"Working Paper No. 1/03: Wireless Spectrum Allocation and New Technologies: Reviewing Old and New Paradigms Through a Case Study of the U.S. Ultra Wideband Proceeding"

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Abstract

This working paper is discussion of the regulation of wireless technologies in the U.S. and in Europe, beginning with the new announcement of spectrum in the U.S. for "Advanced Wireless Services," and continuing on to discuss wireless technology as it applies to spectrum management and general regulatory principles.

The working paper's emphasis is on the results of the four years of proceedings in the U.S. to approve Ultra-Wideband Technology (UWB). A discussion of UWB has recently begun in Europe through the CEPT SE24 and ETSI TG31a projects. It is likely that European regulation will produce industry and governmental concerns similar to those in the U.S., and likewise, similar regulatory constraints.

The working paper also includes a preliminary discussion of how new technologies like UWB may question scarcity in spectrum management, and how this may impact freedom of expression principles under the U.S. Constitution and the European Convention for Human Rights.

Finally, a discussion of the Federal Communications Commission (FCC) rulemaking procedure in the U.S. is also included, with suggestions for alternatives to improving the FCC's efficiency as an administrative lawmaker, such as an interim-final rulemaking procedure, and lessons that the FCC can learn from its sibling FDA. The regulation of spectrum by the courts by a discussion is also included in light of the of the NextWave and GWI litigation.

Comments and feedback to the author are encouraged: pryan@pryan.net

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By Patrick S. Ryan[1]

Author's notes

The author is a Ph.D. student at the Katholieke Universiteit Leuven and is writing his dissertation on wireless allocation methodologies in the U.S. and in Europe in light of the quickly shifting environment of changing technologies. The purpose of this Working Paper is to develop some initial ideas and to provoke thought and feedback from academics and from industry professionals. The paper covers a lot of ground with a discussion of various topics of wireless spectrum management.

It should be stressed that many of the ideas in this paper are in continuous refinement. Comments and critiques of any nature are invited via email to pryan@pryan.net.

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> 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.
>
> *- The entire comment filed Frank Burns, a citizen respondent, during the Rulemaking procedure of the FCC's Ultra-Wideband proceeding*[2]

Section I: What are "Advanced Wireless Services?"

1.1 The FCC announces a Notice of Proposed Rulemaking

On November 7, 2002 the U.S. Federal Communications Commission ("FCC") created a new allocation for so-called "Advanced Wireless Services,"[3] ("AWS") which includes an array of next-generation 3G services similar to those promised in Europe. The total amount of spectrum to be offered by AWS in the U.S.A. is two 45 MHz bands for a total of 90 MHz of spectrum. This amounts to only a portion of what was planned for allocation under the US-equivalent UMTS auctions[4], although perhaps the proposed restrictions on use and regulation of AWS spectrum are considerably less in U.S. than in Europe.[5]

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[2] *Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, ET Docket*, 98-153 F.C.C. (1998).

[3] FCC PRESS RELEASE, FCC *Allocates Spectrum for Advanced Wireless Services and Proposes Licensing and Service Rules,* November 7, 2002. www.fcc.gov.

[4] WALL STREET JOURNAL, *Space Wars*, September 23, 2002.

[5] The Notice of Proposed Rulemaking proposes "post-auction disaggregation and partitioning," which is tantamount to spectrum trading and is not currently allowed in Europe.

The 1701-1755 MHz and 2110-2155 MHz bands which are being allocated for AWS partially belong to the Federal Government and partially are reserved for non-Federal Government mixed use. AWS will now become the subject of a Rulemaking Procedure[6] for the determination of the following topics:

- To receive comment on the licensing, technical and operational rules to be promulgated for use within AWS;
- To discuss auction-related issues, such as the use of "bidding credits,"[7]
- To seek comment on what geographic areas should be used to license the spectrum
- Whether the band should be divided into particular blocks, and if so, in which pairings; and finally
- To seek comment on a variety of technical issues, including how best to control interference, power limits, and border coordination matters.

A Rulemaking Procedure is an Administrative Law function in the U.S. whereby the FCC officially announces its intention to administratively regulate a topic within its authority (in this case, airwaves). Industry and the public are invited to submit comments. The procedure can take several months or several years and is quite cumbersome. The process generally does not happen in less than a year and has taken as long as 15 years for some allocations.[8] After an introduction to wireless technology and regulation, this paper will review the rulemaking procedure as it was used in allocation of Ultra-Wideband ("UWB") in the U.S. and propose some

[6] See ET Docket No. 00-258 and WT Docket No. 02-353

[7] It is the author's assumption that by "Bidding Credits" the FCC is referring to it's *Report and Order and Further Notice of Proposed Rule Making* in WT Docket 99-266 (June 8, 2000) whereby the FCC established a so-called "bidding credit program" for future auctions to provide incentives to wireless telecommunications carriers to serve tribal lands. Also see "Extending Wireless Telecommunications Services to Tribal Lands," *Report and Order and Further Notice of Proposed Rulemaking,* WT Docket No. 99-266, 15 FCC Rcd. 11, 794 (June 30, 2000).

[8] Thomas W. Hazlett, *The Wireless Craze, The Unlimited Bandwidth Myth, The Spectrum Auction Faux Pas, and the Punchline to Ronald Coase's 'Big Joke',* WORKING PAPER 01-02, AEI-BROOKINGS JOINT CENTER FOR REGULATORY STUDIES (January, 2001), at 120.

alternative ways of administering the process so as to speed up rulemaking in the future. Unlike the UWB proceeding (which was the subject of a waiver to Part 15),[9] through the Rulemaking Procedure, AWS will seek to license under Part 27[10] of the Commission's Rules. The procedure is likely to be similar for both, however, as they will each be subject to the same Rulemaking Procedure.

1.2 Where did AWS come from; or, what happened to the U.S. UMTS auctions?

The FCC had planned to auction and license various bands in the 700 MHz spectrum block for some time for services similar to those expected to be developed out of the European UMTS auctions. The most recent target for the 700 MHz auctions was June 19, 2002,[11] a target which had changed numerous times already, and was again reset to January 14, 2003.[12] In the meantime, lawmakers have voted again, opting to postpone the auctions indefinitely.[13] This time, the FCC has not provided any guidance as to when they may take place again.[14] The delay is partially due to the switch-over of digital television – originally planned for 2006, a date selected for when the expectation would be reached that U.S. households would be at 85% digital penetration. Many commentators believe that the FCC should consider a full switch-off and free up the unused broadcasting channels now, or at least very

[9] 47 CFR 15, http://www.access.gpo.gov/nara/cfr/waisidx_01/47cfr15_01.html

[10] 47 CFR 27, http://www.access.gpo.gov/nara/cfr/waisidx_01/47cfr27_01.html

[11] Federal Communications Commission, *Auction of licenses in the 747-762 and 777-792 MHz bands scheduled for June 19, 2002*, Report No.l AUC-02-31-B (April 1, 2001), Available at: http://wireless.fcc.gov/auctions/31/releases/da020659.pdf

[12] Federal Communications Commission, *Auction of licenses in the 747-762 and 777-792 MHz Bands (Auction No. 31) Postponed Until January 14, 2003*. FCC 02-158 (May 24, 2002), Available at: http://wireless.fcc.gov/auctions/31/releases/fc020158.pdf

[13] WALL STREET JOURNAL, *Lawmakers vote to postpone wireless spectrum auctions*, June 19, 2002.

[14][14] Federal Communications Commission, *Auction of licenses for 747-762 and 777-792 MHz Bands (Auction No. 31) is rescheduled* Report No. AUC-02-31-G (Auction No. 31) (July 26,2002), Accessible at: http://wireless.fcc.gov/auctions/31/releases/da021829.pdf

soon.[15] Under any scenario, the 700 MHz auctions are frozen for the time being, pending the development of a revised spectrum allocation plan. In the interim, it appears that AWS is the only mid-term *licensed*[16] alternative for new wireless services. Indeed, unlike the UMTS auctions, large portions of this spectrum are in control of the government rather than private industry, so the transfer to private use should (theoretically) be easier than the 700 MHz proceedings.

1.3 Classifying AWS among other new technologies

Where does AWS fit among new technologies? Since AWS will be the granting of new frequencies, it is similar to UMTS, although AWS will be offered over a different frequency range than UMTS and with considerably less bandwidth. It is probably easiest to think of AWS as a frequency allocated for 3G services, although Annex 1 provides an overview of the different technologies as well as a glossary of other terms that may be useful.

1.4 Ultra-Wideband: Is this 4G? If so, will 4G be available before 3G?

Ultra-Wideband (UWB) is a ground-breaking technology that could potentially eliminate wireless airwave congestion, reduce power consumption requirements to a minimum, and improve the safety applications of wireless in many dramatic ways. In April, 2002 the FCC authorized UWB, with certain conditions, by an amendment to Part 15.[17] The authorization severely limited power levels of the emissions below 3.1 GHz. An explanation of the impact of this decision and the justification will be discussed below.

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[15] Thomas W. Hazlett, *The U.S. Digital TV Transition: Time to Toss the Negroponte Switch*, AEI BROOKINGS JOINT CENTER FOR REGULATORY STUDIES, WORKING PAPER 01-15 (November 2001), accessible at: http://www.aei.brookings.org/publications/working/working_01_15.pdf

[16] Note that there may be other unlicensed alternatives, such as Ricochet (www.ricochet.com) , Wi-Fi, Software Defined Radio and other spread spectrum technologies.

[17] Federal Communications Commission *In the matter of Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems*, ET Docket 98-153 (April 22, 2002). Accessible at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-02-48A1.pdf

Potential applications of UWB include LAN-like uses within buildings,[18] secure military communications, through-the-wall radar and underground imaging to rescue people buried in natural disasters (like earthquakes).[19] Aside from it's unique ability to accurately depict size and distance in radar technologies (described in detail in a separate section devoted to UWB), many of the other applications are interchangeable with existing wireless technologies.[20] The vital contribution of UWB technology is that it is not inhibited by the same restrictions that inhibit present 800 MHz cellular and 1.9 Gig PCS phones: UWB technology will be able to theoretically produce transmit and received devices with the same range and communication essentials as present-day cell phones, yet will use only one (1) to four (4) milliwats, which is about *1/100th the power consumption* of conventional cell phones.[21] This means the devices can be smaller (perhaps making the wrist-watch phone a reality), and the batteries could last a full 100 times longer than present cell phone technology.[22] Furthermore, the technology is so simple that it is in fact very inexpensive to produce: the UWB chip is expected to cost merely $8 or

[18] *See* TELECOMMUNICATIONS REPORTS INTERNATIONAL, INC.*, Ultra-Wideband Backers Say They're Next Wave,* September 28, 1999. (mentioning the application of the devices in wireless LANs).

[19] Amara D. Angelica, *Powered by Pulse: More than a Pipe Dream, a New Technology Could Revolutionize Wireless Communications*. TECH WEEK*,* May 3, 1999. (An overview of future applications of UWB technology in communications systems).

[20] Bruce Schoenfeld, *Welcome to Idea Town*, YOUR COMPANY*,* May/June 1999. (Article includes a detailed history of Time Domain, the pioneer firm that developed UWB technology and an overview of tested applications and future aspirations).

[21] *See* Angelica, *supra.*

[22] As will be discussed below, only one wireless carrier objected to the promulgation of UWB technology, perhaps indicating that the carriers do not view the technology as a present, viable threat. Yet anecdotal evidence seems to indicate that many carriers and radio frequency engineers simply have not been "englightened" to the use of the technology. In writing this paper I spoke with several radio frequency engineers in hopes of developing a simple way of explaining the technology. One senior RF engineer at one of the largest wireless carriers in the nation (company to remain unnamed) was so shocked at the potential of this technology that he wrote a risk memorandum to the corporate vice president on the potential threat this technology may bring. It's probably about 4 years or more in the future – but a threat none-the-less for present technologies and infrastructures. (See Angelica, *Ibid*, for the notion that the UWB phones are expected to be considered 4th generation or 5th generation wireless phones – 1st generation would be analog cellular, 2nd generation are digital and PCS technologies, and 3rd generation – underway now – are the internet-enabled phones.)

$9 per unit to produce.[23] In spite of the fact that UWB is still relatively in it's infancy, in the U.S. it has received lots of favorable press from high-power techno-pundits who endorse the technology.[24] A full review of the technology and the approval procedure will be covered in Section III below.

1.5 The regulation of wireless

AWS is simply a sampling of the wireless technologies which are making headlines today. There are others: see Annex 1 for a non-exhaustive list of many of the commonly discussed technologies and a description of them. The great challenge of the future will be setting up a regulatory framework in both the U.S. and in Europe that can keep pace with new technologies and allow for growth. It is the author's proposition that it is impossible to understand the regulation of wireless technology without a basic understanding of the technology itself. The regulation and allocation procedures used in the U.S. will be reviewed in Section II.

Section II: A basic review of wireless technologies

2.1 What is "wireless" and what is "spectrum"?

"Wireless communications" as a general rule includes all forms of communication *without the aid of a physical conduit*, i.e. through the "ether" or the

[23] *See Ultra-Wideband Market Awaits Regulatory Approval*, WIRELESS TODAY, September 28, 1999. (A quote from the Chief Technology officer of Time Domain Corporation, founder of the technology, predicting the price of the production costs of the chip. Licensing costs and other costs associated with the patented technology are not included in this figure.)

[24] *See* WALL STREET JOURNAL, *The Wireless Pioneer: What products may be reshaped by ultrawideband technology? Look around and start counting*. Technology Special Report Section (May 13, 2002). Also see Rafe Neeldeman, Editor of *Red Herring* (a well-known technological magazine), March 17, 1999 (For the contention that UWB may be the "new dimension" in wireless data. "It took me back to last year's Venture Market East conference in Boston, at which the CEO of Nexabit, Mukesh Chatter, talked about building routers 'about 100 times faster than Cisco has on the market.' Since then, the terabit router market has begun to open up, and I have to credit visionaries like Mr Chatter who are unwilling to accept that a market must move at the incumbent's pace. Time Domain [the UWB inventor], potentially, has even more disruptive technology. Its 'time modulated ultra-broadband wireless' chip enables ultra-fast, ultra-low-power radio transmission. It uses what's considered the 'noise' of ordinary frequency bands, so it doesn't even need traditional spectrum allocation. On paper, it smokes the Bluetooth Standard … Watch this one.")

airwaves. One way to distinguish between different forms of wireless technologies through is a brief discussion of *light* vs. *radio.* Many wireless communications commentators completely ignore the topic of light as a wireless technology[25], although it is a viable form of wireless data transmission, and in my view a brief discussion of the topic often helps "frame" the more popular (and more regulation intensive) discussion of radio technologies. The discussion will also help frame another important underlying aspect of wireless telecommunications: transmissions which are "mobile" vs. transmissions which are "fixed." It is axiomatic that the highest value spectrum is that which is in the "mobile" services, which is only about the lower 10% of the official designation for "radio" spectrum.[26]

2.1.1 "Light" technologies

Wireless transmission via light waves (as opposed to fibre optic transmission of light waves) is a growing means of transmitting data. Light technologies are all "line of sight" technologies, which means that the two devices communicating with one another must be able to physically "see" each other. Light-based applications are therefore limited to fixed connections rather than mobile uses. Light technologies are generally not regulated by the same bodies that control radio spectrum[27]. Generally one can not *own* or *license* light as spectrum.

i. Laser technologies ("fixed" use only): the transmission of data via laser light. Typical laser applications are very high speed point-to-point type connections[28]. Companies that operate in this domain include

[25] Also referred to as "Free-space optical technology." *See generally*, COMMUNICATIONS DAILY, April 13, 2000.

[26] This assertion is based on the assumption that "mobile" wireless continues through 3 Ghz, which is 10% of the full "spectrum chart" which delineates spectrum usage through 300 Ghz.

[27] For a web-based overview, see http://www.freespaceoptic.com/Fiber_Optics_Without_Fiber.htm

[28] There are other terms for laser technologies, including "Free Space Optics Technology" and some proprietary names. See references *supra* and *infra* for more details.

TeraBeam[29], Furtera[30] and many others. Laser technologies are also growing in Europe. For example, London-based COLT used it in a recent MTV Europe broadcast and has published an excellent review of the applicable technology.[31] Laser technologies are not licensed for use[32], although as with all technologies, certain safety regulations may apply. Laser technologies are cutting edge technologies for very high transfer data rates (potentially much higher than radio technologies) and feature potentially uncrackable stream encryption.[33]

ii. Infrared technologies ("fixed" use only): the transmission of data through the air via infra-red light beams. On a frequency scale, infrared begins approximately at the 300 GHz range, where Radio stops.[34] Like laser, infra-red is not licensed for use and are most apt for very short range data transfer applications. Typical infrared applications are remote controls for television, PDA devices, peer-to-peer networking between computers. The Infra Red Data Association (IrDA) is a well-established trade for the development of standards and protocols for intra-device communications.[35] Although many devices which use infrared technology are themselves portable, they must be "fixed" during their operation and they must "see" the device with which they are connecting.

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[29] *See* Terabeam Corporate Website, www.terabeam.com

[30] *See* Futura Corporate Website, www.furtera.com

[31] *See* Colt Document on Colt Corporate Website, http://www.colt.net/news_events/white_papers

[32] Generally, the term "use" in this context refers to the application, e.g. use "for data transfer," or use "for point to point connections," or use "for the delivery of public television."

[33] *See Cutting the cable*, THE ECONOMIST, February 14, 2002 (for a discussion on Free Space Optics Technology and the potentially uncrackable integration of "quantum key distribution encryption.")

[34] See United States Frequency Allocations, cited below.

[35] *See* IRDA industry group website, www.irda.com

2.1.2 "Radio" Technologies

Radio waves are the frequencies between 3 kHz and 300 GHz, although the legal and regulatory definitions vary slightly between Europe and the U.S. at the very-seldom-used low-end of the frequency spectrum.[36] For purposes of this analysis, the U.S. definition of 3 kHz and 300 GHz based on the Allocation Chart [37] shall be used.[38]

As stated, one way of distinguishing between different types of radio spectrum is by dividing between *mobile uses* and *fixed uses*. The understanding of which frequencies can be used for which purpose is vital, because *no reasonable frequency allocation policy or regulation may be set forth without a basic understanding of their general transmission characteristics.* It was not until 1897 -- just barely over one century ago -- that Marconi first transmitted a wireless signal. [39] It took another 10 years (1907) for Lee de Forest to develop a workable amplifier and oscillator for broadcast purposes.[40] And only 20 years after the de Forest invention, in the United States, the 1927 Radio Act was passed into law – which was done quickly in response to a broadcasting crisis[41]– and far before we really knew anything about how radios really worked, and long before mobile phone technologies were

[36] The EU defines "Radio Spectrum" as the frequencies between 9 kHz and 3000 GHz (see 2000/0187 (COD) *Proposal for a Decision of the European Parliament and of the Council on a regulatory framework for radio spectrum in the European Community (Common Position)).*, and the U.S. starts much lower at 3 kHz (see U.S. FREQUENCY ALLOCATION CHART, published by the U.S. Department of Commerce, NTIA Office of Spectrum Management, last edition March 1996). Statutorily, in Article 4.1.1 of the NTIA MANUAL OF REGULATIONS & PROCEDURES FOR FEDERAL RADIO FREQUENCY MANAGEMENT (January 2000 edition with January/May/September 2001 Revisions) the United States incorporates ITU standard from Article S5 of the ITU Radio Regulations, 1998 edition . in article 4.1.1.

[37] *Id.*

[38] The NTIA publishes a visual presentation of the frequency chart. *See* www.fcc.gov .

[39] SUNGOOK HONG, WIRELESS: FROM MARCONI'S BLACK BOX TO THE AUDION (MIT Press 2001).

[40] *Id.*.

[41] Hazlett, *Wireless Craze*, *supra* at note --.

considered to be viable. The basic premises of the 1927 Radio Act remain intact today,[42] yet some of the most groundbreaking progress in wireless technology has taken place in the past 20 years. Although the mating of computer technology to spectrum management dates back to the introduction of the microprocessor in approximately 1971,[43] the first mass commercial deployment digital signalization (as opposed to analogue signalization) was the 1991 launch of GSM in Europe.[44] Other digital standards were simultaneously being developed in the U.S., although the first mass deployment of a digital standard in the U.S. was the launch of the Nextel Communications' network in 1993.[45]

Long before the digital launch academics and pundits have been heavily critical of regulatory bodies such as the Federal Communications Commission (FCC). In 1959 Nobel Laureate Ronald Coase was quite critical of the FCC and its allocation methodologies.[46] To explain the rational behind the present (i.e. annum 1927) system, Coase selected a quote from Justice Frankfurter of the U.S. Supreme court in the famous case NBC v. United States[47]:

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[42] *Id.* at 18.

[43] *See Intel Web Museum*, Intel Corporation web site, *at* http://www.intel.com/labs/innovations/ (visited Dec 10, 2002). (Notes that the microprocessor was introduced in 1971 with the introduction of the 4004 "chip on a computer).

[44] *See History of GSM*, GSM World, *at* http://www.gsmworld.com/about/history (visited December 16, 2002). (The web page notes a 1 July 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).

[45] *See Fleet Call, Inc. Changes Name*, WALL STREET JOURNAL, March 24, 1993, at A5. (Noting the planned August, 1993 system launch); *See also* Gautam Naik & Dennis Kneale, *Radio Flier: Old Dispatch Systems Are Ticket to Riches For Former FCC Man*, WALL STREET JOURNAL, August 31, 1994, at A1. (Noting the history of Nextel, its acquisition of numerous dispatch licenses for conversion to digital use, and it's plan for the launch of the [first] nationwide digital network in the U.S.).

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

[47] National Broadcasting Co. v. United States, 319 U.S. 190 (1943).

> 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 [emphasis added].

Indeed, the "certain basic facts" and the "potentialities of radio" were not truly known in 1927, when the Radio Act was passed. They were probably not known in 1943, when Frankfurter wrote the above passage, and when, during WW II, the American military thought that placing soldiers in front of microwave antennas would temporarily infertilize them during shore visits. Even in 1959, at the time of Coase's famous article,[48] mobile uses were far from commercial deployment, and the personal computer was still about 20 years away from full commercialization.[49] To be fair, even today, we probably do not know what the "certain basic facts" and the "potentialities of radio" are.[50]

We do know, however, that inventions such as the mobile phone, cable television, internet, FM stereo and the like are all technologies which vastly improve through advancements in digital compression. Today it is axiomatic that the premises of the 1927 system needs to be changed. In addition to Coase, famous

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[48] Coase, *The Federal Communications Commission*, *supra* note --.

[49] *See supra, Intel Web Museum*, Intel Corporation.

[50] *See generally, The race to computerise biology*, THE ECONOMIST, December 12, 2002 (Discussing the emergence of "bioinformatics" and it technology promises); *See also, Computing's new lodestone*, THE ECONOMIST, March 16,, 2002 (Discussing mergers of electromagnetics and microprocessor technology in future applications).

U.S. commentators such as Lawrence Lessig [51] and Yochai Benkler[52] have provided compelling arguments that the premise of that the old system should change, although commentators have different views as to how *urgent* it is for the system to change. In an article that Benkler and Lessig wrote jointly, they advanced the argument that modern technologies, as they are governed under the present annum 1927 system, may even be unconstitutional: [53]

> If the engineers are right – if the efficiency of an architecture of spread-spectrum wireless technology were even roughly equivalent to the architecture of allocated spectrum – then much of the present broadcasting architecture would be rendered unconstitutional. If shared spectrum is possible, in other words, then the Fist Amendment would mean that allocated spectrum – whether licensed or auctioned – must go. And, if allocated spectrum must go, then so must government's giveaways and sales to private industry. If we are right, the government can no more auction the right to broadcast in Boston than it can auction a license to print a newspaper there.

Professor Stuart Benjamin has further developed this argument as it applies to the First Amendment in the U.S.[54] Benjamin argues that the U.S. government action is in violation of the U.S. Constitution's First Amendment if – given basic concerns about interference -- spectrum remains unused.[55] Benjamin carefully extends and analyzes Benkler & Lessig's printing press proposition under two hypotheticals:

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[51] Lawrence Lessig, *Code and the Commons - Keynote Speech at Conference on Media Convergence (Draft 2)*, Harvard Law School Web, *at* http://cyber.law.harvard.edu/works/lessig/fordham.pdf (February 9, 1999).

[52] Yochai Benkler, *Overcoming Agoraphobia: Building the Commons of the Digitally Networked Environment*, 11 HARV. J.L. & TECH. 287 (Winter 1997-1998).

[53] Yochai Benkler & Lawrence Lessig, *Will Technology Make CBS Unconstitutional?*, THE NEW REPUBLIC (Dec 14, 1998), *at* http://www.tnr.com/archive/1298/121498/benklerlessig121498.html.

[54] Stuart Minor Benjamin, *Logic of Scarcity: Idle Spectrum as a First Amendment Violation*, 54 DUKE L.J. 1, (2002) [hereinafter Benjamin, *Logic of Scarcity*].

[55] *Id,* at 4.

1. The government licenses all printing presses in a content-neutral manner; and[56].
2. The government not only licenses printing presses, but also keeps some presses idle by refusing to license them.[57]

It turns out that, in the U.S., there is no existing doctrine or case law which fits the above two scenarios exactly because the U.S. government has not tried to license printing presses in the fashion noted above. However, the scenarios are similar to the present licensing system used for wireless technologies. Indeed, there is case law which can be extended to review the hypothetical scenarios.

After an detailed review of the Supreme Court's 1943 Decision in NBC v. United States,[58] as well as the U.S. Supreme Court Case Red Lion Broadcasting Co. v. FCC (which reinforced the propositions of NBC),[59] Benjamin concludes that the rationale for control of communications media -- such as printing presses or spectrum – are based on the underlying assumption of scarcity. In conclusion, Benjamin believes that if the *logic of scarcity* is undermined -- i.e. if the resource is in fact underused (be it a printing press, or a wireless frequency) -- then government is engaging in the suppression of free speech. As such, this suppression is unconstitutional.[60]

In Europe, Professor Martin Cave has advocated freeing up spectrum management approaches, although he has not elaborated on the constitutionality of

[56] *Id,* at 18 ff.

[57] *Id,* at 24 ff.

[58] 319 U.S. 190.

[59] Red Lion Broadcasting Co. v. FCC, 395 U.S. 367 (U.S. 1969).

[60] Benjamin, *Logic of Scarcity*, *supra* note --, at 90-91.

the present system.[61] Extending the approach to constitutionality within Europe is by no means unrealistic. Indeed, the author of this article's colleague and supervising professor have already stated that Frequency scarcity was the motive for a number of exceptions to the freedom of speech principle in the broadcasting field, and that restraints were needed for guaranteeing a well-organized use of the spectrum frequencies.[62] This argument will be discussed further in Section IV.

2.2 "Fixed" wireless uses

Generally, *fixed* radio frequencies from 3 GHz to 300 GHz are for "line of sight" uses which means that the two devices must be able to "see" each other. Practical examples include: microwave radio[63], where two microwave dishes are pointed at each other and do not have obstacles between them (such as buildings mountains or trees). Another example of a fixed-type use is satellite communications, in the case where the satellite is in a continuous geo-synchronous orbit (i.e. it rotates at the same speed as the earth) and the terrestrial antenna is located outdoors (such as on a roof) can "see" the satellite. Laser must also "see" the other antenna – this is indeed the extreme end of line of sight technology – there is absolutely no capacity for laser to go through opaque walls and function.

2.3 "Mobile" wireless uses

The most important characteristic of *mobile* wireless uses is the ability for the frequency to penetrate obstacles, such as walls, trees, and the concrete and steel of cityscapes. Examples of appropriate *mobile* uses include: (i) FM radio, where the signal can be received indoors as well as outdoors. One's FM radio antenna does not need to "see" the broadcast antenna. (ii) Mobile phone uses, where the user can

[61] See Professor Martin Cave's study, *UK Radio Spectrum Management Review* and the many other consultant reports and industry comments at the U.K. government-hosted web site which was set up for discussion of spectrum policy: www.spectrumreview.radio.gov.uk

[62] Caroline Uyttendaele & Joseph Dumortier, *Free Speech on the Information Superhighway: European Perspectives* 16 JOHN MARSHALL JOURNAL OF COMP. & INF. LAW 905 (1998) at 930.

[63] German readers please note that microwave here refers to "Richtfunk", not to be confused with "Microwell"

receive signals and use his/her phone indoors and in the city (GSM, cellular, PCS, paging, 3G, ESMR, etc), and (iii) indoor "wireless internet" uses, where the computer can be taken from one room to another without losing signal. It is here, in the mobile applications, where the most attractive consumer technologies operate. It is also in the mobile uses where the money is: one needs to look no further than billions spent for the recent 3G auctions in Europe.

2.4 *Fixed* can operate in *mobile* frequencies, but generally not vice versa.

In order to understand the hot topics of today's regulatory landscape fully (which will be described in the next section), it is vital to highlight this one engineering basic: fixed uses (i.e. line of sight) applications *can* work in mobile frequencies below 3 GHz. The corollary, however, *is not true*, i.e. mobile uses (anything that requires wall penetration) will generally not work within the "fixed" domain above 3 GHz. Many fixed uses which are presently occupying the valuable mobile frequencies below 3 GHz (and, again, which were allocated in the 1920's, when we knew only a fraction of what we know today) are, according to many commentators, not properly allocated. I will provide a couple of examples to highlight the importance and value of understanding the basics of *mobile* frequencies vs. *fixed* frequencies: (a) Iridium; and (b) broadcast television. I have intentionally avoided the topic of 3G since the discussion of this matter would require detail that would go beyond the scope of this paper, although the reader should note that, as stated above, the market has valued the mobile frequencies allocated to 3G higher than any other frequency band by large margins. A review of Wireless Local Loop ("WLL") frequencies[64] provides ample evidence of this. In Germany, UMTS auctions brought in 50,52 billion Euros[65], although WLL licenses were granted virtually for free as part of a "beauty contest."[66] … In the U.K., UMTS auctions brought in 35,2 billion

[64] Wireless Local Loop is a high bandwidth wireless last-mile solution *(not appropriate for mobile use)* which generally operates within the 26 GHz (Germany) or 28 GHz band (England).

[65] WALL STREET JOURNAL*, Licenses Go To 6 Bidders in Germany*, August 18, 2000

[66] FRANKFURTER ALLGEMEINE ZEITUNG*, Der Kampf um die ,letzte Meile' geht in die entscheidende Runde* 6 September 1999, Nr. 206, P. 33.

Euros (22,5 billion GBP),[67] although in contrast to Germany, the WLL licenses were auctioned, not subject to a beauty contest. They brought in only 59,79 million Euros, about 20% of the value of the UMTS auctions.[68]

2.4.1 Short Case Study: Iridium, a fixed/mobile flop

One of the greatest (and yet very recent) flops of misunderstanding the application of mobile and fixed uses is the Iridium system. Iridium phones were setup on a frequency that does not (theoretically) require line-of-site to operate (Iridium phones operate in the 1.6 GHz range).[69] However, because of the extreme distance between the phone and the satellite (about 420 miles)[70] the power loss in traveling this distance made them act as if they had fixed frequency characteristics, i.e. the line-of-site requirement. Amazingly, Iridium phone subscribers were unable to use their phone within the office – or even outdoors in most city situations – unless he/she went *outside to the roof of the building* where his/her phone could get line-of-sight to the satellite![71] This problem was later somewhat band-aided by using dual mode phones that broadcast on local GSM networks while indoors, and used the Iridium system only when outside, but this required complicated reseller agreements with GSM providers and obviated the need for most satellite uses.

There are many other problems that have led to Iridium as a failed business enterprise,[72] however it can not be understated that Iridium "mobile" phones, in spite

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[67] WALL STREET JOURNAL, *High Prices for Licenses Create Risks*, August 16, 2000

[68] *See* U.K. Government website, cited *supra* at note --.

[69] *See generally*, http://www2.sis.pitt.edu/~jkabara/tele-2100/iridium/iridium_final.html. (A website hosted by Penn State which discusses the Iridium system in a presentation format).

[70] *Id.*

[71] Note that the Iridium satellites are not geo-synchronous, but rather Low Earth Orbit, and so technically, the application was " mobile" in the sense that the satellites moved during connection.

[72] The author's favorite news analysis of the Iridium "fall to earth" are the numerous articles which appeared in THE ECONOMIST. *See, for example* (also note the Economist's clever titles which tell the story as well), *Get off my fruequency*, April 18, 1998; *Staying in touch* June 13, 1998; *Star struck* July 17, 1999; *Still stellar?* October 2, 1999; *The global mobile* October 9, 1999; *Lost in space*

of their satellite connectivity functions, were actually "fixed" in much operation since the user had to step outside to open air to use them. Once out in the open air, they worked as "mobile" phones, yet the target customer – the business user – would seldom find himself outdoors. True, the connect anywhere (outside) service would be appealing to the businessman in the Himalayas, or perhaps on his sailboat in the Atlantic Ocean. Yet this market is by no means sufficient to justify an entire satellite network. As a result, an entire multi-billion dollar business plan was laid out, and failed.[73] Other Low Earth Orbit business plans similar to Iridium (in spite of futile attempts to differentiate their products)[74], such as Globalstar, ICO and Teledesic have thus far also failed.[75]

2.4.2 Broadcast television: the great frequency squatters

The first mobile (cellular) licenses in the United States were granted by FCC's re-allocation of UHF channels 70-83 in 1968.[76] There are still many large swaths of frequency in the United States which are generally not used, particularly TV

November 4, 2000; *Wounded birds* May 12, 2001; *A new orbit* July 14, 2001, and *A bigger role for small satellites?* September 22, 2001.

[73] Iridium spent approximately $5 billion on their network, went bankrupt in August 1999, and in December 2000 was sold to a "bottom fisher" private investment group in for $25 million. *Deals & Deal Makers: Chase and Motorola Spar Over a Sour Loan,* WALL STREET JOURNAL, October 31, 2001; Iridium Files for Bankrupcy Protection WALL STREET JOURNAL, August 16, 1999. *See also*, *Iridium case study*, an online discussion of Iridium hosted by Purdue University, at http://gemini.lib.purdue.edu/instruction/gs175/Spring99/gs175d/iridium_.html (Accessed 22 Nov 2002).

[74] Globalstar, for example, attempted to be smaller, cheaper, and more digital. *See Globalstar Promises to Go Place Rival Hasn't: 'Above and Beyond'* WALL STREET JOURNAL, February 24, 2000.

[75] Globalstar filed for Chapter 11 on February 15, 2002. *See Globalstar's Chapter 11 Filing Reflects Lack of Restructuring Plan*, WALL STREET JOURNAL, February 19, 2002. ICO's global satellite phone venture filed for bankruptcy on August 27, 1999. *See ICO Global Satellite-Phone Venture, Affiliates File for Bankruptcy Protection* WALL STREET JOURNAL, August 30, 1999. Teledesic has private funding from Craig McCaw, Bill Gates and others and has not filed for bankruptcy, although they have scaled back operations officially until at least 2005. *See* Teledesic Corporate Website, www.teledesic.com.

[76] Malcom W. Oliphant, *The mobile phone meets the Internet*, IEEE SPECTRUM, volume 36, Number 9 (August 1999). Archive issues available at www.spectrum.ieee.org.

channels 38-69[77] and which could (and per many commentators *should,* as discussed above) be allocated to 3G/UMTS technologies. Instead, TV broadcasters regard this unused spectrum as part of what many commentators call a spectrum *Lebensraum* theory (this is a somewhat common, albeit rude, U.S. use of the German word).[78] Under a *Lebensraum* theory, those that have received spectrum grants are not only allowed to use the bare frequencies required for their broadcast operations, but also the "guard bands" that surround them. This theory extends back to the use of old analogue radios, before the days of digital tuning, when one tuned into a "range" of frequencies to receive his or her television or radio, rather than tuning in to, for example, 98.5 as one can do with great precision today.[79] It is the author's opinion that the *Lebensraum* theory should be discarded (as well as the rude use of the word).

In Europe the television broadcast "squatting" is not as pronounced as the U.S. In 1961 the CEPT more-or-less standardized three to four television broadcast stations per country (the "Stockholm 61 plan")[80], and is already making serious headway towards the study and implementation of a digital plan which will make more efficient use of these channels through analogue switch-off.[81] The

[77] Corresponds to 614 MHz to 806 MHz, see BENNETT Z. KOBB, WIRELESS SPECTRUM FINDER, Mc Gwaw-Hill Books (2001) at pp. 127 – 137.

[78] Hazlett, *Wireless Craze, supra,* at note --, citing George C. Calhoun, Digital Cellular Radio (Norwood, MA: Artech House, 1988), 48. *See also*, J.H. Snider, *Four Theories of Spectrum Property Rights,* NEW AMERICA FOUNDATION SPECTRUM SERIES, #3 (April 2002) at 2-3 (also available online at www.newamarica.net). There is an obvious attempt by U.S. commentators in their use of the German word *Lebensraum* to refer to quite politically-incorrect pre-war German theories expressed in Hitler's MEIN KAMPF and Hans Grimm's book VOLK OHNE RAUM. The application of this unfortunate term to spectrum squatting is quite rude, although German readers should note that in U.S. it is a disgracingly common – albeit disappointing – for the U.S. to refer to terrible points in history to express frustration to an unrelated events (in my view, the relationship between spectrum theory and the Third Reich is unnecessary).

[79] See J.H. Sneider, *Four Theories of Spectrum Property Rights*, *supra* at note --.

[80] Draft EEC report 4*, Initial ideas concerning the revision of the Stockholm (1961) agreement*, January 2002, available at www.ero.dk/doc98/Official/Pdf/ECCRep004.pdf

[81] The Commission published a Call for Tender in October 2002 (OJ S195 of 08.10.2002) and can be found at: http://ted.eur-op.eu.int/static/doccur/en/en/153347-2002.htm?SID=&time=Tue%2; also, the Commission published a comprehensive report on the topic in April 2002: Study by BIPE for DG INFSO on the Digital Switchover in Broadcasting

implementation of the plan will be undertaken by the newly-formed Radio Spectrum Committee.

2.5 Spectrum allocation methodologies

In the United States, the FCC initially used comparative hearings (aka "beauty contests") to assign licenses for spectrum from 1934 – 1998, with the exception of the "lottery detour" described below. Under modern law, however, the FCC requires that all new license be assigned by open auction.[82] In the past, there were special considerations for racial minorities and for women,[83] and many believe that government also regulated to special interests.[84]

In 1981 FCC experimented with a lottery method for awarding frequencies to private parties. The argument behind the use of lotteries as a distribution method are (a) that they are impartial (assuming winners are randomly selected); and (b) they are more efficient and easier to administer; which (c) allows the new technology to enter the market quickly.[85] The lottery was no more than a temporary detour. The FCC no longer uses the lottery method, and companies have spent millions through competitive bidding on securing radio spectrum for wireless uses.

Critics of the competitive bidding process point to the possibility that the newest and most efficient technologies may be hindered as companies wait on the sidelines for licenses to be granted, geographical areas consolidated, and the

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http://europa.eu.int/information_society/topics/telecoms/regulatory/studies/documents/final_report_120402.pdf.

[82] BENJAMIN, LICHTMAN & SHELANSKI, TELECOMMUNICATIONS LAW AND POLICY, Carolina Academic Press (2001) at 81 ff.

[83] *Id.* at 90, also noting the 1978 *Statement of Policy on Minority Ownership of Broadcasting Facilities,* 68 FCC 2d 979, and the U.S. Supreme Court case *Metro* Broadcasting Inc. v. FCC*,* 497 U.S. 547 (1990) *overruled by* Adarand Constructors, Inc. v. Pena*,* 515 U.S. 200 (1995).

[84] *Id.*, at 42.

[85] *See* Andrea Settanni, *Competitive Bidding for the Airwaves: Meeting the Budget and Maintaining Policy Goals in a Wireless World*, COMMLAW CONSPECTUS (1994). (2 CommLaw Conspectus 117).

successful assembly of a large, loyal customer base.[86] Yet with it's faults, the competitive bidding and auction procedure is viewed by most as superior to grants. As Thomas Hazlett explains[87],

> Members of the general public are the nominal spectrum owners, but they are individually uninterested in management of "their" property. Much of the value of the resource is squandered, one graphic example being the 67 year period during which Congress refused to authorize competitive bidding for wireless licenses. Taxpayers literally squandered billions of dollars. Losses from inefficient spectrum use are much larger – and ongoing.

A survey of policy options for spectrum allocation is beyond the scope of this paper.[88] Briefly, however, it should be noted for comparative purposes that Europe's first true foré[89] into auctioning spectrum took place with the 3G auctions. The success of the 3G auctions is questionable – true, they brought lots of money to the governments of Germany and England, but most other countries saw much less revenue and the recent failures of the winning companies stand for the proposition that the 3G auctions may not have been a success.[90]

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[86] Settani, *id,*

[87] Hazlett, *Wireless Craze supra* at note --, at 42.

[88] See excerpt from Yochai Benkler, *Overcoming Agoraphobia: Building the Commons of the Digitally Networked Envoronment*, 11 HARV. J. L. & TECH 287 (1998); and Jon M Peha, *Spectrum Management Policy Options*, IEEE COMMUNICATIONS SURVEYS, Fourth Quarter 1998.

[89] With the exception of Wireless Local Loop licenses which took place often as a "market test."

[90] *See generally*, Daniel Sokol, *The European Mobile 3G UMTS Process: Lessons From the Spectrum Auctions and Beauty Contests*, 6 VA. J.L. & TECH. 17 (2001).

Section III: Ultra-Wideband. The future of wireless?

Proponents of Ultra-Wideband ("UWB") technology claim that its use could eliminate wireless airwave congestion, reduce power consumption requirements to a minimum, and improve the safety applications of wireless in many dramatic ways. Operationally, the technology is purported for use in wireless Local Area Network applications within buildings,[91] secure military communications, through-the-wall radar and underground imaging to rescue people buried in natural disasters (like earthquakes).[92] There are, of course, numerous military applications such as covert communications, radar detection and missile guidance systems.[93] [94] Aside from it's

[91] *See* TELECOMMUNICATIONS REPORTS INTERNATIONAL, *Ultra-Wideband Backers Say They're Next Wave*, September 28, 1999. (mentioning the application of the devices in wireless LANs).

[92] Amara D. Angelica, *Powered by Pulse: More than a Pipe Dream, a New Technology Could Revolutionize Wireless Communications*. TECH WEEK, May 3, 1999. (An overview of future applications of UWB technology in communications systems).

[93] *See* Peter Eisler, *Small-time inventor clashes with mighty government lab*, USA TODAY, April 4, 1999; and *Livermore Lab Draws Fire on commercializing Radar – Lawmakers Say Inventor May Have Been Cheated*, SAN JOSE MERCURY NEWS, April 10, 1999. Lawrence Livermore National Laboratory ("Livermore") is a leading national (U.S. Government) research and development site. Livermore filed for and obtained patents on its version of UWB technology in 1993 (Livermore calls the technology "Micropower Impulse Radar"). It turns out that a leading scientist from Livermore attended a 1990 conference where Larry Fullerton (the inventor and founder of Time Domain Corp.) presented the technology. The scientist then returned to Livermore and allegedly began re-creating it in their laboratories, stating that the idea for it came to him in a "flash of inspiration," [see *San Jose Mercury News* article] with no attribution to the inventor Fullerton. As soon as Fullterton found out about the labs development of the technology and its patent filings, he began challenging the Livermore, which has since led to Livermore's loss of virtually all patent rights and the launch of a Congressional investigation into the professional and ethical standards of Livermore (a federally funded entity). Livermore labs will probably have to pay licensing fees to Fullerton to continue to use the technology. UWB technology has clear military applications, so may have been in the U.S. National interest to develop the technology in top-secret and use it as a military and espionage application. The private sector beat the military sector to the punch; but it is interesting to consider how many other "revolutionary" technologies may exist from public-funded development that may eventually make it to the market for public use (like the internet, originally a military invention); or may never make it to public use.

[94] For additional information on military applications, *see* Ira W. Merritt, *Proliferation and Significance of Radio Frequency Weapons Technology,* a prepared statement, testified before the Joint Economic Committee, February 25, 1992 (document available in the *Congressional Testimony by Federal Document Clearing House* for Wednesday, Feb 25, 1998) (Dr. Merritt provided extensive testimony on several applications of UWB in weapons systems.). Also see *Solicitation re: Engineering Services and Development,* available in the Federal Information & News Dispatch (Solicitation No. N00178-98-Q-0043, March 31, 1998) and reprinted in *Commerce Business Daily* (March 31, 1998). (refers to the government awarding of a contract to an engineering firm for the deployment of UWB technology for use in the Hummingbird unmanned aerial vehicle.)

unique ability to accurately depict size and distance in radar technologies (described in detail below), many of the other applications appear to be interchangeable with existing wireless technologies.[95]

In spite of the fact that UWB is still relatively in it's infancy, in 1998 and 1999 the technology received lots of favorable press from high-power techno-pundits who endorsed the technology.[96] In an attempt to facilitate the regulatory process, in 1998 a loose coalition of more than fifty (50) companies, scholars and organizations formed the Ultra-wideband Working Group.[97] Roughly a year after formation, on September 28, 1999 the Ultra-wideband Working Group met in Washington DC. The Conference included representatives from fourteen (14) countries, as well as FCC Commissioner Susan Ness and Chief of the FCC's Office of Engineering, Dale Hatfield.[98] UWB technology quickly gained tremendous support from so many groups because it has the capacity to revolutionize both the way that wireless spectrum is used, as well as increase dramatically the benefits of wireless technology.[99] Private engineers, international organizations, and regulators alike all

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[95] Bruce Schoenfeld, *Welcome to Idea Town*, YOUR COMPANY, May/June 1999. (Article includes a detailed history of Time Domain, the pioneer firm that developed UWB technology and an overview of tested applications and future aspirations).

[96] *See* Rafe Neeldeman, Editor of RED HERRING in March 17, 1999 ("It took me back to last year's Venture Market East conference in Boston, at which the CEO of Nexabit, Mukesh Chatter, talked about building routers 'about 100 times faster than Cisco has on the market.' Since then, the terabit router market has begun to open up, and I have to credit visionaries like Mr Chatter who are unwilling to accept that a market must move at the incumbent's pace. Time Domain [the UWB inventor], potentially, has even more disruptive technology. Its 'time modulated ultra-broadband wireless' chip enables ultra-fast, ultra-low-power radio transmission. It uses what's considered the 'noise' of ordinary frequency bands, so it doesn't even need traditional spectrum allocation. On paper, it smokes the Bluetooth Standard … Watch this one.")

[97] *See generally,* The Ultra Wideband Industry Website, at: *http*://www.uwb.org

[98] *Ultra-Wideband Backers Say They're Next Wave*, TELECOMMUNICATIONS REPORTS INTERNATIONAL, September 28, 1999. *See also*, *Ultra-Wideband Market Awaits Regulatory Approval,* WIRELESS TODAY, September 28, 1999.

[99] The possibilities are so extensive for this technology, it really is a matter if just sitting back and imagining "what if" scenarios under a completely different paradigm. *See* Kevin Maney, *Ultra-wideband Technology Gets Stuck in Fed's Red Tape,* USA TODAY, October 6, 1999: "At the Ultra-Wideband Conference [in Washington DC], Bjorne Eske Christenson of Germany's Siemens said that if UWB fulfills its promise, 'it would penetrate every product in Siemens, as the laser and transistor

believe that UWB technology, in the long run, will have beneficial effects on society and the economy.[100]

The technical characteristics of a UWB radio include (i) ultra-short duration pulses which yield ultrawide bandwidth signals; (ii) extremely low power spectral densities; (iii) multi-mile ranges with sub-milliwatt average power levels (even with low gain antennas); and (iv) excellent immunity to jamming from other radio systems.[101] In layman's terms: UWB does not operate within any single band, and because it operates with "pulses" at a very, very low energy level, it could open up the capacity for radio communication and conceivably wipe out the need for spectrum allocation all together. The pulses do not have a tendency to interfere with each other or with other radio waves, essentially opening up a nearly infinite amount of "new radio real estate."[102]

3.1 Simplification of UWB Technology

This portion of the paper will attempt to simplify the technology in a lawyer's effort to help non-engineers understand how the UWB "pulses" work. Spectrum is often defined in terms of "pipes" or "freeways." To simplify the freeway analogy, imagine that there is only one highway for all wireless traffic in the world and that this highway represents the entire finite wireless radio spectrum. The highway is

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do now.' Others talked of being able to make untethered cable television, which would allow you to move a TV anywhere in the house, regardless of where the cables run. One company is working on UWB underground radar for finding gold. Another talks of using UWB to create motion sensors so cheap and accurate, you could put one in your elderly parent's house, monitor it via the Internet and tell whether Mom or Dad fell."

[100] Heather Forsgren Weaver, *FCC to Start Ultra-wideband Rule Making*, RCR, October 11, 1999.

[101] Paul Withington, *Impulse Radio Overview* Accessed on Time Domain's Corporate Website (Viewed November 14, 1999) at http://www.timedomain.com

[102] One of the earlier layman-friendly article that I have found describing the technology and its applications that I have found is: Kevey Maney, *Pulsing with Promise supra* at note --. There are many technical papers on the technology, but I believe they are for the most part out-of-reach of the typical non-scientist reader.

divided into, say, 100 specific lanes (TV broadcasting has a few lanes, cellular has a few lanes, PCS has a few lanes, the FAA has a few lanes, etc). Again, in an extremely simplified depiction, only one type of traffic is allowed to drive down any given lane, and any other non-authorized person entering the lane causes an immediate accident and disrupts the traffic traveling down that lane. Assume that the *accident* represents interference from another radio source, two radio waves crashing into each other, not unlike two vehicles crashing into each other.

UWB technology is unique in that is not constrained to any one, single lane. Instead, UWB covers the *entire* 100 lane highway. But, unlike other technologies, UWB enters the highway in the form a nearly invisible vehicle that does not disrupt other traffic. UWB is said to be the same as "background noise", which already exists in the spectrum. UWB proponents suggest that UWB is nonetheless potentially much more efficient than legacy technologies, and therefore, there really is no need for "lanes" or allocations on the freeway.[103]

Although tests seem to prove UWB's viability, it is still arguably in the venture capital stage and neither capital markets nor consumers have yet had an opportunity to evaluate the products. The threats to UWB implementation are many. One possible threat to the implementation of this frequency is the notion that the radio frequency auctions have resulted in millions of dollars in licensing the spectrum,[104] and millions more in land acquisition, construction, and equipment costs for deploying the present cellular and PCS technology. As a reward for this investment each provider enjoys the operation of its services within the scope of

[103] *See Comments of Interval Research Corporation*, prepared by Interval Research Corporation and submitted as a Comment to the UWB NOI (submitted December 7, 1998).

[104] *See* discussion in section below for further details on the proposition of whether or not the licensing of spectrum could constitute a property right.

limited competition. Barriers to entry are high: with some exceptions, one can not enter the wireless market as a carrier without a license.[105]

Companies that have attempted to provide services using unlicensed spectrum have been swallowed up by the capital markets and most have declared bankruptcy. One of the most notable was Metricom Corporation, which spent billions developing infrastructure that operates in unlicensed bandwidth[106]. The company went bankrupt in 2001[107] after spending over $1.4 billion in capital and building networks in 17 U.S. markets.[108] and it's assets were purchased for pennies on the dollar by startup Aerie Networks.[109] Aerie has re-launched the service in Denver and in San Diego under Metricom's previous product name Ricochet.[110] The product is less than 200 Kbps and the author believes it is questionable if it will be able to compete with forthcoming overlay technologies (GPRS, EDGE) and non-overlay technologies such as AWS.

[105] One exception to this general rule that may be growing is the use of advanced spread-spectrum technologies and digital wireless packet switching within unlicensed spectrum, such as that used for garage door openers, cordless phones, and others. Metricom, Inc., is presently deploying a wireless internet network nationwide based on this technology: See Ricochet (Aerie Networks) Corporate Website at www.ricochet.com for a detailed explanation of the technology and the network footprint (accessed December 15, 2002).

[106] Unlicensed areas of 900 MHz band between the user modem and the pole top radio, and 2.4 GHz band between the radio and WAP.

[107] WALL STREET JOURNAL *Metricom Seeks Bankruptcy Court Protection* (July 3, 2001)

[108] WALL STREET JOURNAL, *Avid Fans Lament Passing of Pioneer Wireless Web Service Ricochet*. (Aug 15, 2001).

[109] Aerie paid $8.5 million for the assets from the bankrupt company. WALL STREET JOURNAL, *Metricom, Inc: Aerie Networks of Denver Will Buy Company's Assets*. (Nov 5. 2001).

[110] *See* Ricochet corporate website, supra at note --.

3.2 Concerns to UWB implementation

Southwestern Bell (SWB) filed what could be read as a "concern" to the implementation of UWB technologies.[111] One noteworthy comment is that that as of December, 1999 SWB was the *only private* (non-governmental or NGO) wireless telecommunications provider that the author could find who filed a concern to the implementation of UWB technologies (there were a total of 103 comments to the Notice of Inquiry).[112] See Annex 2 for a listing of all the responses to the initial Notice of Inquiry as well as a comment on the reasons for objection.

It is difficult to draw conclusions from the lack of direct opposition to the NOI in 1998 and 1999. It could be suggested that the strategy undertaken by the Ultra-wideband Working Group was extremely effective – i.e. couching the first application in terms of safety and radar applications rather than the paradigm-shifting possibilities of applying the technology to communications. Nextel Communications took a similar approach in obtaining their waiver. Nextel founder Morgan O'Brian obtained his license as a Specialized Mobile Radio license for use in taxis, dispatch services, etc. Once he received his license as an experimental application, he then turned the application into a consumer technology and made millions.[113]

Another possibility is that the growing power of the Southwestern Bell and the other Bell Operating Companies (BOCs), (who possess a pending capacity to provide Internet services), may find UWB to be a direct threat to what may be

[111] ET Docket No. 98-153, Jeanne Fischer and Bruce Beard, *Reply Comments of Southwestern Bell Wireless Inc*, (document undated, but stamped as "received" by the FCC on February 3, 1999).

[112] The complete list of comments to NOIs can be retrieved at www.fcc.gov. I believe that this quantity of filings (and particularly the lack of protesters) is key data in support of my thesis for an expedited review process, I have completed a cursory review of the filings and rated each as "supporting," "concerned," or "neutral" in the appendix. The discussion with respect to this data is in a subsequent section of this paper. Note, however, that as of the end of 1999 approximately 150 filings were present. After the close of the proceeding, another 1,800 filings have been submitted!

[113] Hazlett, *Wireless Craze*, *supra* at note --, at 65-67.

viewed as a natural monopoly.[114] Wireless technologies have not heretofore been seen as a major threat to household access, due to reasons of cost, speed, and spectrum efficiency. Another possibility is that the growing power of the Southwestern Bell and the other Bell Operating Companies (BOCs), (who possess a pending capacity to provide Internet services), may have a natural monopoly and may not be overly worried by alternate technologies.[115] Even as late as 1999 many commentators doubted that higher-priced broadband (cable or DSL) services may become a substitute for dial-up telephone service.[116]

Not surprisingly, Southwestern Bell attacks UWB from an interference angle. The contention of SWB, through their filing, is fairly simple: they believe that it may be possible, given the assumption that many thousands of UWB devices are operating at one time, to create enough noise so as to inhibit the operation of cellular and PCS devices: "Some UWB devices, if they are in operation near enough to a cellular or PCS phone, could raise the noise floor of the phone sufficiently to prevent call initiation."[117] SWB concedes that UWB operation in radar applications is unlikely to cause a problem because of the intermittent and relatively infrequent use of radar devices. A second contention is that UWB devices may interfere with the proper use of Global Positioning Systems ("GPS"), because like UWB, GPS systems operate in a very low threshold (even though they only use one lane).

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[114] See Steve Bickerstaff, *Shackles on the Giant: How the Federal Government Created Microsoft, Personal Computers, and the Internet*, TEXAS LAW REVIEW, November 1999 (78 Tex. L. Rev 1) (For the proposition that the BOCs, once they begin supplying internet services, are likely to be major contenders in the market: "[b]y virtue of their continued ownership and control of the local exchange network and their effective control over the provision of high-speed broadband access over that network, BOCs are in a position to be major providers of all aspects of Internet access and services.") (p. 75).

[115] *Id.*

[116] *Id.,* at 80.

[117] *Id.*, at 2.

In the previously-described superhighway example, the theoretically non-interfering UWB traffic may not disturb other users in respective lanes, but UWB may bother traffic in some other lanes where the traffic is licensed, but in the case of GPS, some systems may not be totally immune, or immunizable to UWB interference. Radio astronomy, for example, requires extremely sensitive devices to obtain radio information from very far away, and radio astronomy devices are even susceptible to low-power devices regulated under FCC Part 15.[118] [119] Consequently, as with the development and deployment of any new technology, a "Learned Hand" type analysis may be useful in determining if any given technological gain will outweigh the harm that it causes.[120]

The Federal Aviation Administration ("FAA") opposes the use of UWB technology because it will, by definition (i.e. by technological requirement), also penetrate the restricted radio bands used for aeronautical navigation. This conflict set off some disagreements between the FAA and the FCC.[121] The irony is that one of the principal functions of UWB technology that is being touted at this time is the dramatic improvement in radar – a direct benefit to aviation. Radar essentially functions by timing the speed radio waves bounce off objects, and current radar technology sends it's measuring pulses at a relatively great distance apart from one another, making it difficult to get a clear resolution on the object. This is why

[118] *See* Siri Carpenter, *Lost Space: Rising Din Threatens Radio Astronomy*, SCIENCE NEWS, September 11, 1999. (Noting that the overall increase of radio devices tends to interfere with advanced radio astronomy research; "Virtually any strong source of radio waves can cause interference if its signals stray too near the frequencies at which scientists are observing. Even the transmissions from an ordinary cordless telephone, if used close to a radio telescope, would be strong enough to throw off the instrument." (p. 168).

[119] FCC Part 15 is the applicable section for unlicensed radio devices like garage door openers and cordless phones. FCC Part 15 and it's sister sections, Parts 2 and 68 are discussed below in a separate section in this paper.

[120] Judge Learned Hand, a well-know concluded in *U.S. v. Carroll Towing* that negligence was to be found only if the burden (cost) of precautions was less than the probability of the accident multiplied by the gravity (cost) of the accident.

[121] *See* William B. Scott, *UWB Industry Fate May Hinge on Review*, AVIATION WEEK & SPACE TECHNOLOGY, December 14, 1998.

sometimes it is said that a military boat can mistake a whale for a submarine; or a large flock of birds can appear as an airplane on conventional radar. With UWB technology the pulses are very, very close to each other, allowing much more detailed images.[122] What the FAA is concerned with, however, is the possibility that many UWB devices may "aggregate" and disrupt existing technologies (particularly GPS), and in the FAA's view, this detriment may outweigh the benefits that UWB would bring. In all other respects, UWB technology could not only be a complete substitute for existing radar (it is usable at the same distances, but with much greater accuracy), but is also transferable to other aviation uses.[123]

A comprehensive and detailed study submitted by the Interval Research Corporation ("Interval") [124] looked specifically at the possibility of "noise aggregation," perhaps even answering directly the questions posed by SWB and the FAA (neither SWB nor the FAA completed their own studies, they only raised abstract concerns.) With respect to the FAA concern, Interval stated that their studies "indicate that substantial background noise build-up does not, and will not, occur as a result of the operation of a substantial number of UWB devices."[125]

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[122] *See* James McWilliams, *City Man's Radar Technology Sweeping Innovation,* THE HUNTSVILLE TIMES, October 21, 1999. (N.B. – this and many other articles can be found on Time Domain's corporate website, at www.timedomain.com)

[123] *See Response Filed by the Department of Aeroonautics and Astronautics*, filed September 7, 1999. The Dept. of Aeronautics and Astronautics is actually an academic department at Stanford that develops advanced GPS and other systems. Stanford recognizes the advances to technology and its benefits over existing radar applications, yet filed a protest because of concerns with interference of existing GPS technologies. In Stanford's final filing (Sept 7, 1999), the department withdrew its protest, but "urge[s] the Office of Engineering and Technology and the National Telecommunications and Information Administratio to complete a comprehensive evaluation of interference from all sources to GPS before any increases in the number of UWB systems [2,500 were authorized under the present waiver] over those permitted … are contemplated." (p. 1).

[124] Interval Research Corporation is a research laboratory founded by Paul Allen and David E. Liddle. In submitting their report, Interval assembled a team of ten (10) experts who studied UWB technology for a period of several months. Interval developed several algorithms and data samples that were referenced by other organizations that filed replies.

[125] Docket No. 98-153; Rivera, et al, *Comments of Interval Research Corporation*, In the Matter of Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, December 7, 1998.

Furthermore, Interval suggests that if there were any interference, that the interference from aggregation may be eliminated by adjusting the attenuation of the antenna or by installing a filter (much as present devices already do to filter out background noise).[126] What this means in lay terms is that there is little possibility for UWB signals to aggregate to the extent that they will ever bother anyone else. Although in reality, this can not really be tested until the devices are manufactured and operated in some quantity. It has been shown in other technologies that even seemingly harmless applications – like email – have been known to overload networks once email became a widespread communication medium. But there is a possibility that even if UWB would bother other vehicles, the risk could be eliminated simply by installing filters, (sort of electronic "mud flaps") that would deflect the signals from disturbing the other traffic. To control email, servers often set size limits requiring users to delete old messages before new ones are allowed in.

A Time Domain study indicated that if 2,500 UWB radios were in one place operating at the same time within one mile of a GPS system (a likely unrealistic and extreme condition), the total combined power would only be 125 milliwats, which corresponds to approximately 25% of the energy emitted from a single cellular telephone.[127] An untested question with respect to the attenuation capacities of interference to other devices still remains untested in practice, however.

A Reply filed by Arthur D Little, Inc. ("ADL") reached a similar conclusion as the Interval reply, but ADL chose in one section to look at UWB in a non-communications application.[128] Many automotive and research corporations are developing anti-collision technology for automobiles. ADL suggested that vehicle

[126] Id., P. 9, also citing Exhibit 3, W.C. Lynch et al, *An Analysis of Noise Aggregation from Multiple Distributed RF Emitters,* IRC #1998-069.

[127] William B. Scott, *UWB Industry Fate May Hinge on Review*, *supra* at note --.

[128] Docket 98-153, Hugh Burchett *et al, Comments from Arthur D Little, Inc*, In the Matter of: Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, December 10, 1998.

collision systems could conceivably be introduced by the year 2006 (although vehicle reversing aids could be introduced as soon as 2003).[129] If these devices use UWB technology, as anticipated, theoretically all vehicles put to market after a certain date would be constant broadcasters of UWB signals. The ADL Comment was vague in its findings (i.e. ADL did not state in as strong terms that there would likely be no interference), although ADL cited the Interval research report as well as other reports that come to that conclusion.

3.3 The allocation of UWB spectrum through the Part 15 "back door"

Because of the time and money spent on developing an incumbent network, existing wireless (and wireline carriers, like the BOCs as noted above) have an interest in maintaining the status quo. The existing wireless carriers not only own millions in equipment and product development, they may also "own" the spectrum itself, by virtue of a virtually guaranteed renewal, even if their licenses do not, on their face, permit ownership. Some authors have set forth a plausible argument that there may be grounds now to believe that spectrum is evolving toward a property right.[130] [131] Under a property rights theory, the property right holder (i.e. the licensee of the spectrum) has a right to be free from injurious interference and trespass.[132] This also includes the right to exclude others, and to trade and sell the property via a secondary market. The Supreme Court has already recognized that in certain

[129] *Id*., p. 13.

[130] Pablo T. Spiller and Carlo Cardilli, *Towards A Property Rights Approach to Communications Spectrum.* YALE JOURNAL ON REGULATION, Winter, 1999 (16 Yale J. on Reg. 53) (The authors clarify that the notion of property rights associated with spectrum is not a new one, but that it may becoming a closer reality due to the costs associated with their acquisition).

[131] On the other side of this argument is the notion that even if spectrum evolves to a property right, that it's highest and best use could be easily transferred to the entity that is willing to pay the most for it. Indeed, one of the fundamental notions of property law is that real property can and should be transferable among parties at any time according to it's highest and best use, and to the highest bidder.

[132] Spiller & Cardilli, *supra* note --, at. 72.

circumstances exclusive spectrum assignments are legally enforceable rights.[133] Two issues worth considering in this context are:

(1) Does the right of exclusion, if it applies to spectrum, also apply to an underlying spectrum (like UWB) that does not interfere in any way with the physical use and enjoyment of the property right?

(2) What property rights, if any does "radio noise" (i.e. UWB emission) enjoy? Can a radiator in "spectrum noise" obtain easement agreements with spectrum holders? Or has spectrum noise been around substantially long enough to be considered to hold an easement by prescription?

Some commentators take the view that the FCC has an innate raison d'être and that the institution continues to thrive, as "increased demand for spectrum has increased its political value, enhancing the incentives of regulators to maintain the command-and-control system in order to use spectrum to maximize political support."[134] [135] All licenses theoretically expire and it is up to the FCC's discretion to renew them.[136] The Courts have granted the FCC quite a bit of latitude in its decision-making capacity. Although it would be unlikely that the FCC would act in a manner inconsistent with public interest, under the WAIT Radio test, the FCC could probably enjoy freedom to discretionarily choose not to renew a given license, unless their decision is arbitrary and capricious.[137] The FCC's authority with respect

[133] FCC v. National Broadcasting Commission (KOA),319 U.S. 239 (1943).

[134] Spiller & Cardilli, *supra* note --, at. 54.

[135] I do not intend to take a cynical view of the FCC and insinuate that it's drive for self-preservation would outweigh it's mandate to operate in the public interest. I only intend to point out that the management of spectrum and other radio frequency "real estate" has dominated much of the FCC's agenda since its' inception, and this aspect is unlikely to go away within the near future.

[136] Spiller & Cardilli, *supra* note --, at. 82.

[137] WAIT Radio v. FCC, 459 F.2d 1203 (Applicant for waiver of a concededly valid FCC rule faces a high hurdle at the starting gate, but on appeal it faces an even more difficult problem since it must

to licenses is particularly important when looking at spectrum as a property right, because if they are granted property right status, the government presumably could not confiscate them and re-allocate spectrum for other uses. Indeed, the courts have held that FCC licenses are subject to suspension, modification or revocation in the public interest to the detriment of any property rights.[138] To hold otherwise may present a conflict to the FCC's obligation to promote the development of new technologies, an objective that would be severely limited under a spectrum-as-property regime.

3.4 The Courts as Regulator

Spectrum allocation is a task which is carried out by the FCC, however it is subject to the checks-and-balances of the court system. Spectrum allocation policies are also subject to trends in market valuations and to commercial laws and the bankruptcy code. Two cases, *GWI*[139] (the company is now known as Metro PCS) and *NextWave*[140] provide examples of how conflicting laws can delay the release of spectrum into the market. At stake is the fundamental question of whether the FCC is a licensor, a creditor, or both. In reviewing these cases, the reader is asked to take note of the dates provided in the titles so that he may make his own conclusions as to the efficiency of this process. There may also be conclusions that can be drawn from the similar financial difficulties that European 3G licensees are presently

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show that the commission's reasons for declining to grant the waiver were so insubstantial as to render that denial an abuse of discretion.)

[138] FCC v. Sanders Brothers Radio Station, 309 U.S. 470 (1940). Also see William Fishman, *Property Rights, Reliance, and Retroactivity under the Communications Act of 1934*, 50 FED. COMM. L.J. 1 (1997), citing Yankee Network, Inc. v. FCC,: " … after acknowledging that the Communications Act specifically precludes application of the concept of common law rights to licenses, the court observed that 'the Act does definitely recognize the rights of license holders in express terms no less than seven times' … the court added … '[i]t is equally apparent that the granting of a license by the commission creates a highly valuable property right, which, while limited in character, nevertheless provides the basis upon which large investments of capital are made and large commercial enterprises are conducted." 309 U.S. 470 (1940).

[139] FCC v. General Wireless, Inc., 230 F.3d 788 (5th Cir. 2000).

[140] In Re NextWave, 200 F.3d 43 (C.A.D.C. 2001).

experiencing (although these conclusions will not be dealt with in this Working Paper)..

3.4.1 The "C Block" Licensing Fiasco (1995-1996)

In two legal proceedings in the U.S., license winners NextWave Communications ("NextWave") and General Wireless Inc. (GWI), were small communications companies that had purchased "C-Block" licenses in 1995-1996 from the FCC at public auction. NextWave had bid $4.74 billion for their licenses, the largest C Block winner. GWI had bid about $1 billion for theirs. In both cases the market value of the licenses declined dramatically after the bid during a 1995-1997 telecommunications market dip.[141] When the companies were unable to secure financing to repay their debts, they filed for Chapter 11 bankruptcy.

The outcome of these two cases demonstrated a divergence between the U.S. Second and Fifth Circuits. [142] In particular, the courts demonstrated two very different approaches of deference to the FCC as a licensor.[143] The Second Circuit granted extreme deference to the FCC licensing procedure (which was reversed by the Appeals), although the Fifth Circuit granted no deference to the FCC by dismissing their case. The U.S. anxiously awaits the outcome of the Second Circuit Court of Appeals case from the Supreme Court.[144] Regardless of the outcome, both cases raise important questions concerning the authority of government agencies,

[141] Scott Ritter, *Business Brief: FCC Says Many Wireless Bidders, Short of Cash, to Return Licenses*, WALL STREET JOURNAL, June 18, 1998, at B12.

[142] 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). (The author describes a *three-way split*, including the D.C. Circuit view. The author describes the views as follows. (i) Second Circuit view: "The Bankruptcy and District Courts do not have jurisdiction over the FCC's regulatory action" (ii) the D.C. Circuit view: "The FCC is subject to the D.C. Circuit's Jurisdiction, and the FCC's regulatory power is limited to the bankruptcy code"; and (iii) the Fifth Circuit view: "The Bankruptcy and District Courts have jurisdiction over the FCC." While these observations are entirely accurate, in this article I will focus on the divergences described in (i) and (iii).)

[143] Steven Lipin, *Two Opposite Court Rulings Raise Questions About FCC's Next Move on NextWave Licenses*, WALL STREET JOURNAL, November 2, 2000, at C17.

[144] Oral arguments were presented on October 22, 2002 and the decision is pending.

particularly when the Bankruptcy Code is implicated. The implication of bankruptcy law also has significant ramifications on the future of "propertization" of spectrum in the U.S.

3.4.2 GWI: the Fifth Circuit holds for the Licensee (1996 – 2001)

The GWI[145] decision by the United States Court of Appeals for the Fifth Circuit affirmed the lower district court's judgment regarding the GWI Chapter 11 reorganization plan.[146] The company's reorganization plan included an order allowing the GWI to retain the radio spectrum licenses they had purchased at the auction at a significant discount. The order permitted the GWIs to avoid approximately $894 million of the debtors' $954 million obligation to the FCC for the purchase of the licenses.

The Fifth Circuit observed that the bankruptcy court may have erred in permitting avoidance of the payment obligations and enjoining the FCC from revoking the licenses, thereby "taking onto itself a quasi-regulatory function held by the FCC." The Fifth Circuit stated, however, that since the FCC did not contend that the bankruptcy court lacked jurisdiction to enter the orders, that GWI's reorganization plan was nearly complete, and that the FCC's appeal was "equitably moot."[147] This resulted in the authorization to the GWI to retain the licenses and avoid $894 million of their obligation to the FCC. The FCC attempted to appeal the case to the U.S. Supreme Court, however in July, 2001 the Supreme Court refused to

[145] Note that GWI is now known as Metro PCS

[146] In re GWI, 230 F.3d 788.

[147] David A. Montoya, *The FCC v. Powers of the Bankruptcy Courts -- A Closer Look at NextWave and the Other C-Block Cases*, AMERICAN BANKRUPTCY INSTITUTE JOURNAL, April, 2001, at 14. (Discussing both the NextWave and GWI cases, and noting that the 5th Circuit's test of whether a reorganization plan is moot: (1) whether a stay has been obtained; (2) whether the plan has been substantially consummated, and (3) whether the relief requested would affect either the rights of the parties not before the court.)

hear the case, letting the Bankruptcy Court decision stand. This resulted in GWI having to pay only about 20% of its full debt to the FCC. [148]

3.4.3 The NextWave Decisions (1996 to Present)

The NextWave decisions are complicated and involve in-depth discussions of U.S. bankruptcy code. In order to understand the NextWave decisions, a simplified presentation of bankruptcy law is in order, particularly for the European readers. The purpose of this section will be to present a simplified view of bankruptcy code and to discuss relevant aspects of the decisions at the various instances. In the spirit of simplification, although I will not cite each case as the relevance for telecommunication policy may be lost with an overly detailed description.[149]

In the U.S., Chapter 11 bankruptcy is known as "reorganization" or "restructuring" bankruptcy. The intent is to allow the business to put a freeze (known as a "tolling") on all debt payments while it negotiates with its creditors on a reorganization of their business. During this period, the Bankruptcy Court grants what is known as an "automatic stay" under § 362.[150] During the automatic stay assets of the company in question may not be repossessed, liquidated or resold without the consent of the Bankruptcy Court.

If, during the reorganization process, it turns out that creditors are not willing to negotiate with the debtor, the Bankruptcy Court may either (a) "cram down," (force) a plan upon the creditors, or (b) the Court may force liquidation of the

[148] Yochai J. Dreazen, *High Court Deals Blow to FCC Side in Spectrum Cases*, WALL STREET JOURNAL, July 2, 2001, at B9.

[149] *See* In re NextWave, 235 B.R. 263 (Bankr. S.D.N.Y. 1998); In re NextWave, 235 B.R. 277 (Bankr. S.D.N.Y 1999); In re NextWave, 235 B.R. 305 (Bankr. S.D.N.Y. 1999); In re NextWave, 235 B.R. 314 (Bankr. S.D.N.Y. 1999).

[150] 11 U.S.C. Section 362 (a)(3) will provide "stay" to "any act to obtain possession of property of [an] estate . . . or to exercise control over property of the estate," but Subsection 362(b)(4) provides an exception to 362 (a)(3) for "governmental unit[s]" acting to "enforce" their "regulatory power." In Re NextWave, 200 F.3d 43 (C.A.D.C. 2001). (The court held that the regulatory power exception did not apply in this case.)

company's assets. Generally, the company is able to arise from bankruptcy and retain the core assets and real estate that it owns, if it can show that the assets and real estate are required for it to operate as an ongoing concern. For NextWave, the licenses were clearly the single most important core asset to the ongoing operation of the company.

3.4.4 The Bankruptcy Court Decisions (1998-1999)

Under § 548 of the Bankruptcy Code, a debtor in possession of property may avoid payment of, or obtain a reduction for payments on that property if: (a) the property was acquired within one year of the commencement of bankruptcy; and (b) the debtor received less than reasonably equivalent value for the transfer and the debtor was at the time, or (c) the debtor subsequently became insolvent as a result of the purchase. During the automatic stay period, NextWave stopped making payments to the FCC. In reviewing NextWave's assets under § 548, the Bankruptcy Court determined that the NextWave bid exceeded fair market value by a total of $3.72 billion. The Bankruptcy Court determined that the retention value of the licenses, therefore, was $1.02 billion, i.e. about 25% of NextWave's original bid.

3.4.5 The Second Circuit Appeal of the Bankruptcy Decisions (1999)

The FCC then appealed the case from the Bankruptcy Court to the Second Circuit, where, this time, the FCC won, holding that the FCC was not a creditor, but instead a licensor. The Second Circuit held that (i) the FCC made a ruling to recover the licenses, and that ruling was fully within it's regulatory authority; (ii) that the Bankruptcy Court had interfered with the FCC's regulatory purpose by reducing the bid price; (iii) that the Bankruptcy Court had exceeded it's own jurisdiction and had unlawfully carried out a regulatory rather than a bankruptcy function. The Second Circuit reversed the Bankruptcy Court's decision citing unfairness to auctions if values of licenses are later reduced by a Bankruptcy Court determination.

Based on the Second Circuit's reversal, and coinciding with better investor timing,[151] NextWave then found investors to support the original $4,74 billion fee. NextWave then offered to pay the FCC the remaining $4,3 billion outstanding for the license.

3.4.6 The FCC makes a bold move (1999-2000)

Surprisingly, the FCC *rejected* NextWave's offer to pay the remaining $4,3 billion, claiming that NextWave had already lost their license. The FCC then called for a re-auction of the licenses, believing that the present market situation could bring much more than the original $4,74 billion.[152] However, NextWave petitioned the FCC to reconsider its cancellation of its licenses. The FCC refused the petition, and NextWave then petitioned for review by the Court of Appeals in the District of Columbia. In the meantime, the FCC was right about the change in market conditions: the re-auction of the NextWave licenses were sold by the FCC for almost $16 billion.[153]

3.4.7 The D.C. Court of Appeals Decision (2001)

The DC Circuit ruled that the Second Circuit had not addressed NextWave's bankruptcy claims and that NextWave was entitled to a review. It also wrote in its opinion that the FCC is prevented from canceling the spectrum licenses by § 525 of the Bankruptcy Code. The Court of Appeals said that the FCC "violated the provision of the Bankruptcy Code that prohibits governmental entities from revoking debtors' licenses solely for failure to pay debts dischargeable in bankruptcy. The Commission, having chosen to create standard debt obligations as part of its

[151] It is noteworthy to keep in mind the time context here. This was towards the end of 1999 and early 2000, when 3G licenses were being sold in Europe for several billion dollars. Based on the European numbers, the NextWave license fees seemed extremely cheap, and NextWave had no problem finding investors for their operation.

[152] Steven Lipin, *FCC Move in Bankruptcy Case Sparks Ire*, WALL STREET JOURNAL, April 10, 2000, at C1.

[153] Yochai J. Dreazen, *FCC Ends Obligations from NextWave Auction*, WALL STREET JOURNAL, November 15, 2002, at B2.

licensing scheme, is bound by the usual rules governing the treatment of such obligations in bankruptcy."[154] The D.C. Court of Appeals created a third split among U.S. Federal courts.

3.4.8 The FCC pays for its mistake (2001-2002)

By the time that the Court of Appeals made it's ruling, the FCC had already completed the re-auctioning procedure, raising $16 billion in commitments from companies like Verizon, who bid for $8 billion in licenses.[155] The auctions required that the winning bidders pay deposits for their licenses – amounting to nearly $3 billion -- and the FCC retained those deposits even though the case was overturned by the Court of Appeals. In March 2002 the FCC agreed to return 85% of the money,[156] but held on to the rest until late 2002. [157] In the meantime, consumers were harmed because the NextWave network's deployment continued to be delayed.

3.4.9 The Supreme Court grants review (2002-2003). Possible ramifications?

The United States Supreme Court granted review of the D.C. Court of Appeals decision. The question that the Supreme Court will review is whether § 525 of the Bankruptcy Code conflicts with and displaces the FCC's rules for congressionally authorized spectrum auctions, which provide that wireless telecommunications licenses obtained at auction automatically cancel upon the winning bidder's failure to make timely payments to fulfill its winning bid.

If the D.C. Court of Appeals decision stands, i.e. if the Supreme Court holds that bankruptcy law prevents the Commission from canceling licenses based on

[154] NextWave Personal Communications Inc. v. FCC, 254 F.3d 130 (D.C. Cir. 2001).

[155] Yochai J. Dreazen & Jesse Drucker, *FCC to Ease Spectrum - Auction Snarl*, WALL STREET JOURNAL, September 12, 2003, at A3.

[156] Kathy Chen, *FCC to Return 85% of Deposits in Wireless Sale*, WALL STREET JOURNAL, March 28, 2002, at A3.

[157] Yochai J. Dreazen, *FCC Ends Obligations from NextWave Auction*, WALL STREET JOURNAL, November 15, 2002, at B2.

failure to make payments, fundamental aspects of the Commission's auction process may be put to question. One of these is the Commission's ability to offer payment plans and act as a creditor. Most importantly, however, it could strengthen the argument that license holders have property rights. If licenses are allowed by the Supreme Court to be retained along with other assets and real property, this would be a major "win" towards other aspects of property rights, which may soon include the right to mortgage, sublease, subdivide, trade and grant easements. If the Supreme Court upholds the Court of Appeals decision, it will of course take time for these rights to be granted to spectrum. In a more realistic scenario, is likely that property rights will also require legislation and other measures for them to be perfected.

Since the oral arguments to the case have been made (Oct 22, 2002), it is not useful to make predictions as to the Supreme Court outcome; we will know within the coming months. In the meantime, as stated, it is the U.S. consumers who have been harmed, because over the six years that the process has taken, the network has not been properly deployed. The markets went from a boom (1995) to bust (1997) to boom (1999) to bust (2002) and the FCC has not shown a capacity to encourage deployment during this natural economic process. As one commentator explains, "[t]he FCC has demonstrated that it may create economic inefficiencies when it is given power over bankruptcy proceedings. It is quite possible that if uncertainty about the scope of the FCC's regulatory power in bankruptcy continues, the FCC would repeat its previous distributionally inefficient behavior."[158] So far, the result for consumers and government has been lose-lose..

3.5 The FCC's commitment to speedy review. And to education.

The Communications Act of 1934, as amended by the Communications Act of 1996 contains sections that encourage the deployment of new technologies and services. These statutes are relevant to this paper in three primary areas: (i) the statutory requirement to promote the development of new technologies would likely

[158] Patterson, *The Nature and Scope ...*, *supra* note --.

trump any common law claim that radio spectrum should be treated as a property right; (ii) the statutory requirements to promote new technologies also contains clear guidelines to encourage the deployment of the technologies in a reasonable time frame; and (iii) any new technology that can be seen as assisting elementary and secondary schools and classrooms shall receive priority treatment by the FCC.[159]

Section 7 of the Communications Act of 1934, as amended, provides as follows:

> Section 7 [47 USC Section 157]. New Technologies and Services
>
> (a) It shall be the policy of the United States to encourage the provision of new technologies and services to the public. Any person or party (other than the Commission) who opposes a new technology or service proposed to be permitted under this Act shall have the burden to demonstrate that such proposal is inconsistent with the public interest.
>
> (b) The Commission shall determine whether any new technology or
> service proposed in a petition or application is in the public interest within one year after such petition or application is filed. If the Commission initiates its own proceeding for a new technology or service, such proceeding shall be completed within 12 months after it is initiated.

[159] This very point was emphazised in Paul Allen's research group in one of the many supportive briefs filed by Interval research Corporation: "UWB technology has the potential to play a key role in our education system. Although universal schoolroom access to the Internet is one of our declared national goals, we are nowhere close to meeting this goal in part because most classrooms lack the wiring. In fact, most classrooms lack telephones or any device for communication among teachers, students and school administrators. Traditional solutions are proving too expensive. UWB technology can help to solve this problem with 'virtual wiring,' which would allow not just Internet access, but cordless phones throughout the school as well." *In the Matter of Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems,* Docket No. 98-153, Comments filed by Interval Research Corporation on December 7, 1998 (p. 5).

Pub.L. 104-104, Title VII, § 706, Feb. 8, 1996, 110 Stat. 153, provides that:

(a) In general.--The Commission and each State commission with regulatory jurisdiction over telecommunications services shall encourage the deployment on a reasonable and timely basis of advanced telecommunications capability to all Americans (including, in particular, elementary and secondary schools and classrooms) by utilizing, in a manner consistent with the public interest, convenience, and necessity, price cap regulation, regulatory forbearance, measures that promote competition in the local telecommunications market, or other regulating methods that remove barriers to infrastructure investment.

(b) Inquiry.--The Commission shall, within 30 months after the date of enactment of this Act [Feb. 8, 1996], and regularly thereafter, initiate a notice of inquiry concerning the availability of advanced telecommunications capability to all Americans (including, in particular, elementary and secondary schools and classrooms) and shall complete the inquiry within 180 days after its initiation. In the inquiry, the Commission shall determine whether advanced telecommunications capability is being deployed to all Americans in a reasonable and timely fashion. If the Commission's determination is negative, it shall take immediate action to accelerate deployment of such capability by removing barriers to infrastructure investment and by promoting competition in the telecommunications market.

3.5.1 The Act in the Context of "Propertization"

Licensed carriers paid rights to obtain the frequency under the auspices of a license agreement. The major differences between a "lease" and a "license" are that

a lease confers exclusive possession against the world and owner, and unless otherwise provided, grants exclusive possession and profits and grants a corporeal hereditament or an estate in land. A license, on the other hand, merely grants permission to use the land under certain conditions and restrictions and are theoretically revocable at any time.[160] Yet as licensees, the holders of cellular or PCS licenses are entitled to the protection of the Constitution, including due process and equal protection rights.[161] The holders of the licenses may also have a claim based on reliance theory.[162] These rights and claims also extend to third parties who may infringe on these rights: the FCC, in its policing function, can levy heavy fines to users of devices that intrude into the frequency spectrum of a licensed operator.

The "propertization" of spectrum has been the subject of much discussion lately, including an excellent symposium held by the University of Chicago Journal of Law and Economics.[163] Propertization is most commonly discussed in terms of the rights that propertization grant to the owner – rights to trade, subdivide, sublease, keep others out. Spectrum as "property" is not unlike a plot of land with a building: those who enter without authorization are trespassers. In Europe, Professor Martin Cave endorses granting of property rights to spectrum as a "management tool" so that government mechanisms may be put in place to encourage the highest and best use of the spectrum.[164]

For purposes of this section, we will consider the other side of the argument: what rights may be granted to the *public* if other users hold a property right.

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[160] Lee v. North Dakota Park Service, 262 N.W. 2d 467 (N.D. 1977)

[161] William Fishman, *Property Rights, Reliance, and Retroactivity under the Communications Act of 1934*, 50 FED. COMM. L.J. 1 (1997).

[162] *Ibid*.

[163] *See The Law and Economics of Property Rights to Radio Spectrum*, 41 JOURNAL OF LAW & ECONOMICS 521 (Oct. 1998).

[164] See Professor Martin Cave's study, *UK Radio Spectrum Management Review*, available at: : www.spectrumreview.radio.gov.uk

Couching the argument from this perspective – and in light of the FCC mandate to promote education per Pub.L. 104-104, Title VII, § 706 – is perhaps a wild idea. It is nonetheless an idea well worth exploring in the context of this working paper. This exploration will be made at this stage based on general property right principles and will perhaps be developed at a later date with more complete citations to back up these principles. Regardless, the reader should not have difficulty accepting the property right principles and doctrines asserted in this section.

Under traditional views of property law, it has been determined that there are certain limits of property rights. An owner can claim exclusive command and control of his property below the ground only to certain depths, and into the air only to certain altitudes. Property owners can do very little to dissuade activities that take place below or above the protected right. Indeed, it is the public interest which is used as a basis for this. Airplanes are in the public interest. Wires connecting telephone and cable systems, as well as power lines which hang over one's property are the public interest. Underground sewers are in the public interest. UWB could operate in a much less intrusive manner than these examples; indeed regulations could be promoted that prohibit UWB operators from disturbing landowners. It is impossible to do so with the other aforementioned examples: a sewage pipe may be buried, but it is still present and restricts construction on top of it. The fact that airplanes fly over property prevents landowners near the airport from erecting structures which penetrate protected airspace.

To extend the property analysis further, let's assume that it could be determined, perhaps by legislation or by common law doctrine, that a UWB "trespasser" over a swath of protected (licensed) spectrum were determined to be out of the scope of the property right. Again, on the airplane example, aircraft which fly over an owner's property and -- aside from noise and nuisance -- generally do not disturb the owner's use and enjoyment of his property. And if the airport authority repeatedly creates disturbance through noise and nuisance, remedies are available to reduce it: complaints to the competent authority, requiring minimum noise standards

and requiring quieter jet engines. Likewise, in the UWB context, filters could be required and "smart antennas" that avoid interference could be mandated.

Sure, allowing UWB to penetrate other license-holder's "property" may cause a diminution of value of the license. Perhaps the property owner could exert a claim similar to a right to compensation based on condemnation. But the case is unusual in this hypothetical, since the diminution in value would not be caused because of interference, or because of a reduction of available property to the landowner, but because of the greater competition that new technology would create. Additional testing may show that UWB may in fact behave as a non-intrusive "easement." UWB may therefore be found to use property that is not within the rights of the property holder, in a similar way that such as the sky a certain distance above the ground is not deemed to be part of the property owner's dominion. Indeed, UWB may use and enjoy property that is not normally seen as useful to the property owner, such as the air space above property currently visited periodically by airplanes, birds, and at a very high distance satellites. Similarly, in the other direction, a city-owned underground piping system can be easily built around because it brings greater benefit than harm. Underground streams are generally not problematic. At the far deep end of the earth's core, the ground is virtually useless to the property owner. Helas, real property and property rights are granted to the property owner only within finite distances above and below ground level, they do not extend to the core, nor do they extend to the heavens.

3.5.2 Relating propertization to Pub.L. 104-104, Title VII, § 706

As stated earlier, the FCC has a mandate by Congress under Pub.L. 104-104, Title VII, § 706 to promulgate the highest and best use of technology. If it can be proved that UWB can operate within spectrum in a non-intrusive manner, then the existing spectrum licensees should have the burden to prove actual harm. Economic harm resulting from loss in market share would probably not be sufficient, because the harm would have to result from invasion or interference in the spectrum itself; if

there is no true "invasion," i.e. the UWB pulses are present but not "invasive" or harmful, than the use of the property is not adversely affected.

As stated above, UWB has the potential to be a very inexpensive – quite possibly one of the least expensive and most efficient wireless technologies available on the market. Given the Congressional directive to promulgate new, inexpensive technologies in primary and secondary education, it would not be a stretch to use this mandate as a mechanism for granting easements across other licensees, to the extent that they do not disturb the license (or property) holders. Perhaps at an initial level the easements could be granted so long as UWB is used for educational purposes, like a "test run." Then, given a reasonable time to evaluate the harm, it could be extended to other consumer uses.

3.5.3 The obligation to approve technologies within a reasonable time frame

The Commission has an obligation under Section 7, to conclude a proceeding with respect to a new technology within twelve (12) months of initiation. It is unclear, however, when a proceeding is undertaken pursuant to Section 7 or not. The Notice of Inquiry for Ultra-wideband does not appear to cite Section 7, raising the question as to whether the Commission is bound to comply with the requirements of Section 7 time frames. The UWB waivers were in fact granted within 12 months, although the Notice of Proposed Rulemaking was not concluded until February 2002, well beyond the 12 month time frame. Does this constitute a violation of Section 7? Some of the applicants seem to think so.[165]

I have not found any case law, however, challenging the FCC's review time frame. Consequently, it is unclear as to what the remedy would be for an applicant that experiences an FCC review extending beyond twelve months. Would it be

[165] *See Comments of Interval Research Corporation*, Reply to NOI docket 98-153 (submitted Dec 7. 1998), p. 15 (referring to the FCC's obligations under Section 7). Also see Comment filed by Time Domain Corporation on Oct 28, 1999 (noting that Time Domain Corporation met with Commissioner Kennard and handed the Commissioner two published newspaper articles suggesting that the Commission was dragging its feet).

automatic approval of the application? Probably not, yet thus far the matter is untested.

3.5.4 The preference to primary and secondary education

A study conducted by the national Science Foundation Wireless Field Test Projects concluded that there are three bandwidth-cost problems of connectivity: (i) from the closest point of presence (POP) to the school building; (ii) between the various schools within a single district; and (iii) within the classrooms of a particular school building.[166] The study concluded that wireless is the cheapest, most effective way to attend to these needs. Specifically, the recommendation of the UWB technology as a low-cost wireless solution to schools that will facilitate their connection to the internet and wireless connection to each other. Not only did the report endorse UWB as a preferred way of transmission,[167] it also encouraged a significantly broader acceptance by the FCC of wideband technologies in furtherance of educational and universal service objectives.

[166] See David R. Hughes, *National science Foundation Wireless Field Test Project*, accessible at http://wireless.oldcolo.com/course/98153.txt. (p. 5).

[167] *Ibid,* at 1. Not only is the National Science Foundation directly supportive of UWB technology in the present application by Time Domain, the NSF also goes as far as to suggest that the FCC substantially modify Part 15 to allow for additional uses in the future of UWB and other wideband technologies as a preferred means to achieve legislative objectives citing that UWB may assist in "[u]niversal service access to advanced telecommunications and information services for all public schools, health services, and libraries, urban and rural. … [and the] Ability of local Internet Service Providers (ISPs) to better and more cheaply deliver 'last mile' telecommunication services without tying up Common Carrier switches originally designed and priced to carry only voice traffic in infrequent, short duration, telephone calls. … [and] spread spectrum radios operating under Part 15 Rules [such as UWB], modified to permit operations at lower frequencies than those currently authorized, and wider bands than now permitted, and, in at least rural areas, at greater power, can meet those expressed public goals."

Section IV: One part sugar, two parts milk, three Parts 15.

4.1 FCC Part 2, Part 68 and Part 15

The three companies that applied to the FCC for approval of UWB technology did so under the auspices of a waiver application to Part 15.[168] Unfortunately, there appears to be very little available academic literature on the regulatory process associated with Part 15, so I have decided to include an introduction and discussion here. FCC Part 15 regulates devices that operate in unlicensed frequencies below a certain power threshold. FCC Part 15 also includes certain spectrum areas that are "prohibited" from *any* broadcast, such as the FAA frequencies and others used by the Government for military or safety applications. Because UWB technology penetrates *all* spectrums, it required a waiver from the FCC for use in these spectrum blocks. Again, because of the super-low power of UWB devices, it is not anticipated that the UWB products will interfere: there is already radio "noise" in these (and all) parts of the spectrum, and UWB will simply be part of the low-power, non-interfering "noise" that already penetrates throughout the spectrum.[169]

For approval of an FCC device, Part 2 and Part 15 are intimately related. FCC Part 2[170] is a massive collection of technical data spawning more than 250 pages, and covers the international regulations, nomenclature and assignment of frequencies, and the complete table of frequency allocations. Any approval of a

[168] The three companies granted waivers were U.S. Radar, Inc. (for Ground Penetrating Radar), Time Domain Corporation (for devices using UWB time modulating technology), and to Zircon Corporation (for radar devices). See FCC Public Notice, Docket 99-1340, July 8, 1999 (the press release associated with the granting of the waivers); and http://www.fcc.gov/oet/waivers/ , *Letter from Dale Hatfield, Chief, Office of Engineering and Technology* dated June 15, 1999 (the accompanying letter from the National Telecommunications and Information Administration approving the specific waiver requests to the respective companies).

[169] See David Hughes, In *re Revision of Part 15 of the commissions Rules Regarding Ultra-Wideband Transmission Systems: Comments by the National Science Foundation Wireless Field Test Projects*., Document ET-153, also available online at http://www.wireless.oldcolo.com/course/98153.txt.

[170] 47 CFR Ch. 1 (10-1-98 Edition), Part 2 – Frequency Allocations and Radio Treaty Matters; General Rules and Regulations

device under any of the FCC parts by default must comply with the provisions of Part 2. This paper will deal with the case study of Ultra Wide Band (UWB) applications, which fall more specifically under Part 15; it is also the author's null hypothesis that the long-run[171] future of Part 2 is due for a complete rewrite, and possibly even completely replaced (i.e. the frequency allocation tables may no longer be nearly as necessary if a technology like UWB becomes tested and prevalent). Yet for now, any device under Part 15 must also comply under Part 2; as does any other device subject to FCC regulation.

FCC Part 68 regulates the connection of terminal equipment to the telephone network.[172] Again, any device that is regulated under Part 68 must also comply with the provisions of Part 15, such as the limits set for intentional and unintentional radiation (as defined below). Part 68 is important to keep in mind, even for future wireless applications, because any change in FCC regulation or policy is likely to have an effect on all the interrelated FCC compliance regulations simultaneously. Present day limited-wireless applications (such as cordless phones) are regulated under both Part 68 (for their connection to the network) and Part 15 (for their radiation limitations in the devices broadcasting capacity). The trend suggests that future technologies are likely to have a cumulative effect on the FCC regulations: where the regulators used to be able to categorize operations, technological advances are supplanting these categorizations and creating hybrid applications that no longer fit neatly within any single FCC provision.[173] Examples of these re-categorizations

[171] "Long Run" is defined here quite loosely to mean as long as it takes, given the cliché "internet speed" of technology changes, to render the frequency allocations as we know it relatively unimportant. UWB has the possibility to do this; but it may not be for another 50 years or more until the landscape truly changes.

[172] 47 CFR Ch. 1 (10-1-98 Edition), Part 68 – Connection of Terminal Equipment to the Telephone Network

[173] I have included in Appendix A a summary of relevant FCC regulations and typical devices that they cover. Devices such as wireless LANs, particularly for home use (such as connecting garage doors, coffee makers, alarm clocks all to a computer wirelessly) was surely not envisioned twenty years ago. Remember the opening 20 seconds to "The Jetsons?" New wireless devices offered in conjunction with advanced "imbedded systems" will make the automated wireless do-all a reality soon: i.e. press your key chain to start your car from a distance (a product that exists for a few years

include frequencies originally intended for UHF television were re-allocated and used for cellular, and frequencies originally intended for garage door openers are now used for cordless phones, wireless in-home LAN, car alarms, and electronic fences for dogs. Categorization is quickly losing its meaning, and future regulations will likely have to address purely technical criteria rather than application-specific criteria.

Consistent with the case study on Ultra Wide Band technology (and primarily for simplification purposes), this section will attempt to segment Part 15 and discuss relevant future measures on the regulation of devices regulated by Part 15. There are three categories of emissions that FCC Part 15[174] covers: unintentional radiators[175], intentional radiators, and incidental radiators that operate without a specific license. Part 15 does not cover any object or device that radiates RF energy pursuant to a valid FCC license (such as a cellular or PCS license), unless the RF energy emanating from the licensed device *also* emits frequencies that are not covered by the license. It is important to distinguish the role of Part 15 from other sections that grant licenses, such as experimental licensing.[176] The terms "intentional, unintentional, and incidental" are terms of art.

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now) call on the way home from work with your cellular, press 1 & 4 to activate the air conditioning (triggered by a wireless connection between the computer and the AC switch), check your emails, and the garage door will automatically open as you pull in, "sensing" that it is you from a wireless signal from your car to the device. There is just no way to predict all the scenarios in a regulatory scheme!

[174] 47 CFR Ch. 1 (10-1-98 Edition), Part 15 – Radio Frequency Devices

[175] In this paper the definition of "radiator" will be applied as used in SS 15.3(u) "Radio Frequency (RF) Energy. Electromagnetic energy at any frequency in the radio spectrum between 9 kHz and 3,000,000 MHz." This essentially covers the entire known radio spectrum. To be a "radiator," the RF energy must also pursuant to SS 15.3 (o), "… generate and emit radio frequency energy by radiation or induction."

[176] Any frequency allocated to non-Government or Government use in the Table of Frequency Allocations may be assigned under the Experimental Radio Service, except frequencies exclusively allocated to the passive services. This Table is found in Section 2.106 of the Commission's rules. However, an application to operate on frequencies allocated primarily to Government use (unless the experiment is to fulfill a contract with the US government) or for safety of life will not be granted. No frequency will be assigned on an exclusive basis to any one applicant. In addition, experimental licensees operate only on the condition that harmful interference will not be caused to any station operating in accordance with the Table of Frequency Allocations. Powers typical to the radio service or frequency band in which the applicant wishes to experiment will be authorized. For example, an

4.1.1 The "unintentional radiator"

An "unintentional radiator"[177] is a device that generates RF energy in it's operation resulting from the normal operation of the device, but was not designed to emit radiation outside of the device itself. These devices are governed by Part 15, Subsection B. The most common types of devices in this category include: TV, FM, CB receivers and other receiving devices, CPU boards, personal computers,[178] and miscellaneous digital devices such as alarm clocks and calculators. The FCC recognizes that many devices will require the manufacture of energy in their operation, and the FCC recognizes that all the RF energy that such devices manufacture can not be efficiently contained in entirety. Consequently, Part 15 delineates the limits that such devices can radiate RF energy without the requirement of a license. It is important to note that unintentional radiators are only "unintentional" in the sense that they radiate outside of the device; the manufacture of RF energy within the device may actually be "intentional" and necessary to the proper functioning of the device.

4.1.2 The "incidental radiator"

An "incidental radiator" is a subset to an "unintentional radiator;" it is a device that generates radio frequency signals, however the radio frequency energy has nothing to do with the functionality of the device.[179] Electrical motors, refrigerators, and hair driers are all examples of incidental radiators: the "wave effect" that these devices can generate when near a television or radio has nothing to

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application to develop a microcellular system would be allowed power and bandwidth typical of the cellular systems operating under Part 22 of the Commission's rules. Other technical standards are treated in a similar fashion.

[177] Ibid, SS 15.101

[178] Computer equipment that is marketed exclusively for use in business and industrial environments is called Class A equipment and requires verification (self approval) by the manufacturer. Personal computer equipment marketed for use in residential environments is called Class B and requires either certification by the FCC or self-approval under the Declaration of Conformity process.

[179] Ibid, SS 15.3(n)

do with the purpose of the device. The radio frequency energy is a by-product, unlike an "unintentional radiator" where the generation of radio frequency energy within a computer chip or a radio frequency receiving device is part of its operation. Manufacturers of devices producing incidental radiation are required to shield the devices, consistent with "good engineering practices," so as to minimize the interference when these devices are in operation.[180]

4.1.3 the "intentional radiator"

An "intentional radiator" is defined as "a device that intentionally generates and emits radio frequency energy by radiation or induction."[181] These devices are governed by Part 15, Subsection C. By their definition, an intentional radiator is a device that uses radio frequency signals not only as a means, but as an end. Where an unintentional radiator generates radio frequencies as a by-product, an intentional radiator generates radio frequencies as an end-product. Some examples of intentional radiators include cordless telephones[182] for home use (note *cordless* phones as differentiated from *wireless*, *cellular or PCS* phones, which require a specific FCC license). Other such devices include biomedical telemetry devices for use on the premises of health care facilities,[183] and radio powered cable locating equipment.[184] There are strict band restrictions for intentional radiators[185], and the power level is strictly governed[186].

[180] Ibid, SS 15.3

[181] Ibid, SS 15.3(o)

[182] ibid, SS 15.214

[183] ibid, SS 15.242

[184] Ibid, SS 15.213

[185] Ibid, SS 15.205

[186] Ibid, SS 15.209

The philosophy behind Part 15 is to allow companies to develop devices that emit radio frequency energy within a framework that does not require individual licensing for each product, but merely a certification that the device does not violate the standards set forth in Part 15. The main disadvantage of a device under Part 15 is that it must accept interference from other licensed carriers; and furthermore, the emissions may be subject to interference (and possible reception or eavesdropping) of others.[187] Approval of a device under Part 15 requires that it meet two "cardinal conditions:"[188] (i) that the device emit no harmful interference to licensed operations; and (ii) that the device readily accept interference from other lawful operations.

4.2 The future of Part 15: Telecommunications Certification Bodies?

Over the past 25 years, the regulatory procedure with respect to a device under Part 15 has not significantly changed. A company wishing to market a radiating, non-licensed device under Part 15 has to first perform a series of tests (either in their own laboratory or outsourced). The test results have to meet certain standards; the test results are documented and forwarded to the FCC for administrative approval. The actual testing process tends to take anywhere from one day to one week. The subsequent FCC approval process will then take up to three

[187] There are some fascinating law review articles written on the constitutional ramifications of free speech and eavesdropping pursuant to a Part 15 devices. New digital technologies appear to have reduced the need to protect privacy that was easily infringed upon with analog devices, and UWB with it's "digital key" technology promises an even higher protection from privacy. See Timothy R. Rabel, *The Electronic Communications and Privacy Act: Discriminatory Treatment for Similar Technology, Cutting the Cord of Privacy*, 23 J. MARSHALL L. REV 661 (1990) (for the proposition that even though FCC Part 15 requires warning labels on cordless phones, the cordless phone tecnology is unfairly discriminated and should be afforded higher standards of privacy protection.), citing Wisconsin v. Smith, 149 Wis. 2d 89, 104, (1989) (FCC requires labelling of cordless phones); see also 50 Fed. Reg. 24514 (1985) (for the public's benefit FCC requires labelling of cordless phones). *Also see* Terri A. Cutrera, *The Constitution in Cyberspace: The Fundamental Rights of Computer Users*, 60 UMKCLR 139 (1991) (Applying the same rationale to computer users, also a Part 15 device, postulating that if the same rationale with respect to cordless phone users is applied to computer users, that computer users should have no reasonable expectation of privacy and that remote wireless scans of computers and, and presumably the information in them, could be conducted without warrant.)

[188] *See Remarks of Commissioner Susan Ness Before the 1999 International Ultra-Wideband Conference, Washington D.C.,* September 29, 1999 (As Prepared for Delivery): *Meeting the Challenge of Innovation at Internet Speed.* The document may be obtained on the FCC website at *http://www.fcc.gov/Speeches/Ness/spsn911.html*

(3) months. It is not until the FCC approval is received that the device can be properly marketed in large commercial applications.

In 1998, with the adoption of Gen. Docket 98-68, the FCC made a radical move in its approval procedures for Approval of devices under Parts 0, 2, 15, 25 and 68 of the Rules. Gen. Docket 98-68 shifts the regulatory burden for approval of radio transmitting devices that fall under the above-mentioned categories to the private sector.[189] The FCC sets forth a provision for Telecommunications Certification Bodies (TCBs)[190] to provide the tests and certifications following essentially the same criteria previously employed by the FCC. Another aspect of GD 98-68 is it's adoption of Mutual Recognition Agreements (MRAs) to allow the designation of parties in foreign countries to approve equipment as conforming to the United States' technical requirements.[191]

The process for approval under the new regulation is quite simple, and it will have a dramatic effect both on domestic and international commerce. The case may be most significant in terms of international commerce. In the case of a product to be marketed by a US company to the European Union, a company with a new device must seek out a Conformity Assessment Body (CAB) under Article 10(2) of the Electromagnetic Compatibility (EMC) Directive (a CAB is similar to a TCB in the United States, also known in Europe simply as a "Competent Body")[192]. The

[189] Gen. Docket 98-16, Report No. FCC 98-338, entitled "1998 Biennial Regulatory Review – Amendment of Parts 2, 25 and 68 of the Commission's Rules to Further Streamline the Equipment Authorization Process for Radio Frequency Equipment, Modify the Equipment Authorization Process for Telephone Terminal Equipment, Implement Mutual Recognition Agreements and Begin Implementation of the Global Mobile Personal Communications by Sattelite (GMPCS) Arrangements."; Adopted 17 December 1998, released 23 December 1998.

[190] Ibid, Section II (A)(10).

[191] Ibid, Section II (19). Also see Document 98-338, Footnote 36, which points out that the FCC authorizes the delegation to MRAs, but that the specific technical data must be delineated within the bilateral agreement in question: "The model APEC MRA provides that countries will identify the relevant regulations and requirements at the time they enter into bilateral agreements."

[192] For a good primer to the early challenges and regulations facing the European Community, see Bengston, John, *Connecting Terminal Equipment under the New EC Regs,* COMPUTER LAWYER, 1992

European Conformity Assessment Body then issues a Technical Construction File, which consists of a technical judgment regarding the overall EMC compliance of a product where the applicable EMC standards cannot be used.

The process is similar in the United States. In both the European Union and in the United States it is expected that the company will keep the certification reports on file in each country where the product is sold, and the report must stand up to scrutiny if the device is brought into question. A CAB (Europe) or TCB (U.S.) certified device may pass all the tests, but if the report does not meet with the approval of inspectors, or incorrect test data is discovered, the company may be forced to suspend shipments until acceptable proof of conformity is presented. This is somewhat of a inspection and "policing" function of the FCC-equivalent administrative bodies in the European Union.

It is in this latter "policing" capacity that the Federal Communications Commission will continue to perform its own, independent surveillance of products on the market.[193] There will be random product testing as well as by investigating allegations of non-compliance.[194] This effectively shifts the role of the FCC from a certification/policing/regulatory body to a policing/regulatory body. The FCC is still responsible for issuing certification to TCBs, although it is anticipated that the certification process of the delegate organs (the TCBs) will ultimately result in a freeing-up of FCC resources.

(9 No. 7 Computer Law. 32). The article may be somewhat outdated now; but it highlights the challenges in the early decade of setting up uniformity in the pre-GSM European climate.

[193] For a discussion of changes made and policing functions (including fines), see David E. Hilliard and Kurt E. DeSoto, *FCC Refines Computer Marketing Regulations*, 9 NO. 9 COMPUTER LAW. 27 (1992) ("[In 1992 the FCC] substantially expanded the enforcement of its computing device rules. … The penalties for marketing unauthorized or improperly tested computers or computer peripherals increased [to] (1) civil forfeitures of $75,000 for continuing violations and $10,000 each for other violations; (2) criminal penalties as high as $500,000 in fines and two years in prison; (3) civil litigation; and (4) equipment confiscation).

[194] *Ibid,* Section III (A)(45).

It is still questionable whether the policing function of the FCC will be effective, and to the extent that harms can be realistically eradicated once TCB allows a product in commercial application that subsequently interferes with other entities. This issue was raised by Bell Atlantic, as they contended allowing foreign entities to authorize equipment may introduce partiality into the authorization process and could lead to different standards. Nonetheless, there appears to be little doubt that the delegation process will free up FCC resources to perform the policing task that GD 98-68 envisions. Pure anecdotal evidence[195] indicates that there is more of a presence of FCC representatives at events such as COMDEX,[196] where new technologies are often shown to the public.

The more important issue, however, is whether the FCC will actually have the power to "undue" a wrong, such as the proliferation of, say, a small, inexpensive key chain game device that, when activated, disconnects cell phones within 10' of the key chain's use. If such a small, inexpensive key chain realizes major sales within a short period of time (like during the Christmas season), it may be difficult or impossible to recall all the devices. In the world of e-commerce, these companies could be sham organizations purchased through international e-commerce portal sites, and very difficult to monitor from the FCC's point of view. Only through an efficient delegation to third party authorities (e.g. the TCBs) will the FCC have any opportunity to be able to allocate resources to the growing need to police the proliferation of new technologies and the e-commerce distribution of them.

[195] Through interviews with engineers at compliance companies. Also see Hilliard & DeSoto, Ibid, (Stating that in Fall 1991 the FCC issued more than 100 violations to vendors who exhibited unauthorized computer equipment at COMDEX).

[196] http://www.zdevents.com/comdex/. Comdex is a major techno-fair, the latest "fringe breaking" technologies can be seen at COMDEX. The event describes itself as: "… the world's largest and most influential information technology event for resellers, corporate decision makers and industry influencers. Recognized as the industry barometer, COMDEX events cover the technology spectrum, from the desktop to the server to Internet-enabled computing and communications technologies."

4.3 The FCC Report and Order on UWB

As described in an earlier section of this paper, spectrum's "prime real estate" is that located below 3 GHz because of it's wall-penetrating "mobile" characteristics. Unfortunately, even in spite of[197] the overwhelming data provided by industry that interference is *not* a concern, FCC placed severe limitations on power levels, effectively forcing UWB to operate at levels above the 3.1 GHz range. The FCC has, however, promised to review the interference levels within "the next six to 12 months"[198]. The topic has not been revisited yet. The justification for the restrictions was explained its First Report and Order:[199]

> 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. In the interim, the following summarizes the emission limits being adopted in this Report and Order.

The power restrictions were heavily criticized by the Ground Penetrating Radar Industry Coalition ("CPRIC"), who filed a petition arguing convincingly that the additional restrictions that were placed on their products. The CPRIC pointed out that most energy from Ground Penetrating Radar ("GPR") is emitted directly into the soil.[200] As noted elsewhere, the concerns of interference to GPS units played a

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[197] *Ultra-Wideband Transmission Systems,* ET Docket No. 98-153, First Report and Order, FCC 02-48 (released April 22, 2002). Accessible at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/_Toc4566166

[198] FCC 02-48 at paragraph 273.

[199] FCC 02-48 at paragraph 223.

[200] *Petition for Partial Reconsideration of the Ground Penetrating Radar Industry Coalition*, Accessed at: http://www.geophysical.com/FCC%20Petition%20020617.pdf

major role in the additional restrictions. In the CPRIC petition it was pointed out that many GPR systems routinely operate with a GPS receiver fixed to the unit, and they included a sketch of such a configuration. The CPRIC also asserted that additional restrictions placed on their devices and their operators were made without regard to proper rulemaking under the Administrative Procedure Act.[201]

It may well be determined at a later date that the additional restrictions that were placed on GPR units are probably not necessary. And given the speed at which the FCC has historically moved, they will *probably not* review and relax the emissions requirements within six to twelve months as promised. Yet the FCC was in a bind. They are in a constant struggle to balance the interests of authorizing new technologies, balancing the concerns of industry, and strapped with a rulemaking procedure and administrative law requirements that make it very difficult to please everyone. The result is a "mask" system which allows UWB technology to make an entrance, obtain funding, and to get products out in the market. Many commentators believe that this was a good compromise, and pioneer Time Domain seems to be happy with it for the time being.[202] Industry is already announcing special chipset radios designed to operate within the mask. Amazingly, the radios sell for as little as $19.95 per unit[203], well in line with previous industry forecasts. The system may be a bit awkward, but it appears to be working.

4.4 The Status of UWB in Europe

UWB is still very new in Europe, and there is at this stage (December 2002) very little information available in any published or official format, with the

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[201] *Ibid,* at 1 and 8 ff.

[202] See *EE Times,* "Ultrawideband radio set to redefine wireless signaling," (Sep. 11, 2001) Accessible 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.)

[203] *UWB Chip Set Meets FCC Spectral Mask*, (Aug 1, 2002), Available at: www.commsdesign.com/story/OEG20020801S0014

exception of a few slides and notes from a 2001 meeting.[204] There is evidence that activity is underway at the member country level, particularly in the UK, where a report was commissioned in 1999,[205] and there is evidence of follow-up studies in preparation of policy review.[206]

The CEPT is developing ERC recommendation 70-03 "relating to the use of short range devices (SRD)"[207], and as part of this recommendation and they are expected to be allowed to operate under with special conditions similar to – or perhaps more stringent than – FCC guidelines. The push for UWB approval in Europe appears to be driven from the wake of the UWB proceeding in the U.S. UWB industry leaders are advancing proposals in Europe, although it is only slowly gaining momentum at this point. Not surprisingly, the same questions are being considered, such as whether to allow UWB to operate within aeronautical and GPS bands.[208]

It would appear that most of the research at present is being completed by the CEPT as part of the CEPT SE24 report[209], although ETSI has also initiated a standards development project entitled ETSI TG31a.[210] The reviews thus far seem to

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[204] *See* CEPT European Radiocommunications Committee Workshop on Introduction of Ultra Wideband Services in Europe, RegTP, Mainz, March 20, 2001 Accessible at: http://www.ero.dk/eroweb/srd/uwb/agenda-presentations.htm

[205] *See:* The Radiocommunications Agency commissioned Multiple Access Communications Ltd to carry out an investigation into the potential impact of Ultra-WideBand (UWB) transmission systems on other radio services. Accessible at: .http://www.radio.gov.uk/topics/research/topics/s-studies/ultrwide/ultrwide.pdf

[206] See Final Report submitted by AEGIS Spectrum Engineering (January 2002), Accessible at: http://www.radio.gov.uk/topics/research/topics/emc/uwb_compatibility-final.doc

[207] See http://www.ero.dk/doc98/official/pdf/rec7003e.pdf

[208] *See* ESF Newsletter, *previously cited.*

[209] *See Presentation of Bob Huang, Sony AWT Group* (Oct 3, 2002), Accessible at: http://csi.usc.edu/INTEL-USC/presentations/huang.ppt

[210] *Ultra Wide Band For Short Range Devices Task Group,* ERM TG31A, Accessible at: http://portal.etsi.org/Portal_Common/lite/TBDetails.asp?TB_ID=597

be focused on the engineering and interference aspects and – from my study – there appears to be relatively little influence of policy makers, economists, and industry. If this is true, it would be quite unfortunate, although many will be tracking the progress with great interest.

Given the lack of publicly available data on the UWB review and authorization process, this section will now review briefly the European regulation on wireless communications, particularly the New Framework. At the end I will make some brief suggestions as to how European lawmakers may (and perhaps should) participate in the review of UWB at this early stage in the European review process, particularly through the Radio Spectrum Decision and the newly created Radio Spectrum Committee.

4.4.1 Directives applicable to Europe under the New Framework

4.4.2 The Framework Directive[211]

The Framework Directive[212] was arguably the keystone directive in a package of directives that were passed together with a package of directives noted below (which included the "Authorization", "Access," "Universal Service" Directives and the Spectrum Decision). With respect to wireless communications, Article 9 of the Framework Directive requires that the member states "... ensure that the allocation and assignment of such radio frequencies by national regulatory authorities are based on *objective, transparent, non-discriminatory and proportionate* criteria." [emphasis added][213] The Directive does not take a position as to *how* governments should apportion spectrum (i.e. comparative hearing, auction,

[211] The author is grateful to his colleagues David Stevens and Peggy Valcke for their review and comment on earlier drafts of this section.

[212] Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services, OJ L 108, 24 April 2002.

[213] *Ibid*, Article 9(1).

etc). It is noteworthy that, unlike the U.S., where auctions are now the only legal way to allocate spectrum, it is common in Europe to use comparative hearings (known in Europe as "beauty contests).[214]

The Framework Directive (like many of its regulatory siblings from the same package) incorporates the Radio Spectrum Decision[215] in to the Directive by reference in both main text and the recitals.[216] Each of these directives must be taken into context with the ITU, the pending review of UWB in its SE24 project.

4.4.3 The Authorization Directive

The Authorization Directive[217] is relevant to the regulatory authorization "*all forms* of electronic communications networks and services",[218] [emphasis added] and most specifically, to their regulatory authorization (hence the name). The main thrust of the Authorization Directive is the prohibition on limitations in the number of new entrants in the telecommunications market[219], except, with respect to radio spectrum, *to the extent required to ensure an efficient use of radio frequencies*.[220]

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[214] For an excellent review of the various auctions and beauty contests in Europe, *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).

[215] See below

[216] Article 9(2) (requiring harmonization of the use of radio frequencies in accordance with the Spectrum Decision); Article 9(4) (ensuring that competition is not distorted and requiring that harmonization as implemented by the Spectrum Decision does not result in the change of use of a given frequency). For a recital reference, see Recital 19 (noting that one of the objectives of the Framework Directive is to "… facilitate the work under [the Spectrum] Decision."

[217] Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorization of electronic communications networks and services, OJ L 108, 24 April 2002.

[218] *Ibid,* Article 1 (1)

[219] *Ibid*, Article 3. For basis discussion, see Recital 7: "The least onerous authorization system possible should be used to allow the provision of electronic communications networks and services in order to stimulate the development of new electronic communications services and pan-European communications networks and services and to allow service providers and consumers to benefit from the economies of scale of the single market."

[220] *Ibid,* Article 6, which incorporates by reference Annex B ("Conditions which may be attached to rights of use for radio frequencies").

Such restrictions, however, are left to the member states to manage, subject of course to overlay EU Competition laws and doctrine. Within the context of the CEPT, it will be important to analyze the *limitations* of EU involvement so as to continue to allow the member states to manage radio frequencies within the powers that they are granted in the scope of the Authorization Directive.

4.4.4 The Access Directive

The Access Directive[221] has numerous implications for wireless. First, the term "access" is carefully defined to include the availability of infrastructure used for the installation of wireless facilities (such as attachment to buildings, ducts, masts).[222] Second, the Directive requires the competent authorities in the relevant member states to promote laws and impose obligations to allow access to infrastructure for broadcasting, particularly in the scope of the digital transition of radio and television.[223] Thirdly, the Directive authorizes member states to enact transparency legislation that may require disclosure of technical information of network characteristics, non-discriminatory access to others, and governments may intervene to control costs.[224]

Access to local infrastructure has consistently hit a sore note in activist communities across Europe, and the topic is the subject of much debate. In Italy for example, locals attempted to shut down the Pope's broadcast facilities due to fear of radiation.[225] In Spain, four alleged cancer cases in a school (el colegio García Quintana de Valladolid) drove a nation-wide paranoia and led to the forced removal

[221] Directive 2002/19/EC of the European Parliament and of the Council of 7 March 2002 on access to, and interconnection of, electronic communications networks and associated facilities, OJ L 108, 24 April 2002.

[222] *Ibid*, Article 2(a)

[223] *Ibid,* Article 5 (1) (b)

[224] *Ibid, generally,* Articles 9 – 13.

[225] WALL STREET JOURNAL, *Italy Has Divisions Over Electrosmog*, April 16, 2001.

of several antenna sitings at the provocation of local citizenry. This virtually froze new site development for months,[226] and such movements could have major impacts on the analogue/digital switchover. There are similar stories in nearly every member state.

One of the unique characteristics of UWB is it's extremely low transmission powers. This should theoretically be a tremendous relief to citizens who have been concerned about "electrosmog." Even if the electrosmog concerns are unfounded, the influence that local communities have under the pretext of Electrosmog and community zoning & planning is significant.

4.4.5 The Universal Service Directive

The wordings of the Universal Service Directive[227] indicate that its scope is focused on (telephone services over) the public fixed telephone network, both with regard to the harmonized universal service obligations[228] (chapter II) as to the regulatory controls on operators with significant market power (chapter III) and the end-user interests and rights (chapter IV). There is very little in the Universal Service Directive which is directly applicable to new technologies such as UWB.

[226] EL MUNDO, *Los operadores advierten del riesgo de 'apagón' móvil por el freno de las antennas*, July 22, 2002

[227] Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services, OJ L 108, 24 April 2002

[228] Recital 8 however mentions that for the provision of users with a connection to the public telephone network at a fixed location and at an affordable price (which is a fundamental requirement of universal service) *"there should be no constraints on the technical means by which the connection is provided, allowing for wired or wireless technologies, nor any constraints on which operators provide part or all of universal service obligations"*. [emphasis added].

4.4.6 The Spectrum Decision

The Spectrum Decision[229] attempts to link EC spectrum demands to the policy initiatives of the EU through the creation of a Radio Spectrum Committee.[230] The Committee was launched in July, 2002[231] and will assist and advise the Commission on radio spectrum policy issues, on co-ordination of policy approaches (advisory procedure) and, where appropriate, on harmonizing conditions and legislative measures (regulatory procedure) with regard to the availability and efficient use of radio spectrum necessary for the establishment and functioning of the common market. The advisory procedure of the Committee will provide feedback to the Commission, which in turn shall issue mandates to the CEPT[232] for implementation.[233] Finally, one relatively concrete aspect of the Spectrum Decision is the requirement for Member States to regularly publish their radio frequency allocation tables (a transparency measure) and make them available to the public.[234]

4.4.7 European Freedom of Expression Considerations

UWB is ripe for policy and lawmaking proceedings by the Spectrum Committee. It is my view that the Spectrum Committee should go to great lengths at this early stage to become involved in the UWB discussions in Europe. Many of the tradeoffs that will be decided in UWB implementation require a delicate balancing of industry, governmental and consumer interests. This is the ideal area for EC legislation and policy-setting. If one believes the literature – that UWB is potentially

[229] Decision No. 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community, OJ L 108, 24 April 2002.

[230] *Ibid*, Articles 3 and 4.

[231] *See* Commission Press Release IP/02/1171, which specifies the creation of a Radio Spectrum Policy Group and a European regulators Group.

[232] The European Conference of Postal & Telecommunications Administrations (CEPT), based in Denmark, has membership which extends well beyond the EC (there are 44 members). See www.cept.org.

[233] *Ibid*, Article 4 (2)

[234] *Ibid,* Article 5

the future of wireless – now is the time to act. Earlier sections of this paper have advanced the argument that UWB could be a tremendous benefit to consumers, yet it is also a topic which appears to be quite influenced by pressure from NGOs and the aeronautical industry. The concerns of these groups are of course legitimate, but should they go unchecked, the result is likely to be one which is overly conservative and damaging to consumers in the long run.

As discussed earlier, UWB and other wireless technologies such as Software Defined Radio have the potential of stripping the scarcity argument of spectrum. This could have sweeping effects on the European constitution, particularly as it relates to free speech and pluralism. As Caroline Uyttendaele and Joseph Dumortier explain, there are different regimes, although in all cases *market access rules* apply:[235]

> Diversity in broadcasted information is safeguarded by the doctrine of pluralism. . . . In short, pluralism is meant to increase the diversity of the information available to the public. It is the responsibility of European states to ensure that such a plurality of opinions is encouraged. . . . [Pluralism] is implemented in all European states through the enactment of various market access rules. Market access rules may vary from a system of free admission (for example, printing press), to a declaration regime (for example, Internet service providers), or a licensing system (for example, broadcasting organizations). Market access rules apply to the information superhighway even if there is little or no question of scarcity.

If UWB technology questions scarcity of wireless technologies – as it does -- the argument will naturally be made that market access should be along a free

[235] Caroline Uyttendaele & Joseph Dumortier, *Free Speech on the Information Superhighway: European Perspectives,* 16 JOHN MARSHALL JOURNAL OF COMP. & INF. LAW 905 (1998), pp 928-929.

admission model such as a printing press. Paper is not in infinite supply, but it would not be considered to be a "scarce" resource in this context. Professor Stuart Benjamin has noted the likelihood of unconstitutionality of a licensing regime if it were it to apply to printing presses in the U.S.[236] Such a proposition would probably also be a violation of Article 10 of the European Convention for the Protection of Human Rights and Fundamental Freedoms.[237] With respect to freedom of expression, the Convention states at Article 10, Paragraph 1 that the exercise of freedom of expression "… shall not prevent states from requiring the licensing of broadcasting, television or cinema enterprises." The Article goes on to further stipulate that the exercise of freedom of speech:[238]

> …may be subject to such formalities, conditions, restrictions or penalties as are prescribed by law and are *necessary in a democratic society* in the interest of national security, territorial integrity or public safety, for the prevention of disorder or crime, for the protection of health or morals, for the protection of the reputation or rights of others, for preventing the disclosure of information received in confidence or for maintaining the authority of the judiciary. [emphasis added].

At risk of mixing U.S. constitutional premises with European fundamentals, it is worth considering the proposition of Professor Benjamin in the U.S., as well as commentators Lessig and Benkler[239] in light of the Convention's standard of what is

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[236] Stuart Minor Benjamin, *Logic of Scarcity: Idle Spectrum as a First Amendment Violation,* 54 DUKE LAW JOURNAL I (2002). At p 20 ff. Also available at: http://aei.brookings.org/admin/pdffiles/The%20Logic%20of%20Scarcity.pdf

[237] Text available at http://conventions.coe.int/ or http://www.pfc.org.uk/legal/echrtext.htm

[238] *Ibid*: Article 10

[239] Yochai Benkler & Lawrence Lessig, *Will Technology make CBS Unconstitutional*? THE NEW REPUBLIC (Dec 14, 1998). Accessible at: http://www.tnr.com/archive/1298/121498/benklerlessig121498.html

"necessary in a democratic society." Few would argue that frequency management regimes were necessary given our technological ability to manage and control spectrum at the time the 1927 Radio Act was passed. Regulation was a must. It still is today. But technologies similar to UWB question this paradigm and, just as it seems absurd today to license and control printing presses based on today's expectation for free speech and freedom of expression. It may seem likewise absurd in 20 years to license and control spectrum if it can be proven that technology can overcome scarcity. It is highly unlikely that such the present controls on spectrum will be necessary in a democratic society.

4.5 UWB in the ITU

Only very recently (September, 2002) has the International Telecommunications Union announced an official in-depth analysis of Ultra-Wideband. The ITU has agreed to set up a task force to analyze, *inter alia*, the following matters and to present the results by late 2003 or early 2004. The study resembles many of the aspects reviewed in the U.S., and shall include:[240]

- The necessary requirements to ensure that UWB devices will not cause harmful interference to any radiocommunication service in particular GPS, aeronautics, and other bands;
- To identify which studies, key technical and operational data characteristics of UWB devices should be collected and appropriately documented;
- The effects of emissions from a single UWB device as well as the aggregate effect of emissions from multiple UWB devices, on the existing electromagnetic environment and consequently on compatibility with radiocommunication services?

[240] ITU Administrative Circular CACE/265, Announcement of the establishment of Task Group 1/8 on Compatibility between ultra-wideband devices (UWB) and radiocommunication services (18 September, 2002). Accessible at: http://www.itu.int/itudoc/itu-r/ac/cace/265e_ww9.doc

- What is the response of non-UWB receivers to UWB emissions, as the parameters of UWB devices become known; and finally
- To document the results of the above and to issue Recommendations.

One of the likely sources of contention will be ITU Regulation known as "Footnote S5.340," which prohibits all emissions within certain radio astronomy bands. The European Science Foundation has already taken a fairly aggressive stance on this matter.[241] The ESF is particularly concerned with any and all emissions which may affect radio astronomy.

It is my belief – not one that has been stated officially by the ITU -- that one of the most useful areas where the ITU can exert influence is in the International Frequency Registration Board (IFRB),[242] where the presently-contested issues may arise with respect to possible UWB interference in the operation of global positioning devices, or radio astronomy, for similar reasons raised by the FAA and initially the Department of Aeronautics at Stanford (as noted elsewhere). Should "masks" of any nature be proposed by the ITU (although hopefully they will not be deemed required, it is likely), the IFRB could enforce the use of masks and promote standards and certifications for their conformity, perhaps in conjunction with ETSI. Rather than an all-out prohibition of broadcast within certain frequencies (such as radio astronomy), the IFRB could set up policing measures to protect the operation of astronomy and to assure that operators, manufacturers of devices and others are in compliance with standards.

If one extrapolates from the UWB proceeding in the U.S., the review of the comments filed there indicate that the single most agreed-upon issue is that of the

[241] *European Science Foundation,* CRAF News (January 2002). Available at: http://www.esf.org/publication/129/CrafNews5.pdf

[242] Convention of the International Telecommunication Union, ch. 1, art. 5, para. 1(2), reprinted in *International Telecommunication Union, Final Acts of the Pleniopotentiary Conference 71* (1989).

various categories of devices may be adversely affected by UWB is Global Positioning Devices. And furthermore, since GPS devices are used in aeronautical navigation, interference with GPS raises an important public safety concern. Specifically, the potential interference of UWB may arise out of Article 12 (c) "to furnish advice to Members with a view to the operation of the maximum practicable number of channels in those portions of the spectrum where harmful interference may occur …"[243]

The registry and mediation role of the IFRB is somewhat of a cross between the administrative law functions of the Federal Communications Commission and the cross-border adjudication of the International Court of Justice:[244] in determining the legal status of a radio station, the IFRB functions like a court; in it's role of assembling data on frequency use and distribution, the IFRB functions like a registrar;[245] and in the ITU's crucial role of helping developing countries have access to modern communications, the IFRB acts as a technical consultant.[246] The IFRB also mediates disputes between member countries when there is an interference issue.[247]

The concerns raised by the U.S. GPS Industry Council, the General Aviation Manufacturers Association, United Airlines and American Airlines[248] will likely find

[243] Ibid.

[244] Allison (Ibid, supra), citing Harold K. Jacobson, *The International Telecommunications Union: ITU's Structure and Functions*, GLOBAL COMMUNICATIONS IN THE SPACE AGE, 38, 49 (1972).

[245] Frequencies are recorded in the Master International Frequency Register.

[246] Allison (Ibid, supra)

[247] In the IFRB's mediation and dispute resolution role, the IFRB has been called "quasi judicial" because it lacks authority to enforce its own decisions. *See* ALLISON (IBID, SUPRA) AND RITA L. WHITE & HAROLD M. WHITE, JR., THE LAW AND REGULATION OF INTERNATIONAL SPACE COMMUNICATION, 86-87.

[248] *See Reply Comments of the U.S. GPS Industry Council, American Airlines, the General Aviation Manufacturers Association, Stanford University (the GPS Research Program) and United Airlines*, submitted by Leventhal, Senter & Lerman P.L.L.C. as a Comment to the UWB NOI (February 3, 1999).

that the ITU (and more specifically the IFRB) will be eager to hear their concerns. The IFRB may be the best forum to mediate any potential disputes for the following two reasons (i) the IFRB is charged with resolving international matters of interference; (ii) the IFRB has a mandate derived from the ITU charter to assure safety[249] and (iii) the IFRB has a mandate to promote inexpensive, advanced technologies to developing countries. With the involvement of the ITU in the process, there exists a high likelihood that the challenge of interference in the GPS band could be overcome thereby facilitating the rapid deployment of the technology in developing countries.

Indeed, it is in developing countries that UWB technology may find its best early application. Many developing countries do not have the billions of dollars in incumbent technology (such as cellular, PCS, ESMR, and the wireline installations such as high-speed cable and DSL). In the United States and in Europe, the companies that invested heavily in these technologies have an interest in making use of them for at least as long as it takes to amortize the investment. Since UWB operates on a completely different principle than the existing technologies (and is a much more affordable technology than frequency-specific technologies such as cellular and PCS), developing countries could use UWB for relatively inexpensive, rapid deployment.

[249] The Airlines' concern is that potential interference with GPS devices may jeopardize the safety of the millions of airline passengers.

Section V: Are there alternative review procedures available to the FCC?

5.1 Rulemaking Procedure and the Administrative Procedure Act

As has been discussed earlier in this paper, the Rulemaking procedure that is used by the FCC is very slow and can often lead to unsatisfactory results. In their rule-making capacity, federal agencies generally operate under the Administrative Procedure Act ("APA"),[250] which sets forth due process requirements for the enactment of an administrative rule and provides "[g]eneral notice of proposed rule making shall be published in the Federal Register,"[251] with an intent to invite public comment and input on the rulemaking function:

> (c) After notice required by this section, the agency shall give interested persons an opportunity to participate in the rule making through submission of written data, views, or arguments with or without opportunity for oral presentation. After consideration of the relevant matter presented, the agency shall incorporate in the rules adopted a concise general statement of their basis and purpose.

There are many reasons why the APA invites public comment prior to the adoption of a rule:[252] (i) the public can provide information at a low cost to the agencies;[253] (ii) a rule adopted after public comment is more likely to be absorbed into practice and cheaper to administer; and (iii) comment periods prior to

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[250] 5 U.S.C. § 553

[251] *Ibid,* section (b)

[252] *See, generally*, Michael Asimow, *Interim-Final Rules: Making Haste Slowly,* 51 ADMIN. L. REV. 703. (An excellent review of interim-final rulemaking and the inspiration for covering this item in this paper.)

[253] The many different responses and comments for the UWB proposed rulemaking are attached in the Appendix. Note the many thousands of pages that were submitted, which sometimes included valuable research (such as that conducted by the Interval Research Corporation, the National Science Federation, etc) that was used in considering UWB technology.

rulemaking serves fundamental democratic purposes, because an "agency that adopts rules makes new law without direct accountability to the voters."[254]

One of the drawbacks of public comment is the time that the process can take in reviewing and implementing a rule. Consequently, the APA provides for an exception to the public comment requirement, known as the Good Cause Exception:[255]

> Except when notice or hearing is required by statute, this subsection does not apply -- … when the agency for good cause finds (and incorporates the finding and a brief statement of reasons therefore in the rules issued) that notice and public procedure are impracticable, unnecessary, or contrary to the public interest.

An excellent article written by Michael Asimow[256] describes the use by federal agencies of rules that are adopted and become effective *without prior notice*, with a provision for subsequent public comment after the rule is set in place. Some examples of interim-final rules employed recently by federal agencies include:[257]

(a) The addition of seventy-eight (78) newly quarantined counties by the Animal and Plant Inspection Service of the Department of Agriculture to the pine shoot beetle regulations;[258]

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[254] Asimow, *Ibid* at 708.

[255] 5 U.S.C. § 553 (B)

[256] Asimow, *Ibid.*

[257] Ibid, at 709.

[258] Asimow, *ibid,* citing 7 C.F.R. § 301.51-1 (1999)

(b) More frequent inspections of fuel pumps on Boeing 747 Aircraft based on an Airworthiness Directive issued by the Federal Aviation Administration;[259]

(c) The suspension of an Imminent Effective Date by the Environmental Protection Agency of ethylene oxide regulations because of new information on explosion of equipment at ethylene oxide facilities.[260]

These examples all share the common trait that they appear to regulate matters related to public safety, for which a public comment period may actually be harmful; in fact, one could argue that, pursuant to the Good Cause Exception, a notice and comment period would be "contrary to the public interest."

The definitions of "impracticable," "unnecessary" and "public interest" (in the context of the Good Cause Exception) have been the subject of great debate in the academic literature.[261] In applying this notion to the FCC, approval process, I have developed some possible [draft] areas for consideration that could fit within these exceptions [pending further research and analysis]:

5.1.1 "Impracticable"

This exception may be more applicable in other administrative areas than it is to telecommunications. It would conceivably always "practicable" to open up a

[259] Asimow, *ibid,* citing 40 C.F.R. § 63.60 (1998)

[260] Asimow, *ibid,* citing 14 C.F.R. pt. 39 (1999)

[261] See Juan J. Lavilla, "The Good Cause Exemption to Notice and Comment Rulemaking Requirements Under the Administrative Procedure Act," *Administrative Law Journal,* Fall, 1989. (For a detailed discussion on the Good Cause Exception, including a detailed definition: " 'Impracticable' means a situation in which the due and required execution of the agency functions would be unavoidably prevented by its undertaking public rule-making proceedings. 'Unnecessary' means unnecessary so far as the public is concerned, as would be the case if a minor or merely technical amendment in which the public is not particularly interested were involved. 'Public interest' supplements the terms 'impracticable' or 'unnecessary;' it requires that public rule-making procedures shall not prevent an agency from operating and that, on the other hand, lack of public interest in rule-making warrants an agency to dispense with public procedures" (p. 333).

hearing process for a new rule. Although if one believes the assertions of Professors Benjamin, Lessig and Benkler (described earlier), to the extent that Constitutional matters are at stake, it may not be practicable.

5.1.2 "Unnecessary"

This category appears to lend itself well to decisions that would be non-controversial, and approval could be granted on an interim basis; and then could theoretically be reversed if it turns out later that the decision was one that required additional analysis. Some examples of decisions in this category could include:

- The provision of services from one carrier (Carrier A) that wishes to provide services to customers using a wireless tower located on the border of another carrier (Carrier B), provided that both Carrier A and Carrier B have agreed that such overlap of service (i.e. the provision of services by Carrier A into Carrier B's territory) has been agreed to by the parties. This may facially require an amendment to a particular FCC license, but it would be unnecessary to have a full public hearing because the interested parties (Carrier A and Carrier B) have tacitly agreed.

- For certain waiver applications in limited scope, such as the UWB waiver application for the manufacture and sale of 2500 UWB devices, if the carrier can show (as Time Domain effectively did) that a limited amount of devices will not offer interference, then the application could be deemed "unnecessary" for the waiver portion only; and the FCC could still withhold blanket approval (i.e. the Notice of Proposed Rulemaking) for a public hearing and comment process.

5.1.3 "Public Interest"

One aspect that distinguishes Public Interest from the other categories is the public-safety aspect. In many respects, an act or decision taken in response to a

public interest is by definition a temporary one, and may not need to be converted to a "final" status, such as:

- The granting of additional frequencies in an emergency;[262]

- or temporarily overruling zoning and planning ordinances in response to a public gathering or a natural disaster (the City of Austin provides such an ordinance);[263]

5.2 Would interim-final rulemaking work in the telecommunications context?

Interim-final rulemaking is an attractive notion in telecommunications, because it could allow carriers to implement and test a new technology while applying for final, permanent approval for the technology in parallel. This could advance and encourage the development and deployment of new technologies without the wait-and-see period associated with a public hearing process, and also without the expense of hiring attorneys to defend the application procedure while it is under attack by incumbent carriers (competition) that may be opposing the technology not because of legitimate fears of interference, but because of how it may affect their markets.

[262] During the Oaklahoma Bombing crisis, for example, cell phones were used extensively to help rescue victims. Channels within the system were re-allocated to accommodate the additional use. One victim was in fact recovered from the rubble only because the rescuers were able to communicate with her with her cell phone. Wireless technologies were also widely used in the wake of the 9/11 terrorist attacks. See *Wall Street Journal,* "Disaster Gives New Life to Wireless Telecom Firms" (October 3, 2001) at B1.

[263] See Austin Ordinance § 18-8, "Telecommunications Ordinance;" also, per telephone conversation on December 2 with Keith Hogel [note- verify spelling] of the Austin Planning department, who explained to me that Austin regularly reviews and approves temporary facilities in response to particular requests by telecommunications carriers. Some carriers in Austin will simultaneously apply for a temporary facility and a "C.O.W." (Cell On Wheels), whereby the C.O.W. meets the temporary needs of the company while the permanent site is located and constructed.

The disadvantages to interim-final rulemaking may, in some cases, outweigh the advantages. Incumbent carriers have invested millions of dollars in obtaining licenses for, and subsequently deploying new technologies. These carriers should have a minimum period to implement and amortize their investment in technologies, and a full hearing and comment period. Also, the risks of deploying a disruptive technology could be great, such as the disruption of phone calls, vital paging systems (transplant recipients, for example, receive one page only and if they don't respond or don't receive the page, the next recipient on the list gets the organ). Finally, there could be a "slippery slope" of approvals that are granted on an interim basis by an administrative, non-public proceeding and are consequently difficult to track and follow-up on once the interim approval is granted.

Part VI: Can the FCC learn from it's sibling FDA?

6.1 Medical devices versus telecommunications devices

From a public policy perspective medical devices are likely to be more heavily scrutinized than a telecommunications device because medical devices are directly linked to the health and physical welfare of the public. From an administrative law perspective, however, the FCC and the FDA may be able to learn from each others' experiences.

The most notable difference from a lay point-of-view is that information on the approval process through the FDA is much more accessible and understandable than the FCC. In spite of the fact that prescription drugs and medical devices are in some ways much more complicated than radiotelecommunications devices, the FDA has found a way to simplify and explain in a very detailed manner the "hows and whys" of the product approval process. The Food and Drug Administration Modernization Act of 1997 (FDAMA) took place one year *after* the FCC amendment to the Federal Telecommunications Act in 1996. Again – ignoring for purposes of analysis the innate differences in the technologies – the average lay person can access the FDA web site and within a very short amount of time leave with a clear understanding of the FDAMA's intent & purpose,[264] as well as a timeline for progress[265], clearly written guidance for industry on fast track drug development programs and application review process, and a breakdown of mechanisms for meeting time review deadlines.[266] [267] The distribution of information and processes,

[264] http://www.fda.gov/opacom/backgronders/modact.htm

[265] FDA Modernization Act of 1997 Implementation Chart, at http://www.fda.gov/po/modact97.html

[266] http://www.fda.gov/ope/fdama/objEintro.html

[267] Part of this is also an excellent job of promoting on the part of the FDA. While downloading the Acrobat viewer, for example, there was a direct link (on Adobe's site) to the FDA touting how the FDA has used the Acrobat viewer since the implementation of the Modernization Act in 1997. Pharmaceudical companies have since submitted more than seven million pages of information (including the complete application for the drug Viagra). http://www.adobe.com/epaper/spotlights/fda/main.html

from a project-managerial perspective, is key in assuring productivity gains and efficiencies.

6.2 The "substantial equivalence" doctrine

On April 6, 1995 the FDA announced its intention to begin a limited pilot program to test the usefulness and practicality of a third party review of medical devices.[268] The program was implemented about one year later, on April 3, 1996, although it did not actually formally begin until August 1, 1996.[269] The third party review of medical devices was limited to 501(k) applications for selected low and moderate risk medical devices, to "(1) Provide manufacturers of eligible devices with an alternative review process that could yield more rapid marketing clearance decisions, and (2) enable FDA to target its scientific review resources at higher-risk devices while maintaining confidence in the review by third parties of low-to moderate risk devices."[270] The pilot program (although more specifically the successor program) were authorized under the FDA Modernization Act of 1997 (FDMA), which was signed into law on November 21, 1997.[271] The successor to the pilot program is known as the FDAMA Program.[272]

While creating the FDAMA Program, the FDA noticed that during the first eighteen (18) months of the pilot program, the FDA only received twenty-two (22) premarket notifications that were reviewed by recognized third parties. There were an additional 1,300 third-party-review-eligible premarket notifications reviewed by the FDA itself.[273] Consequently the FDAMA Program significantly liberalized the

[268] 60 FR 2868 (Public Workshop, Department of Health and Human Services, Docket No. 95N-0124, June 1, 1995)

[269] 61 FR 14789

[270] Federal Register: May 22, 1998 (Volume 63, Number 99).

[271] 21 U.S.C. 360m

[272] Food and Drug Administration, Docket No. 98N-0331.

[273] Federal Register: May 22, 1998 (Volume 63, Number 99)

types of devices that are eligible for third party review, and also set forth an extremely comprehensive catalogue of criteria for approval of devices. As noted above, this catalogue is entirely accessible online.

The FDA implemented a two-tier approach to approving new technologies: (i) the "premarket notification" process for upgrades to existing technologies[274]; and (ii) the "premarket approval" process for brand new technological advances.[275] The pilot program is similar to the TCBs set up under the FCC. Yet since the FDA had a pilot program underway for nearly two years before the FCC's TCB program, it may be valuable to look at the successes and failures of the FDA pilot program so that the same mistakes are not repeated in the FCC's TCB program.

If a similar medical device from a known technology has been on the market, a successor device may be approved under an alternate approval route known as "substantial equivalence"[276] or "premarket notification." The premarket notification process was designed to be a short-term solution to solve backlog of applications.[277] Congress had hoped that with the respite that the premarket notification process would provide, that the FDA would be able to go through and set performance standards for other devices to speed things up; they also hoped to "go back" and certify devices that were on the market prior to the approval process in 1976.[278] It turns out, however, that the FDA did not have the resources to either (a) go back and

[274] 21 U.S.C. § 360e(b)(1)(B) at 514.

[275] Federal Food, Drug, and Cosmetic Act, § 515(b)(1)(A, B), as amended, 21 U.S.C.A. § 360e(b)(1)(A, B); 21 C.F.R. § 814.1(c)(1).

[276] The seminal case in this area is Medtronic v. Lohr, 116 S.Ct 2240. Medtronic dealt primarily with the issue of a tort suit based on a PMA approved device. The holding in Medtronic is not directly relevant to our discussion, however the Supreme Court did evaluate the various forms of regulatory approval adopted by the FDA. On a secondary note, the matter of substantial equivalence can be tested and if a device is not substantially equivalent, it will be rejected. See Dutton v. Acromed Corp., No. 69332, 69333, 69358, 1997 WL 15248 (Ohio App. Jan. 16, 1997)

[277] See Rachel Tumidolsky, *How Medtronic v. Lohr Has Redefined Medical Device Regulation and Litigation* DEFENSE COUNSEL JOURNAL (April 1998).

[278] 21 U.S.C. § 360e(b)(1)(B)

catalog the existing devices, nor (b) have manufacturers with devices already on the market go back and file for the timely premarket approval process.[279]

To obtain approval under substantial equivalence, the manufacturer must demonstrate substantial similarity in design and function to the "predicate device"[280] Under the substantially equivalent doctrine (also known as a "501(k)" approval or "premarket notification"), the producer of a device must (i) notify the FDA of its intention to market the device and (ii) wait out a ninety (90) day period whereby the FDA will see if there are rejections.[281] Absent a rejection, the device may then be legally marketed. Approval is quasi-automatic, although it is limited to relatively small leaps in technology.

The overarching advantage of obtaining approval under a premarket notification (as opposed to a premarket approval) is the dramatic reduction in time-to-market. A full premarket approval notification by the FDA can take approximately 1,200 hours to review; in contrast, a premarket notification under the substantially equivalent doctrine takes merely about twenty (20) hours.[282] Even if both approval processes are equivalent in the time they sit in the FDA's hands (a manufacturer must wait at least 90 days during the objection period), there is a clear benefit in efficiency of the use of the FDA resources in terms of hours spent in the review. In this way, the FDA can focus its time on the newest ground-breaking technologies, while the "small steps" in improving an older technology can still advance. And presumably the quicker time-to-market of the substantially similar technology will provide additional funding for research and development of groundbreaking technologies.

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[279] See Tumidolsky, above; also substantiated in Medtronic, 116 S.Ct. at 2247

[280] 21 U.S.C. § 360c(f)(i)(A)

[281] 21 U.S.C. § 360(k)

[282] Medtronic, 116 S.Ct. at 2247.

6.3 Some possible recommendations for the FCC

The FDA web page, and all materials associated with it, are accessible to *anyone* of nearly any level of education and experience. The FCC web pages (aside from general "overviews") require either knowledge of engineering or law to understand. True, they have improved notably over the past three years, but, it is still a tool for lawyers and technologists. On the FCC web page, for example, there is no one link or summary of what the new Telecommunications Act of 1996 means (in relative lay terms).[283] There are no clear breakdowns of what the various rules and parts mean (aside from the "raw" code itself).[284] Although the FCC now allows for electronic filing of comments, the search engine for comments requires that the individual be aware of the docket number or the matter itself. There is little to "guide" the user through the site and categorize different types of issues under review. To employ an industry cliché, the FCC is in the communications business, yet the FCC could learn from the FDA on how to better communicate with the general public on what they are doing. The occasional introductory Real Video speech by Chairman Kennard is a good start, but real access to information on what is happening goes far deeper than that.

The FCC's Telecommunication Certification Bodies have some resemblance to the FDA's Premarket Notification (501k) process in that they each delegate authority to a third party to review and approve devices. Yet where the FDA had difficulty in launching their first attempt at third party review (only 22 applications), the FDA then responded by clarifying and detailing the review process and by opening up more products that are eligible for review. The FCC may be doing the

[283] There are some links such as "Market Cents" which gives tips to consumers on billing (http://www.fcc.gov/marketsense/), and a section entitled "Rural Initiatives" which points out what the FCC is doing with industry to increase telecom delivery to rural areas (http://www.fcc.gov/rural.html). Yet these small entrés to the general public is very little in comparison to the general accessibility of information available on the FDA site.

[284] Please note that parts of this section were drawn from a paper I wrote in 2000, some of the statements may not be applicable today.

same thing; but there is no way of telling from the publicly-available information.[285] The FCC has come a long way; yet as the administrative body responsible for telecommunications (including the internet), the FCC could use a user-friendly upgrade in layout, content and ease-of-use. Where the FDA had been using online technology for many years in allowing electronic filings of applications, the FCC only implemented the Electronic Comments Filing System in full-force in mid 1998.[286] Again, this is ironic (even if not unusual in the telecommunications business) that the enabling organization for new communications technologies does not appear to be leading the charge in ways that other organizations are.

[285] Typing "Telecommunication Certification Bodies" into the FCC search engine draws several dozen documents, all randomly mixed in terms of their content and age, and most are indiscernible from the title (e.g. what does "nrin9034.txt" mean or "welcome.0611")? Even more frustrating is that most documents have a link next to them entitled "summary," but clicking on it almost infallibly results in the following message: "Error! Uncaught exception: Ik: Couldn't create datafile: Permission denied ["/phat/atrlease/EWS1.0P1/src/src/lib/Index/IkDataFile,C", line 327] exiting." Also, for some unexplainable reason (quite possibly my user error), the results from the Electronic Filing Report were unreadable using the latest version of Internet Explorer (5.0), and only worked after I downloaded Netscape. Again, even though some of these errors may be user-related, they just don't seem to pop up at all with any frequency on the FDA site.

[286] http://www.fcc.gov/Bureaus/Miscellaneous/News_Releases/1998/nrmc8039.html

Conclusions

New technologies are being developed at "internet speed," and the FCC has obligations to review and approve them under its mandate from Congress. As more and more applications are submitted to the FCC, the Commission will have to develop faster and more efficient processes in reviewing and approving the applications. One way that the FCC can do this is through continued delegation to third parties, such as the Telecommunication Certification Bodies. Another way that the FCC can help speed up the approval process is through a clarification of its rules and regulations, and through an improved use of electronic filing and review. A third way that the FCC can achieve greater efficiency is garnering further support from the International Telecommunications Union in its standard-setting role. Finally, the implementation of an interim-final rulemaking process may also help shift the burden of non-interference away from government and to industry. A combination of these approaches, with time, is likely to have a positive effect on the approval of new technologies.

If new technologies such as UWB are successful, the role of the FCC may shift away from a command and control model to more of a spectrum policing model. Or perhaps it may shift to a spectrum judicial model, a similar function as the ITU's IFRB. It is not useful to say today that these changes are overdue; they are not. Indeed, new technologies that question "scarcity" are only emerging, and the FCC should be applauded for its efforts in the UWB proceeding. Coasian propertization of spectrum will occur; it will of course take time to complete. In the mean time, the FCC will hopefully make continuous advancements and improvements in its administrative functions consistent with the long term propertization model.

Annex 1: Description of new technologies

First Generation (1G) mobile phones were started in the 1970's, mostly in the USA, and use analogue technology. The use of spectrum in 1G phones is inefficient, allowing only one phone call per channel (compare with GSM, a 2G technology, which provides with approximately 8 calls per channel.) The Economist estimates that as of late 2001 approximately 70 million users – mostly in developing countries -- continue to use 1G phones.[287]

Second Generation (2G) mobile phones use digital technology instead of analogue technology. There are various forms and protocols of digital encoding, including Time Division Multiple Access ("TDMA"), Code Division Multiple Access ("CDMA") and GSM (a variation of TDMA technology). Text messaging and other basic services available as part of today's GSM phones are all considered 2G.

Enhanced Second Generation (2.5G) phones offer data transfer services, such as General Packet Radio Service ("GPRS"). Indeed, GPRS is the primary feature of what is known to be 2.5G. In theory one can reach data transfer speeds as fast as 115 Kbps, although in reality the speeds are more like a dial-up connection, i.e. about 56 Kbps. Note that the next step beyond GPRS in terms of data connectivity is known as "EDGE," and many industry commentators consider EDGE to be a 3G service.[288] Although since EDGE is deployed as an "overlay" product onto existing networks using existing licenses, it may be closer to a 2.75G product. When deployed, EDGE is intended to support data transmission rates of up to 384 Kbps, although it can go as high as 474 Kbps.[289]

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[287] THE ECONOMIST, *Generation Game*, 11 Oct 2001

[288] Indeed, EDGE does offer services that could compete with 3G. See http://www.3gamericas.org/PDFs/gprs_alone.pdf

[289] See http://www.3gamericas.org/English/Technology_Center/edge.cfm

Third Generation (3G) phones are a bit trickier to define. On the one hand, 3G denotes a service offering: high-speed, always-on data connections and support for high tech applications such as videotelephony and internet access. On the other hand, 3G is also associated with Universal Mobile Telecommunications System ("UMTS"). But they are not necessarily associated with each other. UMTS is unquestionably a third generation product, however one should not confuse the UMTS standard and the UMTS licensing allocations in Europe with the service offerings of 3G. It is possible to offer third generation services by using a different standard. This is exactly what industry is attempting to do through their overlay EDGE networks.

Fourth Generation (4G) is an all digital world, although definitions for this category have perhaps not yet been solidified by the pundits; some describe it as a technology, others as an application. Some believe that 4G is simply a conglomeration of multiple (digital) wireless access technologies.[290] Others say that 4G will extend 3G by an order of magnitude and may not be backwards compatible with other technologies.[291] Still others associate 4G with holograms and "virtual presence."[292]

GSM: This stands for global system for mobile communications (note that it originally stood for the French acronym Groupe Speciale Mobile), and is the standard transmission and reception technology used for wireless phones in Europe and much of the rest of the world outside the U.S. GSM is the standard for approximately 65% of the world's mobile users. Unlike the U.S., most countries decided to pick a single standard wireless phone technology years ago. That standard is GSM. The U.S. chose not to agree on a single standard but to allow the

[290] EE TIMES, *4G wireless nets blend voice with data driven services* (Nov 8, 2002) Accessible at: http://www.eetimes.com/in_focus/mixed_signals/OEG20021107S0023

[291] See Broadband and Wireless Networking Laboratory, http://users.ece.gatech.edu/~jxie/4G

[292] http://www.newsfactor.com/perl/story/19381.html#story-start

markets and the industry to choose the standard. This resulted (particularly initially) in a myriad of multiple, incompatible technologies – in the mid 90's, one who had a phone in New York could probably not use it in California. On the upside, however, the result has been that the U.S. has been a test-ground for new technologies, and the newest technologies (such as the future 3G technologies) arose from live testing in the U.S. Although the new technologies were not tested in Europe to this extent, there are certainly other advantages. For example, more innovative wireless phones and wireless services have developed in Europe than in the U.S. SMS messaging and other services arose out of this standardisation and they are still not prevalent in the U.S. GSM exists in the U.S., and is gaining some acceptance there, although though it is broadcast on a different frequency than the system used in Europe. It is used by companies including VoiceStream, Cingular and AT&T, which is in the process of converting its network to GSM.

CDMA: The most widespread of the three main wireless phone technologies used in the U.S., it stands for code-division multiple access, and is the system used by Verizon and Sprint. It is a digital, spread-spectrum technology developed by Qualcomm. It is the basis technology upon which 3G is based.

TDMA: This stands for time-division multiple access, and is the third of the three major U.S. wireless technologies. In the U.S. it has been mainly used by AT&T, which is abandoning it for GSM. Note, however, that GSM is based on TDMA technology, it is not exactly the same thing as GSM.

UMTS: This is the new "third-generation" standard that allows for high-speed, always-on data transmission and reception. It promises to handle e-mail, instant messaging and Web browsing as smoothly as current wired technologies. It is supposed to be able to transmit data at speeds up to two megabits a second, which is

faster than most home DSL and cable-modem connections. The official "standard" for UMTS is known as IMT-2000.

GPRS: This is the name for the 2.5G system that will work on GSM phone networks. It stands for general packet radio service.

EDGE: EDGE is an International Telecommunications Union (ITU) approved standard endorsed by ETSI and in the U.S. by various standards organizations. It is a key component of the ITU-endorsed third generation option known as IMT-SC (UWC-136). EDGE's greatest benefit is it's narrow band 200 kHz channels that allows operators to offer 3G services (or very close to it) without the necessity of purchasing a UMTS license.

Wi-Fi: This is an *unlicensed* wireless networking technology for PCs that allows multiple devices to share a single high-speed Internet connection over a distance of about 100 meters. It can also be used to network a group of PCs without wires. Wi-Fi is growing quickly at homes, offices and public places such as Starbucks coffee shops in the U.S., as well as hotels and airports. If you connect to a Wi-Fi-equipped area with a properly outfitted PC or PDA, you can quickly be on the Internet at true broadband speeds, as if you were connected by wire to a DSL line or cable modem. Wi-Fi is very fast. It can transmit data at speeds of up to 11 megabits per second.

Wi-Fi 5: A new version of Wi-Fi that's even faster, with a maximum speed of 54 megabits per second. It is not yet widely available.

802.11b: The old technical name for Wi-Fi. Note that the technical name for Wi-Fi 5 is 801.11a.

Bluetooth: A short-range-only wireless technology. The theory is that Bluetooth replaces cables over very short distances of about 10 meters or less. Bluetooth is slower than Wi-Fi (operating at about one megabit per second), and is designed to

link a cell phone to a laptop, or a PDA to a cell phone, or a laptop to a printer. Some mobile phones use Bluetooth technology to provide the "link" between the mobile phone and a headset. The technology has not been nearly as successful as originally hoped. See www.bluetooth.com

Ultra-Wideband ("UWB"), is a form of "pulse" wireless technology. It uses a form of small on-off bursts of energy at extremely low power *over the entire radio spectrum*. The extremely low power nature of the transmissions is such that transmitters and receivers are said to not interfere with one another. The pioneer of this technology is a U.S. based company called Time Domain. See www.time-domain.com.

Annex 2: Comments Analysis to NOI

This is a compilation of the entire list of comments as filed under the FCC's Electronic Comments Filing System (ECFS) through December 30, 1998.[293] The purpose of this portion of research and the development of this appendix was to (i) compile a tally of how many comments were in support or concerned about the implementation of UWB technology; (ii) see if there was any development through time of the opinions of any major groups; and (iii) get an idea as to what the FCC had, in terms of volume and complexity, to review in making its decision.

Of the one hundred and three (103) Comments filed, thirteen (13) were considered (by my review) to have registered concerns with the implementation of UWB technology. Several other filings in support of the technology offered a balanced review of the issues. The latter cases were not considered to be a "concern" if the conclusion in the document was to generally recommend the implementation of UWB technology as proposed.

Regarding the supporting documents, the most lengthy (in pages), and numerous (in amount of submissions) of the reports are: (1) Time Domain Corporation:[294] (8 Filings, 213 total pages); and (2) Interval Research Corporation:[295] (6 Filings, 263 total pages). Many of the other filings were one-off comments by interested industry members and from the scientific community.

[293] https://gullfoss.fcc.gov/cgi-bin/ws.exe/prod/ecfs/comsrch.hts, for a search under Docket 98-153.

[294] Time Domain is the company of the modern pioneer of UWB technology.

[295] Interval Research Corporation is the research organization of Paul Allen, a telecommunications venture capitalist and co-founder of Microsoft.

Regarding the "concerned" filings, there were thirteen (13) "concerns"; although some are repeat filings. The salient concerns were related to fears of implementation to the operation of GPS spectrum, particularly in the context of aeronautical safety.

Summary

# Filings:	103
Time span:	8/20/98 to 10/28/98 (includes an extension thru 12/30/98)[296] *Note that several hundred (thousand) filings have been posted since the statutory close.*
Total parties:	72
Total law firms:[297]	7
Total pages:	1,076

#	Date	Who filed	Filed on behalf of	#Pgs	Disposition
1	10/28/99	Wiley, Rein & Fielding	Time Domain Corporation	6	Support
2	10/28/99	Coudert Brothers	Interval Research Corporation	1	Support
3	10/27/99	Wiley, Rein & Fielding	Time Domain Corporation	2	Support
4	10/13/99	Wiley, Rein & Fielding	Time Domain Corporation	2	Support
5	9/29/99	Coudert Brothers	Interval Research Corporation	83	Support
6	9/29/99	Coudert Brothers	Interval Research Corporation	106	Support
7	9/29/99	Wiley, Rein & Fielding	Time Domain Corporation	1	Support
8	9/17/99	Wiley, Rein & Fielding	Time Domain Corporation	1	Support
9	9/7/99	Dept. of Aeronautics & Astr.	Dept. of Aeronautics & Astr.	8	Concerned[298]

[296] See *Order Granting Extension of Time,* letter by Dale N. Hatfield of the Office of Engineering and Technology, dated December 30, 1998: "The commission does not routinely grant extensions of time in rule making proceedings. However, we believe that providing more time will enable interested parties to submit additional information that will be beneficial to the record in this proceeding." (p. 1). The extension of time was through to February 3, 1999; It appears from the filings that there may have been a server problem with the FCC complicating filing on Feb 3, so the FCC appears to have accepted documents filed on Feb 4, 1999. There are only eleven (11) documents filed between 2/5/99 and 10/28/99, and all appear to be stamped "ex parte or late filing."

[297] Although many larger companies have their own counsel, this small number may suggest that the FCC is quite open to filings by non-represented parties. It is interesting to note that one of the three grantees of the waiver, U.S. Radar, does not appear to be represented by counsel, and did not appear to file documents in response to the NOI.

#	Date	Who filed	Filed on behalf of	#Pgs	Disposition
10	7/9/99	Wiley, Rein & Fielding	Time Domain Corporation	5	Support
11	2/8/99	Kathryn Vestal	Kathryn Vestal	2	Support
12	2/4/99	Fish & Richardson	Krohne, Inc.	12	Support
13	2/4/99	Fish & Richardson	Zircon Corporation	12	Support
14	2/4/99	David R. Hughes	David R. Hughes	15	Support
15	2/3/99	Time Domain Corporation	Time Domain Corporation	92	Support
16	2/3/99	Leventhal, Senter & Lerman	US GPS Council et al	7	Concerned[299]
17	2/3/99	Shook, Hardy & Bacon	Interval Research Corporation	30	Support
18	2/3/99	Southwestern Bell Wireless	Soutwestern Bell Wireless	8	Concerned[300]
19	2/3/99	Booth, Freret, Imlay & Tepper	American Radio Relay Leauge, Inc.	9	Concerned[301]
20	2/3/99	Ultra-Wideband Working Grp	Ultra-Wideband Working Group	17	Support
21	2/3/99	Oak Ridge Nat'l Laboratory	Oak Ridge Nat'l Laboratory	7	Support
22	2/3/99	Arthur D Little	Arthur D Little	10	Support
23	2/3/99	Oak Ridge Nat'l Laboratory	Oak Ridge Nat'l Laboratory	8	Support
24	2/3/99	Oak Ridge Nat'l Laboratory	Oak Ridge Nat'l Laboratory	5	Support
25	2/3/99	Thomas E. McEwan	Thomas E. McEwan	8	Concerned[302]

[298] The Department of Aeronautics and Astronautics is actually an academic department at Stanford. In the September 2, 1999 filing, Stanford withdrew an earlier protest, but "urge[s] the Office of Engineering and Technology and the National Telcommunications and Information Administration to complete a comprehensive evaluation of interference from all sources to GPS before any increases in the number of UWB systems over those permitted by the subject waivers are even contemplated." (p. 1)

[299] The "et al" of the GPS Industry Council (the "Council") includes American Airlines, the General Avaiation Manufacturers Association, Stanford University (the GPS Research Program), and United Airlines. The Council contests any operation of UWB radiation in the GPS bandwidth, for fear that it may jeopardize the safety of air passengers by interfering with GPS devices. The Council directly contests the as-applied-for waiver for UWB technology. It appears from the letter that Stanford (supra) later withdrew their request with the caveat that the FCC further study the matter once waivers were granted. It is also noteworthy that an earlier filing by the Council (12/7/98) was much more supportive of UWB technology.

[300] Southwestern Bell Wireless is concerned about the proliferation of UWB in the future and the possibility that aggregate UWB signals may prevent cellular or PCS call initiation.

[301] The American Radio Relay League is concerned about the potential interference to highly sensitive amateur radio devices, and that UWB may not be as easily filtered as the proponents suggest. The wording of the league's comment is not very clear; regardless, they do not support UWB approval "on a blanket FCC Part 15 unlicensed basis." (p. 7).

[302] Thomas E. McEwan (TEM Innovations) is an electrical engineer, purporting to file an independent comment. His very strongly worded protest to UWB technology suggests that it may create a disaster to the radio spectrum, although in an earlier comment, he was a strong proponent. In this brief, McEwan states that "… UWB impulse radio is an old, fatally flawed idea. It violates a fundamental tenet of information theory and offers nothing but interference to vital spectrum users, including my

#	Date	Who filed	Filed on behalf of	#Pgs	Disposition
26	2/3/99	Timothy J. Shepard	Timothy J. Shepard	4	Support
27	2/3/99	Thomas N. Cokenias	Thomas N. Cokenias	1	Support
28	2/3/99	Rosemount, Inc.	Rosemount, Inc.	4	Support[303]
29	2/2/99	Xtreme Spectrum, Inc.	Xtreme Spectrum, Inc.	1	Support
30	2/1/99	Bonnie Williamson	Bonnie Williamson	1	Support
31	1/28/99	ENSCO, Inc.	ENSCO, Inc.	1	Support
32	1/13/99	E. Renee Goss	E. Renee Goss	2	Support
33	1/7/99	Saab Marine Electronics	Saab Marine Electronics	6	Support
34	1/7/99	John A. Williams	John A. Williams	1	Concerned[304]
35	1/6/99	Jim Rezowalli	Jim Rezowalli	1	Support
36	1/6/99	Geo-Recovery Systems, Inc.	Geo-Recovery Systems, Inc.	1	Support
37	1/6/99	California Geophysical Group	California Geophysical Group	1	Support
38	1/6/99	Robert W. Jacob	Robert W. Jacob	2	Support
39	1/5/99	Sub-Surface Infmt'l Surveys	Sub-Surface Informational Surveys	1	Support
40	1/5/99	Thomas E. McEwan	TEM Innovations	4	Concerned[305]
41	1/5/99	Geo Recovery Systems, Inc.	Geo-Recovery Systems, Inc.	1	Support
42	1/5/99	Clifford Harter	Clifford Harter	1	Support
43	1/4/99	M/A – Com	M/A – Com	7	Support
44	1/4/99	Community Tech Centers	Community Tech Centers	2	Support
45	1/4/99	Miltronics	Miltronics	5	Support
46	1/4/99	Brian Zisk	Brian Zisk	2	Support
47	1/4/99	Thomas E. McEwan	Thomas E. McEwan	4	Concerned (duplicate)
48	1/4/99	Barbara Dean Clark	Barbara Dean Clark	1	Support
49	12/31/98	Steven D. Warwick	Broadband Telecom Systems	5	Concerned[306]

company's sensors, while failing to provide any advantage to its customers or redeeming value to the public." (p. 7).

[303] Rosemount Inc. was quite supportive, however made some excellent suggestions for proposed modifications to Part 15 rules which I have incorporated into my arguments in the body of this paper.

[304] John Williams strongly protests UWB technology. He works for a company that employs an existing radar technology and states that "the newly proposed regulation would in-effect eliminate the use of one of the most valuable proven methods available today for shallow surface exploration." (p.1).

[305] Unless I am missing something, Thomas E. McEwan's statement here *directly* contrasts with his previous statement (supra), where he states that UWB will be disastrous to spectrum management. In the present filing, McEwan appears to take the exact opposite approach, although suggesting some limitation in emission, and states that the FCC's "[f]ailure to take *prompt*, positive action on wideband technology will encourage the next decade's hottest sensor technology to flourish outside the United States." (p. 4).

#	Date	Who filed	Filed on behalf of	#Pgs	Disposition
50	12/30/98	FCC	Office of Engineering & Tech.	1	Support
51	12/30/98	Janice Bradley	Janice Bradley	2	Support
52	12/29/98	Fish & Richardson	Zircon Corp.	3	Support
53	12/28/98	Frank Burns	Frank Burns	1	Support
54	12/23/98	Shook, Hardy & Bacon	Interval Research Corporation	2	Support
55	12/17/98	SPARTA, Inc.	SPARTA, Inc.	2	Support
56	12/14/98	Paul Werner	Paul Werner	1	Support
57	12/11/98	Jeff Kramer	Jeff Kramer	1	Support
58	12/10/98	University of Southern Calif.	University of Southern Calif.	3	Support
59	12/10/98	Technos, Inc.	Technos, Inc.	1	Support
60	12/10/98	Dr. Gordon K A Oswald	Dr. Gordon K A Oswald	16	Support
61	12/9/98	TRW Elec. & Tech. Division	TRW Elec. & Tech. Division	1	Support
62	12/8/98	NeoVac	NeoVac	1	Support
63	12/8/98	Geophysical Survey Systems	Geophysical Survey Systems	8	Support
64	12/8/98	SATCOM Consultants, Inc.	SATCOM Consultants, Inc.	1	Support
65	12/8/98	Martin Rofheart	Martin Rofheart	13	Support
66	12/7/98	Shook, Hardy & Bacon	Interval Research Corporation	41	Support
67	12/7/98	Ultra-Wideband Working Grp	Ultra-Wideband Working Group	23	Support
68	12/7/98	Time Domain Corporation	Time Domain Corporation	104	Support
69	12/7/98	M/A—Com	M/A—Com	13	Support
70	12/7/98	Pulson Medical, Inc.	Pulson Medical, Inc.	3	Support
71	12/7/98	Consumer Elec Manuf. Assn	Consumer Elec Manuf. Assn.	4	Concerned[307]
72	12/7/98	Multispectral Solutions, Inc.	Multispectral Solutions, Inc.	29	Support
73	12/7/98	Fish & Richardson	Zircon Corporation	12	Support
74	12/7/98	Endress + Hauser GmbH	Endress + Hauser GmbH	8	Support
75	12/7/98	Leventhal, Senter & Lerman	U.S. GPS Industry Council	7	Concerned[308]

[306] Broadband Telecom Systems (BTS) protests UWB technology on technical and policy grounds. The technical grounds delineated by BTS are the standard interference concerns. The policy grounds are the first that I have noticed to mention the concern for uprooting the competitive advantage of existing spectrum auction winners.

[307] Consumer Electronics Manufacturing Association (CEMA) is in the business of developing electronics for television reception; the Comment is also filed jointly with the National Association of Television Broadcasters (NATB). They oppose UWB on the basis that it may interfere with television broadcast. Neither CEMA nor NATB submitted new data to support this contention.

[308] Actually, the U.S. GPS Council filing could be read either as a support or a concern; since most experts agree that if there is any interference by UWB that it may occur within the GPS band of operation, I would have expected the U.S. GPS Council to take a firm stance against its implementation. To the contrary, the Council takes an almost apologetic approach in filing its concern: "The Council is cognizant of the desires of UWB proponents, and acknowledges the potential benefits that UWB systems promise. It is only out of the need to preserve the integrity of the

#	Date	Who filed	Filed on behalf of	#Pgs	Disposition
76	12/7/98	Booth, Freret, Imlay & Tepper	American Radio Relay League, Inc.	16	Concerned (duplicate)
77	12/7/98	Low Tech Designs, Inc.	Low Tech Designs, Inc.	2	Support
78	12/7/98	Dwain K. Butler	Dwain K. Butler	3	Support
79	12/7/98	P. Patrick Leahy	P. Patrick Leahy	1	Support
80	12/7/98	Rexford Morey	Lawrence Livermore Nat'l Lab	10	Support
81	12/7/98	David R. Hughes	David R. Hughes	11	Support
82	12/7/98	Thomas J. Fenner	Thomas J. Fenner	2	Concerned (duplicate)
83	12/7/98	Alan Schutz	GSSI	7	Support
84	12/7/98	George L. Johnston	George L. Johnston	2	Support
85	12/7/98	David R. Hughes	David R. Hughes	11	Support
86	12/7/98	Win Forum	Win Forum	46	Support
87	12/7/98	Win Forum	Win Forum	46	Support
88	12/7/98	John Payne	John Payne	1	Support
89	12/7/98	Radar Solutions International	Radar Solutions International	1	Concerned[309]
90	12/7/98	Thomas E. McEwan	Thomas E. McEwan	30	Concerned (duplicate)
91	12/4/98	Merritt Pulkrabek	Merritt Pulkrabek	9	Support
92	12/4/98	Saab Marine Electronics	Saab Marine Electronics	9	Support
93	12/3/98	Quality Research, Inc.	Quality Research, Inc.	1	Support
94	12/3/98	Kathryn Vestal	Kathryn Vestal	2	Support
95	12/3/98	Kathryn Vestal	Kathryn Vestal	2	Support
96	12/1/98	Gary R. Olhoeft	Gary R. Olhoeft	5	Support
97	11/20/98	Enrico M. Staderini	Enrico M. Staderini	1	Support
98	11/16/98	ANRO Engineering	ANRO Engineering	9	Support
99	11/13/98	UltraPulse Communications	UltraPulse Communications	9	Support
100	11/13/98	John Benway	John Benway	9	Support
101	10/23/98	Department of Transportation	Department of Transportation	3	Concerned[310]

GPS system on which over five million users directly rely and mny times that number rely indirectly - - [ed. – such as in airplane guidance systems], an objective that is codified in statutes and reflected in a presidential decision directive, among other places - - that the Council respectfully requests here that if the Commission initiates a rulemaking proceeding on the UWB concept it does so in a manner that ensures that there is no increase in the noise floor in the GPS bands."

[309] The employee at Radar Solutions International submits a four-sentence concern by stating that he has personally noticed increased interference in using cellular phones over the past five years. No data is submitted.

[310] The Department of Transportation (DOT) and the Federal Aviation Administration (FAA) are concerned about possible interference with the restricted FAA frequencies. The Comment states, however, that "[t]he FAA could agree with an appropriate licensing procedure if the manufacturers of UWB systems could demonstrate how radiation from UWB systems could be inhibited/filtered-out in those restricted bands, in Part 15, that are designated for aeronautical safety systems. (p. 2).

#	Date	Who filed	Filed on behalf of	#Pgs	Disposition
102	10/22/98	UltraPulse Communications	UltraPulse Communications	2	Support
103	8/20/98	FCC	Office of Engineering and Tech.	9	Support

Annex 3: Summary of select FCC regulations; sample devices within their scope

Part 15[311]

- Unintentional Radiators (UR)
- Computers (UR)
- Computer Peripherals (UR)
- Receivers (UR)
- Telephones (UR)
- Intentional Radiators (IR)
- Radio Controlled Devices (IR)
- Cordless Phones (IR)
- Car Alarms Transmitters (IR)
- Spread Spectrum Devices (IR)
- Walkie-Talkies (IR)
- Wireless Video Devices (IR)
- Wireless LAN's (IR)

Part 18

- Industrial, Scientific & Medical Devices
- Electronic Ballast

Part 22

- Paging Equipment
- Rural Radio

Part 68

- Connection of Terminal Network Equipment

[311] Parenthetical references are Unintentional Radiators ("UR") and Intentional Radiators ("IR")

- Modems
- Telephones
- ICLIDs
- Dialers
- Alarm Systems

Part 74

- Broadcast Radio
- Aural Braodcast
- STL's
- Low Power TV
- Low Power Auxiliary Transmitters
- Wireless Microphones

Part 80

- Marine Radios
- Emergency Locator Beacons

Part 87

- Aeronautical Graund Stations
- Unicoms
- DME

Part 90

- Business Band Radios
- Special Emergency Radios
- Wireless Microphones

  Remote Control Transmitters

Part 95, 97

- CB Radios
- Family Radio Services
- General Mobile Radio Services