissioner McDowell states that as a result of unlicensed white-space “the pressure created by dynamic competition will knock down barriers created by walled gardens and pry open closed networks.” McDowell, *supra* note 100, at 2.

²⁰³ See Wu & Yoo, *supra* note 36, at 582 (postulating that an ISP will prefer one search engine over another based on exclusive dealing).

²⁰⁴ See generally *INTERNET FOR EVERYONE*, *supra* note 149.

²⁰⁵ See Frieden, *supra* note 24, at 466 (describing price discrepancies).

²⁰⁶ See Frieden, *supra* note 24, at 468 (describing FCC regulations where they will be considered disparate pricing for VoIP discriminatory).

²⁰⁷ See Frieden, *supra* note 24, at 466 (reasoning bright line division encourages providers to avoid being deemed a common carrier and encourages discriminatory price allocations).

²⁰⁸ See Frieden, *supra* note 24, at 466.

ferent quality of service (QoS).²⁰⁹ QoS metrics include transmission delay, rate, jitter (consistency of transmission), and probability of a failed transmission.²¹⁰ One user may be playing a streaming video with time-sensitive traffic.²¹¹ The other user may simply be downloading a large file that need not be transferred at a constant rate.²¹² Giving priority to the streaming video over the large data file transfer is also considered discriminatory according to the principles of network neutrality.²¹³ Network diversity proponents consider this last example to be good network management, not discrimination.²¹⁴ However, the ISP is deciding priority for the user based on the type of application and in some cases the source.²¹⁵

It is not clear that regulating bandwidth alone would resolve the discrimination issue, since applications also should be afforded equivalent QoS.²¹⁶ Furthermore, the move toward packetizing (and buffering) promises to make the Internet cloud application agnostic, thus eliminating the distinction between common carrier and information services for all but the last mile of Internet connection.²¹⁷ Packetizing is the conversion of analog voice and digital data into homogenous bundles of data, which may then be parsed and routed more efficiently.²¹⁸ ISPs should

²⁰⁹ See Wu, *supra* note 38, at 149 (stating QoS dependent applications may require cooperation with multiple ISPs).

²¹⁰ See Wu, *supra* note 38, at 148.

²¹¹ See Wu & Yoo, *supra* note 36, at 576 (describing VoIP and streaming video as time-sensitive applications).

²¹² See Wu & Yoo, *supra* note 36, at 576.

²¹³ See Wu & Yoo, *supra* note 36, at 576.

²¹⁴ See Wu & Yoo, *supra* note 36, at 576 (stating prioritization of time-sensitive applications as “one obvious solution . . . that network neutrality would condemn.”). See also FCC Press Release Aug. 1, 2008, *supra* note 173 (rejecting Comcast’s defense to prioritizing traffic as practice that “constitutes reasonable network management.”).

²¹⁵ See Wu & Yoo, *supra* note 36, at 582 (analogizing type and source discrimination to Most Favored Nation discrimination).

²¹⁶ See Wu & Yoo, *supra* note 36, at 576.

²¹⁷ See Wu & Yoo, *supra* note 36, at 588-89 (stating “[a]pplication-based distinctions between transmission media will completely collapse once all applications become packetized.”); ITU, *supra* note 184 (defining NGN network as a fully packetized Internet cloud).

²¹⁸ See generally Wu & Yoo, *supra* note 36, at 588-89.

not, and often cannot, fairly decide which services should receive priority, regardless of which tier of Internet access the consumer has paid for a priori.²¹⁹

What is required is an operating model in which the consumer can negotiate terms of access based on a variety of metrics such as price, bandwidth, time-sensitive nature, and QoS.²²⁰ This model will introduce competition between ISPs in the last mile allowing the market to self regulate the Internet and accommodate the growing diversification of services.²²¹ Each service may place a different value on each metric.²²² For example, stock market transactions may value time-sensitivity and QoS, while a user watching a streaming video may prefer to wait a few seconds before watching the video in exchange for lower rates.²²³ Users will get service commensurate with what they are willing to pay, and ISPs can retain an economic incentive to continue infrastructure development without burdensome regulation.²²⁴ ISPs may continue to offer service and price differentiation but now will be subject to the checks and balances of a free market economy.²²⁵ Consumer demand ultimately would define the types of services and their corresponding prices.²²⁶

The goal is not to enable every consumer to have equal access to the Internet but to ensure that such access is fairly priced and offered in a non-discriminatory manner for each transaction based on relevant criteria such as bandwidth, QoS

²¹⁹ See Wu, *supra* note 38, at 146 (quoting network theorist Jerome Saltzer's description of the "End-to End" argument as not "forc[ing] any service feature, or restriction on the customer; his application knows best").

²²⁰ See generally Weinman, *supra* note 189 (describing patent application for "Flexible Communication Systems and Methods").

²²¹ Cf. Wu *supra* note 38, at 143 (describing historical approach as inefficient self-regulation).

²²² Cf. Wu *supra* note 38, at 143 (claiming bans on applications may distort the market).

²²³ Cf. Wu *supra* note 38, at 143 (analyzing how operators want to ban emerging applications for their interest in price discrimination).

²²⁴ See generally Weinman, *supra* note 189.

²²⁵ See generally Weinman, *supra* note 189.

²²⁶ See generally Weinman, *supra* note 189.

and other factors.²²⁷ By analogy, consumers are not universally afforded access to private jets, but rather are free to choose from a variety of transportation modes at a commensurate price.²²⁸ Where public policy demands a higher minimum level of access, the government is free to subsidize Internet access in a similar manner to other essential services.²²⁹

B. The Third Pipe Opportunity

The introduction of broadband mobile access is the “third pipe” that will introduce competition into what is otherwise a duopoly.²³⁰ Cable and DSL providers controlled ninety-eight percent of the broadband market in 2006.²³¹ Unlike the wire-line infrastructure of cable and DSL, there are no property rights in the airwaves, only term limited spectrum licenses to use FCC-approved radio devices.²³² FCC Commissioner Adelstein called the unlicensed white space spectrum a “central element of the national broadband strategy.”²³³ While many ILECs are concerned about cognitive radios disrupting their sizable investments in spectrum licenses, they do broadly support cognitive radio experimentation in the unlicensed spectrum.²³⁴ One ILEC believes it is possible for licensed and unlicensed devices to share existing spectrum.²³⁵ A second ILEC notes that cognitive radios

²²⁷ See Wu, *supra* note 38, at 155 (stating “certain classes of applications will never function properly unless bandwidth and quality of service are guaranteed”).

²²⁸ See Wu & Yoo, *supra* note 36, at 578-79 (analogizing access tiering to paying for “premium mail services like FedEx”).

²²⁹ See Wu & Yoo, *supra* note 36, at 586 (describing U.S. subsidies for roads and Asian subsidies for Internet infrastructure).

²³⁰ See Farquhar, *supra* note 34, at 128 (stating “[n]etwork operators in a duopoly environment . . . have the incentive and ability to leverage their market power”).

²³¹ Scott, *supra* note 30, at 16.

²³² See Hazlett, *supra* note 76, at 453 (stating “the FCC does not issue property rights to radio spectrum”).

²³³ Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies, 20 F.C.C.R. 5486, 5486-87 (2005) (ET Docket No. 03-108).

²³⁴ See Verizon Comments, *supra* note 133, at 10. See also AT&T Comments, *supra* note 133, at 9-11; Cingular Comments, *supra* note 135, at 16.

²³⁵ AT&T Comments, *supra* note 133, at 10.

might actually reduce interference in unlicensed bands.²³⁶ This is because cognitive radios have the ability to be aware of existing radio users before attempting to transmit a signal in the same spectrum.²³⁷ Although ILECs are not ready to embrace ad-hoc open mobile access in their licensed spectrum, they appear willing to accept it with sufficient validation through experimentation.²³⁸ The third pipe is an essential component to enable the open mobile Internet.²³⁹

The concept of ad-hoc mobile Internet access finally may be viable after many years of development.²⁴⁰ With handsets that can now operate over a wide range of frequencies and modes, a single user can now access virtually any ISP on a competitive basis.²⁴¹ A mode defines how data are encoded for transmission.²⁴² Common modes are code division multiple access (CDMA), time division multiple access (TDMA) and global system for mobile communications (GSM).²⁴³ Different modes coexist because they arose out of market competition.²⁴⁴ ISPs use different frequencies to avoid interference with other ISPs.²⁴⁵ These frequencies further depend on the ISPs ability to acquire spectrum licenses during FCC auctions.²⁴⁶ Previously, a user who wanted to switch ISPs often was required to switch handsets.²⁴⁷ The newly available television white space will enable an ad-hoc mobile Internet access model to be implemented without consideration of the ef-

²³⁶ See Cingular Comments, *supra* note 135, at 16-17.

²³⁷ Facilitating Opportunities, 20 F.C.C.R. at 5496-97; Stillwell, *supra* note 82, at 1 (describing spectrum sensing).

²³⁸ See Verizon Comments, *supra* note 133, at 10-11; AT&T Comments, *supra* note 133, at 9-11; Cingular Comments, *supra* note 135, at 16.

²³⁹ See generally Farquhar, *supra* note 34, at 128 (describing need to utilize white space spectrum).

²⁴⁰ See Weinman, *supra* note 189.

²⁴¹ See Vanu, *supra* note 188 (describing existing multi-frequency and multi-mode radios).

²⁴² See generally Vanu, *supra* note 188 (describing modes).

²⁴³ See generally Vanu, *supra* note 188.

²⁴⁴ See generally Vanu, *supra* note 188.

²⁴⁵ See generally Vanu, *supra* note 188.

²⁴⁶ See generally Vanu, *supra* note 188.

²⁴⁷ See generally Vanu, *supra* note 188.

fect on existing term limited spectrum licenses held by ISPs.²⁴⁸ Furthermore, the dynamic allocation of ISPs will provide more efficient resource utilization, which should reduce the cost of Internet access.²⁴⁹ For example, if excessive TDMA capacity results in short term price reductions, a user may switch from CDMA to TDMA.²⁵⁰ This reallocation could occur on a per-call basis.²⁵¹

C. Unbundling Existing Infrastructure

Although cognitive radios can operate over a wide frequency range, including the unlicensed band, they must be paired with a receiver operating at the same frequency.²⁵² The 1996 Act requires ILECs to provide a requesting carrier with unbundled access to their networks at any “technically feasible point” with terms that are just, reasonable, and nondiscriminatory.²⁵³ Therefore ILECs must allow receivers operating in the unlicensed band to be connected to their networks.²⁵⁴ The requirement of forbearance tempers this mandate where enforcement is not necessary for protection of consumers or and is inconsistent with public policy.²⁵⁵

As the allegations of discriminatory practices of Verizon Wireless, AT&T and Comcast highlight, the current operating model of ILECs does not serve the public policy of nondiscriminatory Internet access.²⁵⁶ The growing “Digital Divide” further rein-

²⁴⁸ See generally Stillwell, *supra* note 82 (describing how ad-hoc mobile internet access would not create interference with limited spectrum licenses through FCC regulation of devices allowing for mobile internet access).

²⁴⁹ See Stillwell, *supra* note 82, at 1 (stating FCC’s order will “promote efficient use of spectrum”).

²⁵⁰ See Stillwell, *supra* note 82.

²⁵¹ See Stillwell, *supra* note 82.

²⁵² See generally Vanu, *supra* note 188.

²⁵³ 47 U.S.C. § 251(c)(3) (2006).

²⁵⁴ See *id.* (describing mode of compliance).

²⁵⁵ 47 U.S.C. § 160(a) (2006).

²⁵⁶ See Dorgan & Snowe, *supra* note 168 (alleging discriminatory practices by Verizon Wireless, AT&T and Comcast); FCC Press Release Aug. 1, 2008, *supra* note 173, at 1 (ordering Comcast to end discriminatory practices).

forces this concern.²⁵⁷ ILECs may counter that the FCC is chartered with preventing radio interference, so ILECs should not be required to provide unbundled access to devices operating in the unlicensed spectrum.²⁵⁸ However, interference concerns are a result of how the radio devices are operated, not a result of their operation in an unlicensed spectrum per se.²⁵⁹ The FCC still has the obligation to certify that radio devices operating in the unlicensed spectrum will not cause harmful interference.²⁶⁰ Furthermore, the FCC's four guiding principles for preservation of Internet freedom entitle consumers to "competition among network providers . . ." ²⁶¹ This is further codified by the legislative mandate to promote access to advanced telecommunications capability.²⁶² With NGN networks reducing application differentiation within the Internet cloud, competitive access to the last mile serves the public policy of nondiscriminatory access.²⁶³

²⁵⁷ See InternetforEveryone.org, *supra* note 149 (describing the "Digital Divide" as a lack of access to broadband internet based on economic, geographic and racial/ethnic lines).

²⁵⁸ See generally 47 U.S.C. §151 (2006). The primary charter of the FCC is to "regulat[e] interstate and foreign commerce in communication by wire and radio". *Id.*

²⁵⁹ See V-Comm Comments, *supra* note 133, at 3-4 (describing concerns about how cognitive radios are operated in unlicensed spectrum); Verizon Comments, *supra* note 133, at 4-5 (describing concerns that interference problems may occur where there is no private owner); AT&T Comments, *supra* note 133, at 10 (stating cognitive radios may one day share licensed and unlicensed spectrum); Seybold, *supra* note 97 (recalling FCC's loss of control over unlicensed Citizen's band radio).

²⁶⁰ See generally 47 U.S.C. §151 (2006). See also Tate, *supra* note 93, at 2. "Addressing interference in the use of the spectrum has always been one of the primary roles of the Federal Communications Commission since its creation by Congress in 1934." *Id.*

²⁶¹ See Frieden, *supra* note 24, at 489 (summarizing FCC's four principles for Internet freedom) (internal citation omitted).

²⁶² See 47 U.S.C.A. § 1302 (2001) (advocating underlying policy for non-discriminatory access).

²⁶³ ITU, *supra* note 184 (describing next generation network as allowing "consistent and ubiquitous provision of services to users").

D. Connecting Foreign Equipment

In addition to entitling consumers to competition, the FCC's four guiding principles entitle consumers "to connect their choice of legal devices that do not harm the network."²⁶⁴ The FCC added geo-location and permissions database requirements in response to concerns from ILECs that spectrum sensing may result in harmful interference to their networks.²⁶⁵ For example, a device may transmit with a range further than the detectable range of other preexisting transmitters.²⁶⁶ This may be exacerbated by topography or variations in transmission propagation characteristics.²⁶⁷ Geo-location provides the geographic position of the consumer by using either a global positioning system (GPS) or signal triangulation.²⁶⁸ The permissions database defines the geographic location and anticipated range of existing radios.²⁶⁹ When geo-location and a permissions database are used together, the consumer is assured of not operating an unlicensed device that may interfere with existing radios.²⁷⁰ The beacon approach provides additional assurances beyond those currently required by the FCC.²⁷¹ The beacon approach relies on the continuous de-

²⁶⁴ See Frieden, *supra* note 24, at 489 (summarizing FCC's four principles for Internet freedom).

²⁶⁵ See Martin, *supra* note 83, at 2 (discussing rationale for FCC requirement that white space devices use "geo-location in conjunction with database consultation . . ." until "sensing-only" devices demonstrate non-interference); Adlestein, *supra* note 104, at 1 (claiming spectrum-sensing technology has not been proven to offer comparable protection from interference as geo-location); Copps, *supra* note 87, at 2 (stating geo-location technology added as compromise to users of television band).

²⁶⁶ See generally Martin, *supra* note 83 (describing challenges to manufacturer to create devices that broadcast within a greater range than those already available).

²⁶⁷ See generally Martin, *supra* note 83.

²⁶⁸ See generally Martin, *supra* note 83. See also Anderson, *supra* note 87, at 3 (describing geolocation).

²⁶⁹ See generally Martin, *supra* note 83.

²⁷⁰ See Martin, *supra* note 83, at 2 (describing how geo-location creates a technological overlay in conjunction with permissions database to prevent unlicensed transmissions).

²⁷¹ See Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies, 20 F.C.C.R. 5486, 5514 (2005) (ET Docket No. 03-108) (describing how the limiting frequency range

tection of an enabling signal rather than the absence of existing transmissions.²⁷² The handshaking approach further prevents interference by requiring the consumer to request permission to transmit, which is then followed by a signal granting permission.²⁷³ The proposed model, where consumers would negotiate each transaction based on a variety of competitive metrics, would use the handshaking approach – the most reliable method.²⁷⁴ This inherently avoids many of the technical concerns expressed by ILECs.²⁷⁵

Radio device operation in unlicensed spectrum is subject to numerous procedural safeguards in addition to the substantive provisions for geo-location and a permissions database.²⁷⁶ Devices must be certified in the presence of interested parties and be deactivated if they do not continue to conform to certification standards.²⁷⁷ For example, a device may eventually fail to detect other transmitters using spectrum sensing as a result of device aging or exposure to unforeseen environments.²⁷⁸ The use of a permissions database has been criticized, since it cannot be accessed through the Internet if Internet access is dependent upon it.²⁷⁹ Alternatively, distributing the database beforehand runs the risk of obsolescence.²⁸⁰ The more reliable handshaking approach requires positive interaction between the cognitive radio and ILEC independent of a permissions database.²⁸¹ This approach

of “master devices” will minimize likelihood of interference through broadcast outside of the permissible frequencies).

²⁷² See *id.* at 5514.

²⁷³ See *id.* at 5514-15.

²⁷⁴ See Weinman, *supra* note 189 (describing patent application for “Flexible Communication Systems and Methods”).

²⁷⁵ See V-Comm Comments, *supra* note 133, at 3-4 (describing concerns about interference where cognitive radios use spectrum-sensing and geo-location).

²⁷⁶ See Copps, *supra* note 87, at 2 (describing procedural safeguards).

²⁷⁷ See Copps, *supra* note 87, at 2.

²⁷⁸ See generally Copps, *supra* note 87.

²⁷⁹ See Anderson, *supra* note 87, at 3 (discussing paradox of accessing Internet database without having Internet access).

²⁸⁰ See Anderson, *supra* note 87, at 3 (discussing general database issues).

²⁸¹ See Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies, 20 F.C.C.R. 5486, 5514-15 (2005) (ET Docket No. 03-108).

still requires the cognitive radio to be aware of other cognitive radios competing for the same ILEC, but it does not depend on a permissions database in order to avoid interfering with existing ILECs.²⁸²

The order authorizing use of TV white spaces does not specify the legal responsibilities or clearly define the complaint process against a user creating harmful interference.²⁸³ With the handshaking approach, the owner of the cognitive radio is identified.²⁸⁴ This approach will address the liability issues that are otherwise present with anonymous white space users.²⁸⁵

E. Contractual Matters

A cornerstone of this proposal is the creation of competition between ILECs as required by the FCC's guiding principles for preservation of Internet freedom.²⁸⁶ Network diversity proponents claim that sufficient competition already exists.²⁸⁷ They argue that users are free to contract with ILECs and terminate with appropriate fees.²⁸⁸ There is merit in the argument that binding to a long-term contract allows ILECs to subsidize the cost of handsets, which in turn may encourage more Internet access.²⁸⁹ However, the fallacy of this position is that even unsubsidized (unlocked) handsets that are not tied to one ILEC still

²⁸² See *id.* at 5514-15.

²⁸³ See Tate, *supra* note 93, at 1 (dissenting about lack of language specifying legal responsibilities and complaint process).

²⁸⁴ See *Facilitating Opportunities*, 20 F.C.C.R. at 5514-15.

²⁸⁵ *Id.*

²⁸⁶ See Frieden, *supra* note 24, at 489 (recalling fourth principal that "consumer are entitled to competition among network providers, application and service provider, and content providers").

²⁸⁷ See Farquhar, *supra* note 34, at 129 (recalling arguments of service providers which state, "Existing competition among network operators, as well as possible future entry, is sufficient to ensure competition at all levels in the marketplace. Market forces are likely to produce a "net neutral" outcome without intrusive regulation.").

²⁸⁸ See Bray, *supra* note 186, at B9, B13 (describing prepaid alternative to two year terminable contracts).

²⁸⁹ See Reardon, *supra* note 186. "We'll have to see how willing people are to give up the subsidy and pay \$200 or \$300 for a device." *Id.* (quoting Lowell McAdam, CEO and President of Verizon Wireless).

cannot use other ILECs without entering into another contract.²⁹⁰ ILECs have responded with prepaid handsets offering minimal functionality but without long-term contracts.²⁹¹ This is a step in the right direction, but it still does little to foster competition among ILECs.²⁹² The incentive to discriminate against certain applications will continue to exist if ILECs receive the same compensation for applications that consume significantly differing amounts of Internet resources.²⁹³

In contrast, an ad-hoc access method will allow each application to be priced according to its market value.²⁹⁴ Furthermore, ad-hoc access may place a different value on competitive parameters such as bandwidth, continuity of transmission or QoS.²⁹⁵ The FCC could make agreement to general contract terms a condition of handset certification.²⁹⁶ The ILEC could transmit parameters as part of the handshaking process.²⁹⁷ Access charges could be managed through a scheme similar to existing wireless payment systems.²⁹⁸ There are numerous approaches to contracting for ad-hoc services that are not central to the concept

²⁹⁰ See McGrath, *supra* note 186 (explaining that in Hong Kong “phones are often purchased without a wireless service contract”).

²⁹¹ See Bray, *supra* note 186, at B13.

²⁹² See McDowell, *supra* note 100, at 2 (discussing competitive barriers created by walled gardens).

²⁹³ See McDowell, *supra* note 100, at 2 (rationalizing greater access will foster greater competition for the American consumer and will remove incentive to discriminate).

²⁹⁴ See Wu, *supra* note 38, at 143-44 (discussing market distortion when certain applications are favored).

²⁹⁵ See generally Eliot Weinman, *supra* note 189 (discussing competitive bidding method). See also Wu, *supra* note 38, at 155 (highlighting importance of multiple parameters including bandwidth and quality of service).

²⁹⁶ See generally Copps, *supra* note 87 (discussing certification requirements).

²⁹⁷ See Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies, 20 F.C.C.R. 5486, 5514-15 (2005) (ET Docket No. 03-108).

²⁹⁸ See Hafner, *supra* note 190 (describing wireless payment system where cell phone is linked to PayPal.com). This payment scheme allows billing independent of a wireless provider. Hafner, *supra* note 190.

of enabling ad-hoc access as a way of resolving network discrimination.²⁹⁹

VII. Conclusion

Ad-hoc open mobile access will meet the needs of both network neutrality and network diversity proponents without stifling competition with excessive regulation. There are encouraging signs that ILECs may eventually open up their networks to unlicensed mobile radios, although it is still prudent to enact minimally intrusive regulation to ensure development of last mile competition. While there is broad support for using cognitive radio in unlicensed spectrum and secondary markets, ILECs want additional assurances before allowing access to their licensed spectrum. This is understandable given the sizable investment that ILECs have made in their spectrum licenses and the potential for harmful interference if the handsets lack adequate controls.

The proposed model enabling consumers to negotiate for each access based on competitive metrics inherently requires handshaking that should provide for adequate control against harmful interference. Therefore, it is reasonable for the FCC to require ILECs to support ad-hoc mobile access with cognitive radios operating in the unlicensed spectrum. Since spectrum licenses are for a limited term, the FCC has the authority to eventually require ad-hoc mobile access a condition of future spectrum licensing.

Wireless technology has advanced to the point where it can effectively compete with wire-line access using cable or DSL. It not only mitigates discriminatory behavior by introducing competition in the last mile of the Internet but also permits more efficient use of the Internet. It is fortuitous that poorly served rural areas have the most available spectrum to use for mobile

²⁹⁹ See generally Weinman, *supra* note 189 (citing examples of contracting and paying for ad-hoc mobile access are provided to illustrate a complete system supplemented by Google's instant bid proposal). However, the author, Weinman, does not consider these examples to be central to the thesis of injecting competition into the last mile as a solution to the network neutrality debate. See generally Weinman, *supra* note 189.

access. The FCC should move swiftly to enable ad-hoc mobile Internet access to foster the growth of the Internet, price Internet usage fairly and reduce discriminatory practices so that more citizens can gain access to this vital resource.